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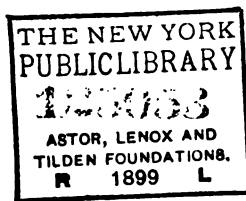
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AND WORLD OF SCIENCE.

THE STORAGE AND TRANSMISSION OF POWER.

THERE is abundant evidence in the proceedings at the meeting of the British Association to show that we are on the eve of a great revolution in our methods of utilising the available sources of energy. Sir W. Thomson, in the Section of Physics, and Sir W. G. Armstrong, in the Section of Mechanics, both addressed themselves to an elucidation of questions which are just now attracting the attention of mechanical engineers and physicists; and the modern developments of electric science warrant the tone of confident anticipation in which the two presidents spoke to their respective sections. A few years ago it was pointed out by a distinguished savant that the economy of steam-power had made considerable progress in the preceding decade, and as the advance towards perfection was still proceeding, it was not impossible that in another ten years we might reach a limit beyond which it would be hopeless to expect much progress. Events have not altogether borne out that expectation, and it is now recognised that the advance has been smaller in the last than it was in the preceding decade. Engineers are not at the present day in a hurry to write the word "finality" on their designs, but they are compelled to recognise the fact that they are rapidly approaching the limit beyond which they cannot hope to progress. Just as they approach that limit, however, a new field opens to view, and the possibilities of advance in other directions attract their attention. The results obtained with the modern forms of dynamo-machines, the capabilities of Faure's modification of the comparatively old form of Planté's storage battery, and the suggestion of Dr. Siemens that it is possible to utilise the gigantic power of such a waterfall as that at Niagara, have given rise to speculations which, in the immediate future, may play a very important part, and the present exhibition in Paris will direct the attention of many minds to a subject of growing interest. Sir W. Thomson, in his address to Section A, reviewed the sources of energy which man can utilise, and dwelt with special emphasis on the value of wind and water-power in combination with the artificial production of electricity. Sir W. Armstrong, in his address to Section G, drew attention to the fact that we have nearly reached the limit of possible development of the steam-engine, for, as he pointed out, the advantage to be derived by increasing the range of temperature is seriously dis-

counted by the enormous waste of heat in the escaping gases and by radiation, while introducing mechanical difficulties and dangers that it would be better to avoid if possible. Mere increase of pressure is not an altogether unalloyed gain, and even if we can improve the steam-engine to the utmost extent at present deemed possible, it would still be a wasteful though undoubtedly a valuable servant. The steam-engine, which is really a heat-engine, acts by expansion of volume—a principle which is known to be essentially wasteful, whereas electricity operates by, for want of more explicit terms, what we call attraction and repulsion, thus producing motion in a manner which is subject to no greater loss of effect than attends the motive action of gravity. If we could produce electricity with the same facility and economy as we can produce heat, the gain would be enormous, and the question then arises whether we cannot actuate dynamo-machines by natural forces, and save our coal for other purposes. As a secondary motor, the dynamo-machine has already been utilised in several ways, and if we can actuate it by some power which is at present allowed to run to waste, the gain will be just the value of the coal and the interest of the capital that would otherwise be expended in laying down motive-power engines. Of the available sources of energy, other than fuel, we have wind-power, water-power, and tidal-power; but, so far as the latter is concerned, it is, as Sir W. Thomson has shown, comparatively insignificant. In wind-power and water-power we have agents which cost nothing, and though, so far as the latter is concerned, in this country we have little more than the power of running water, the former may possibly, with the aid of recent inventions, be turned to good account. Sir W. Armstrong, in his address, reviewing the known means of obtaining electricity, pointed out that, until we can make the combination of coal with oxygen directly available for the development of electric energy, there seems to be no probability of obtaining the current from chemical action at such a cost as would supplant heat as a motive agent. Coal, and the other hydrocarbons, are the only abundant and cheap bodies which have their chemical affinities unsatisfied, and are, therefore, capable of evolving energy when combining with oxygen; and, although a method of storage would enable us to use water and wind-power for the production of electric currents our dy-

namo-machines will probably, for some years to come, depend mainly on coal as their prime mover. It is not impossible that with some form of gas-battery we may be able to use coal directly in the production of the electric current, and it is probable that future developments of the thermo-electric pile may place us in a position to obtain sufficiency of current by a direct application of heat; but at present the former idea is only in the laboratory stage, and the thermopile is rather more wasteful than the steam-engine. As Sir W. Armstrong put it, however, the vice of the steam-engine lies in its inability to utilise heat of comparatively low grade, while it wastes an enormous quantity up the flue of the furnace. If we could utilise that waste and the leavings of the engine itself by a supplemental machine acting on the principle of the thermo-electric battery, we should approach very near to the possible theoretical economy. By whatever means obtained, however, it is certain that electricity will play an important part in the world of mechanics as a motive power, though for some time it may be in a subordinate character, as a sort of handmaid to the steam-engine. Sir W. Armstrong has himself shown that a small watercourse may be made, by electrical appliances, to transmit its energy to a considerable distance, and there are many places where natural forces are available for producing power to be transmitted to situations in which it can be conveniently utilised. We give elsewhere some notes by Sir W. Thomson on the possibility of distributing the gigantic power of the falls of Niagara, the scheme depending for its success mainly on the practical utility of Faure's accumulator; but the idea is one that in different shapes has occurred to many investigators and experimentalists. If we can store in an economical manner the current produced by our dynamo-machines, we are then and there ready to take a large step in advance, and even if the storage should prove to be a rather costly operation, there are still many instances in which it could be employed with advantage. Mr. Swan has tested Faure's accumulator in connection with an installation of his lamps, and has expressed the opinion that it is the very thing wanted to make electric lighting all that was needed, while, as our readers will remember, Mr. Rankin Kennedy has explained in our columns the method in which he utilises it for a similar purpose (pp. 524-598, Vol. XXXIII.). By means of the accumulator, electric energy, generated &

steam-engine and a dynamo, can be stored up, and can be drawn upon as required; but an equally valuable feature of the Faure battery is the fact that it can be used as a regulator, so that in the event of the engine stopping from any cause, that stoppage would not extinguish the light, but would only reduce it slightly, while the store of electricity would probably be sufficient to enable the defects of the engine to be made good without a failure in the light. Sir W. Thomson has devised an automatic instrument for making and breaking the circuits between the Faure battery and the dynamo, which also protects the coils of the machine from damage, and the accumulator from loss through the current flowing back, owing to the E.M.F. of the dynamo being overpowered by the battery. Dr. Siemens is of opinion that if the Faure accumulator can be used as a storehouse of power to be resorted to automatically at any moment, practical electricians have a valuable aid in carrying out the application of electricity, either to lighting or the transmission of power. So far, however, we have only the Planté and the Faure form of secondary battery, and the former has probably remained in its original condition so long, because until recently there appeared to be little opportunity of its becoming in great demand, and a commercial as well as scientific success. Now, however, that the advantages afforded by accumulators are beginning to be apprehended, it is not unlikely that other forms will be introduced, which may possibly be so small in proportion to the work they do, and so cheap, as compared with existing devices, that they will be used in many places for storing up the electric current generated by dynamo-machines actuated by mills driven by the wind, or by water-wheels. Sir W. Thomson thinks, as matters are at present, that the cost of dynamo and accumulator will not be fatal to the plan, but that windmills are rather expensive machines, regarding the power they are capable of exerting, and comparing them with a good steam-engine for relative cost. A wind-engine employed to drive a dynamo-machine need not be so expensive as a windmill, and as the latter averages about eight horse-power in Holland, the country where they are most abundant, there is no reason to suppose that it would be inefficient or too costly when specially designed for the work. Sir W. Armstrong, though he naturally puts more reliance upon water-power, thinks that even the fitful power of the wind will "probably acquire new life when aided by a system which will not only collect but equalise the variable and uncertain power exerted by the air." But that is on the supposition that a thoroughly effective electric accumulator is provided, capable of giving out electric energy with almost unlimited rapidity; and as that is the important point, we may refer to a statement which M. Faure has recently made. It appears that some time ago he procured a number of Planté cells for the purpose of experiment, and the best of them yielded a current of twenty webers during five minutes. The two lead electrodes were each one millimetre thick, of millimetres long by 20 centimetres deep, and the amount of sub-oxide of lead which had been formed on the positive, when dried and weighed, was found to be 77 grammes. M. Faure says that in some of his recent cells of the same dimensions, he has placed in each of the electrodes 100 grammes of red-lead, and the current furnished was equal to 20 webers during two hours and a half, or about proportionate to that furnished by the Planté battery. The Faure accumulator can, however, be made up at once, and by testing with the red-lead the storage capacity is stated by its inventor to be quadrupled whereas the Planté cell experimented in had been made up two

years, and then had only 75 grammes of sub-oxide of lead. It is not improbable that further investigations may lead to greater improvements in accumulators, and then electricity will become the motive power par excellence, and Steam will cease to be king, though he will doubtless remain prime minister for many years.

LATHE-MAKING.

By J. H. EVANS.

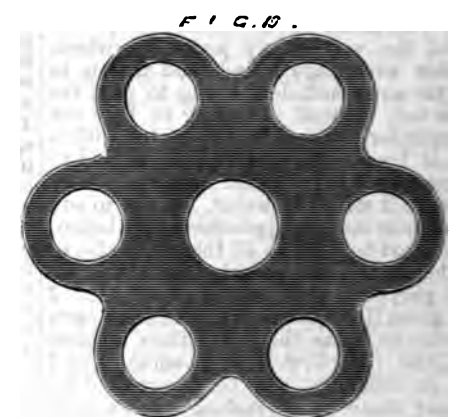
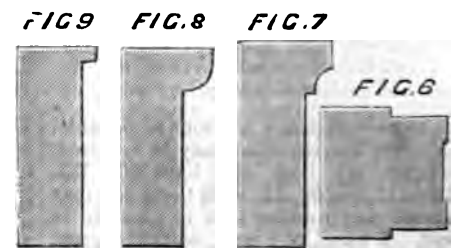
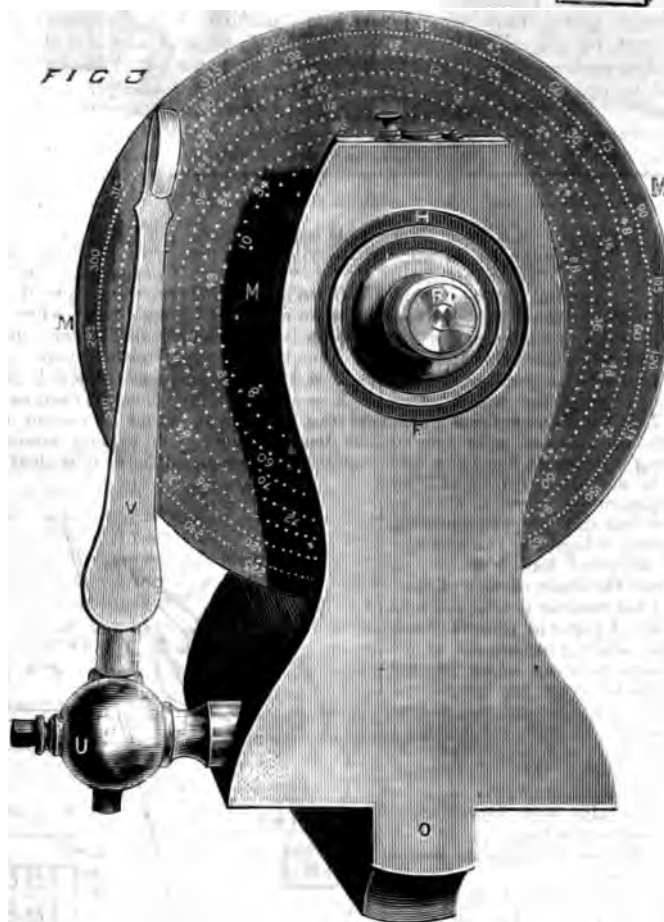
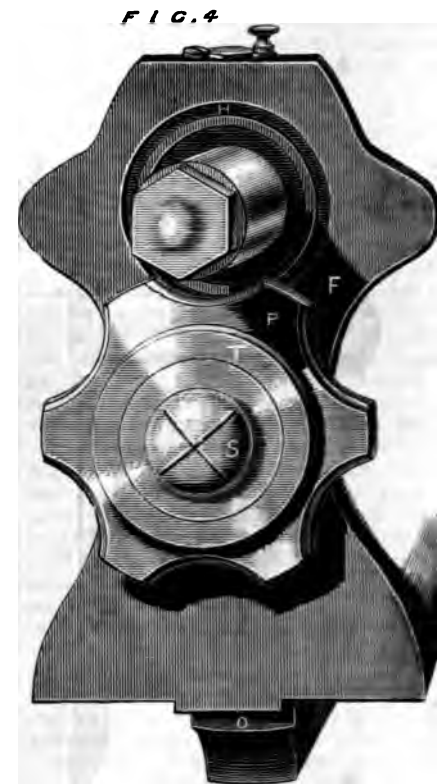
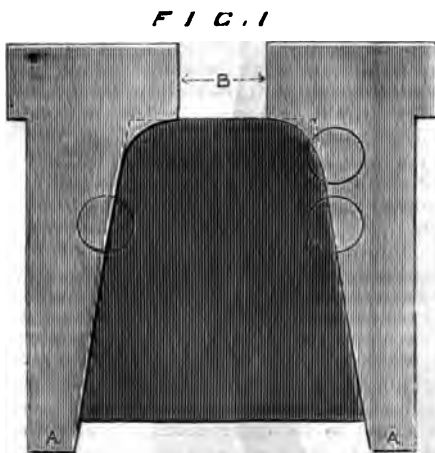
A FIVE-INCH traversing mandril is now mostly used; and in making a lathe of thoroughly good quality there is only one method to adopt, and that is, of course, the right one. I am well aware that various makers have different ways of fitting up this class of work; and it is also obvious that the very cheap lathes could not be put through the processes that a more expensive and, consequently, more extensive one is subjected to. I know of more than one London firm who centre the heads one to the other after they are made. However, what other people do is no business of mine; therefore, I intend to give a description of the manner in which we make our best lathes—that is to say, the fitting up from the rough castings. To begin, then, of course, the bed must be planed up wherever necessary, and then got up to a true surface. I must point out that this is, of course, the very groundwork of ultimate truth; it will need little controversy to establish the well-grounded fact that, unless the centres of a lathe are perfectly true, it will be useless to attempt to do accurate work with it. The first thing, then, to be done will be, as I say, to plane up the bed, on the surface, inside and out; and a cut must also be taken along the bottom—the object of this latter being to allow the washers, when the bolts are loosened, to move freely, that is to say, without being compelled to undo three or four turns of the screw so that it (the washer) will pass over a lump. It will not be a very long process, as it will only require planing off the narrow part A. This Fig. 1 is an end view of the bed, the dotted line showing the actual substance of it, from which it will be seen that it is very massive, and not at all likely to spring in any way; it will be better to plane the bottom first, as this will give you a surface to chuck the bed to in order to plane the top and sides. We always make our best lathes with what we term inside fittings, that is, the lower part of heads fit accurately into the recess B, Fig. 1. Although the casting is massive and not likely to spring, it must be carefully fixed on the machine, as it is in holding such work for planing that the mischief takes place, and, if not properly done, most likely it will not be so true when taken off the machine as it was before the holding-down bolts were loosened. This I can only leave to the workman to see to. When the top surface is finished, the sides must be planed with a down cut without moving the work and resetting. This, then, being ready, we will assume, to receive the heads, the poppet-head, Fig. 2, will be the one to fit first: the centre must be carefully laid out, and the hole to receive the cylinders drilled and bored out with a proper cutter to its standard size—viz., $\frac{1}{4}$ in.; into this hole, after it is ground out to fit the boring-bar of the same size, the centring bar is then placed, and the casting so set upon the planing-machine that the lower fitting, A, Fig. 2, can be planed and fitted: this will require the most careful attention, as the accuracy of the lathe depends a great deal upon this point, and it is from this hole that the mandril frame will have to be bored. To test the accuracy of the poppet head we have what we call a standard bed kept for the purpose, and it is wider than those upon which the heads are fitted permanently.

The object of it being wider is to enable one side—viz., the front—to be got perfectly true, and tested before planing off the metal on the other side, because there is no chance of adjustment afterwards—that is, after both sides are planed. Now, to test the accuracy is a difficult job, and what are termed centring blocks will be required. These are somewhat after the style of a scribing-block, only the points do not make a mark, but simply point to one, and that is the point of the centring bar. This latter is a long cylinder, about 2ft. long, with a sharp steel point at each end, and the fittings turned positively true from the points, and before the second or off-side of the poppet-head is planed the two centres of the bar must agree in every respect. It is a trying part; but it must be absolutely true, or the result will be most unsatisfactory. To facilitate this there is no objection to a file or scraper being used, and when it is completed to your satisfaction, it must be again set on the planing-machine, perfectly true to the bar, and the front side planed. When this is done it must be made to fit the opening in the bed B, Fig. 1, as accurately as possible—the inside of the bed being quite parallel from end to end, the poppet-head will, when fitted, slide the entire length. So far, then, we have the one head fitted and ready, and the mandril headstock must now be got into the same condition. The casting for this must be lined out, so that when the lower part, Figs. 3, 4, and 5, is fitted to the bed; both faces, C, Figs. 3 and 4, can be planed square all ways. The part extending below the fitting is simply to allow of more screw-holes being tapped for the holding-down bolt, also to make the casting more massive where the binding-pressure takes place. I have known a lathe-head to spring, and cause the mandril to run hard when it has been bound down tightly on to the bed. When the headstock is fitted to the bed, and centred so that it is square at all points required to be so, and as true as possible to the bosses D, Fig. 5, which will have to be cut into shape after the head is bored, it must be fixed securely on the bed, and with a large drill, having a plain cylinder fitting to pass through the hole in poppet-head, the first hole in the front-face of headstock F, Fig. 3, is drilled; and to drill the corresponding one in back-face, F, Fig. 4, the poppet-head must be brought to the other side of the mandril-frame, but not turned round. It must be kept always with the same face towards you—viz., the front. A large centre will now be required, sufficiently large to fill the first hole made. The heads being fitted on to the bed, the whole thing must, of course, be lifted so that the square end of drill will fit into a square-hole chuck, and the bed can be allowed to rest upon the common rest. We always use two of the latter. If this operation is carried out properly, it will be seen at once that a cylinder of the same diameter as the plain part of the drill will pass clean through the three holes so made—viz., poppet-head and those in front and back of mandril-frame. If the heads have been properly centred and fixed, there can be no difference when bored. We now come to the cutting-out of the large holes to receive the steel collars, Figs. 3 and 4. To cut these, we must have what is termed a boring-bar. This instrument, as I have said, should be about 2ft. long, and turned perfectly true to the size of the hole in poppet-head, which will be $\frac{1}{4}$ in. in diameter, in the centre of which a mortice-slot 3-16in. wide must be made, and about 1 $\frac{1}{2}$ in. long; and to cut out the recess for the collars, a cutter similar to Fig. 6 will be required, and must be made to cut with a somewhat obtuse angle. If the dimensions are taken from the engravings, which are half-size, it will help materially—as, for instance, the

cutter is made so that when it is just through the casting, the larger recess is deep enough for the collar. It will be seen that at the front of this cutter a recess is filed in; this is to fit over the ends of the mortice-holes, to keep it from moving; it is held in its place by steel wedges at the back. The cutter-bar into which it is fitted has a square on the end that fits into the same chuck as the drill. In cutting out holes of such a diameter, it is scarcely necessary to point out that a very slow motion must be used. We always use a large hand fly-wheel for the purpose, and find it answers in every way, giving plenty of power, and the speed is decreased by it having a small groove attached to it. In the present time of improvements in machinery, this may appear a somewhat old-fashioned way; but as I find it answer in every way, I see no reason to alter the means of driving the cutters to effect the same purpose. The two holes being cut that are to receive the collars, the next thing will be to cut the back of these out about an eighth of an inch larger than the mandril, because 13-16ths will be quite sufficient depth for the collar. We must now proceed to shape up the bosses D, Fig. 5, inside of the frame. The first part will be the round bead: this must be cut with a cutter in the same bar, the cutter being, of course, made to the shape required, as seen in Fig. 7. The curve in this cutter naturally cuts the iron work to a bead. This done, the concave curve must be shaped up in a similar way with a cutter having the curve the reverse way—viz., convex as seen in Fig. 8. It will be noticed that these two cutters, Figs. 7 and 8, have no recesses to fit the bar; the reason of this is that they are required at different positions, for various purposes, and being parallel they can be easily shifted to wherever required. The process of using these cutters will be found to be identical; in some cases the holes may require bushing in order that the cutter-bar may fit more accurately. As all cutting from this point of view must be done now, the circular recess H, Figs. 3 and 4, remains to be done, and then we may proceed to get the collar in. This is cut with a cutter like the engraving Fig. 9, the cutting part being just the depth and width required, so that it has only to cut as deep as it will go and it will be correct. So far, then, we have overcome the principal part, and have before us the groundwork, or foundations of a first-rate lathe, and must now proceed to get the steel collars in. In the front collar a cone is turned, the object of this being to give greater steadiness and allow of more wear and tear; the front collar should be turned out to one inch in diameter, and the back one to 13-16ths diameter. I had better here mention that these collars should be forged from the best cast steel to be had, and must be chucked in a jaw chuck carefully, and care must be taken not to hold them too tightly, or when they are taken out they will go into an elliptic form. In order to avoid this, I should advise that they are put into a box-wood chuck instead: they must be turned perfectly parallel; this done, a perfectly true steel arbor must be turned to fit them, on which they must be turned to fit into the recesses made for them in the mandril frame. Before, however, driving them in, an oil-hole must be bored through the top of each end of the headstock, about 3-16th diameter, countersunk at the top. The distance that this hole is from the face must be marked off on the collar, and a corresponding one made in the collar. Perhaps it would be as well not to make it quite so large. And now we arrive at a point where some little disappointment may occur, and that is hardening the collars. A pailful of clean water and a clear fire will be all that is required for this. Make the steel to a

gentle deep-red heat and plunge them into the water, allowing them to remain in the water until quite cold. If they are hard and not cracked consider it lucky, for they are not unlikely to break in going through this process. Upon trying them in the holes that they are to be driven in, it will probably be found that they have expanded considerably. An allowance for this must always be made in fitting them in the first place; that is to say, they must be turned to fit according to the substance of them. They have now to be got into their places, and to do this, let the ends of mandril-frame be placed over a gentle clear fire or hot plate, and made so warm that you would not be likely to let your fingers remain on very long. They must not be made too hot. This done, place the collar in, with the hole opposite that in the frame, and the inside of the latter bearing on a flat surface. The collar must be driven in with a piece of brass very nearly its diameter. We always consider it a good thing to get a lathe so far advanced as to have the collars securely in their places without any mishap. Attention must now be turned to the mandril, J, Fig. 5. As full directions were given for this in the No. for July 29, in the remarks upon hardening and tempering steel, I need not go so thoroughly into it here; but before turning the mandril, the collars must be ground out with leaden grinders charged with emery, until they are perfectly smooth and clean. This done, the mandril must be turned exactly as instruction previously given, and when hardened and set must be placed between the centres of a lathe, and on the nose a small pulley is fitted in order to be able to drive it from the overhead motion. In the sliderest a universal cutter is placed with a spindle running between centres, upon which spindle an emery-wheel is mounted. This latter is about 3 in. in diameter; this is also driven by the overhead motion at great speed in the opposite direction to that in which the mandril is running; it is then brought to bear lightly upon the hardened mandril, and will cut it perfectly true and cylindrical, provided, of course, that the sliderest is set parallel. Such points as these are entirely in the hands of the workman doing such a piece of work. Great care must necessarily be taken, the mandril being made perfectly true in diameter and quite cylindrical. Care must also be used in order that it may be ground to the correct size of the collars, and very little will be required to be left to grind when finally fitting the one to the other; the cone must be trued up with the emery-wheel in the same manner, only that the application of both hands at the same time will be necessary; in fact, the action will be similar to turning a cone with the sliderest; this cone must also be ground well home in its place when the mandril is fitted. The next part to do will be to get the steel cap, K, Fig. 5, at the end of mandril fitted; this is made from a piece of round steel that has been worked at the fire, bored out to fit well over the end of mandril, and the face that bears against the steel collar must be hardened; the screw, L, Fig. 5, is tapped into the end of mandril, and should be a fine thread. At the bottom of the hole in steel cap a round hole is drilled. This is to let the steady-pin that holds the steel guides in their place pass into, also to keep the cap itself from turning round. The screw K should fit tight when the mandril runs easily between the collar and cap; but it is better not to go home dead, as it allows no adjustment in case of wear and tear. Having gone so far, we may now turn our attention to the metal-pulley, M, Figs. 3 and 5. The first part in proceeding with this will be to see that the castings are perfectly sound; the pulley, itself is, of course, hollow, the front face

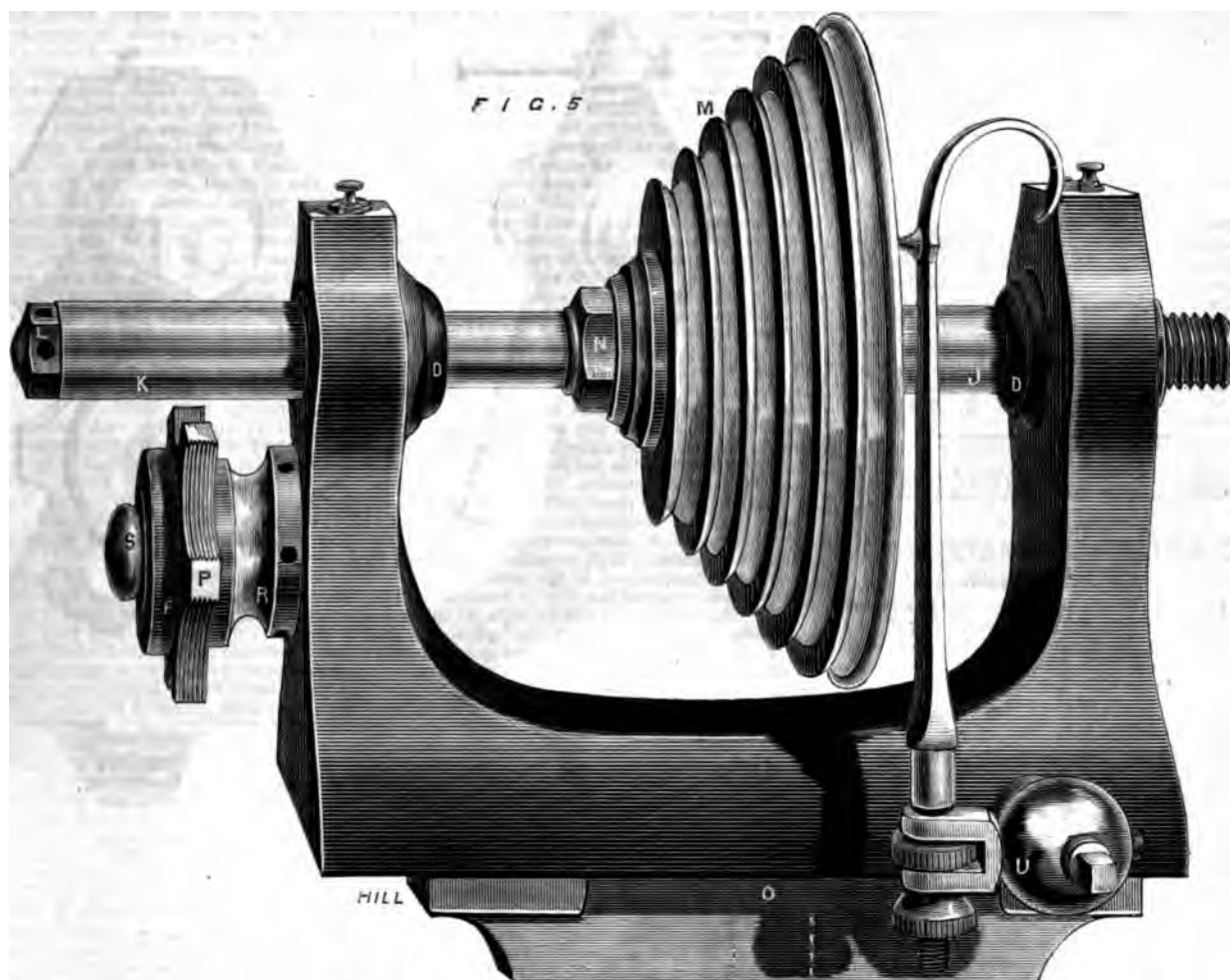
being put in, after the whole of the inside has been turned perfectly true. Although not seen, it is quite necessary to turn the inside in order to balance it. The inside turned, and outside roughed over, chuck it by one of the parts where the grooves are to be made, and bore out the centre, not quite, however, to the finishing size. This done, the front is recessed in about 3-16ths deep, and the fitting turned like a dovetail, about 6° or 7° of angle being given. The front face must be turned all over, and a corresponding angle turned up on its edge, and left about a 32nd of an inch larger than the recess. In its present state, it will not, of course, go into its place, but if the pulley is placed upon a hot plate, and gently heated, it will expand and allow the front plate to drop in on to the lower face of fitting, and when cold will contract itself round the plate, and if the angles have been well turned, no joint will be visible, and it will never come out again unless turned out. In case of any little mishap in the fitting there is no harm in hammering it all round where the joint is; when faced over and found to be quite sound, it may be fitted on to its place and be turned true. A steel steady-pin must first be fitted; the easiest way to do this is to drill a round hole in mandril, fit in the pin, and file two of the sides away. Then drill and cut out a hole in the pulley-face to fit it; this should be done before the pulley is turned over in its place. When fitted up to its permanent position, it is held in its place by the nut N, Fig. 5, the mandril being screwed with a fine thread, and the nut which is steel made to fit well. This screw should be quite true: any error in it is most likely to throw the pulley out of truth. There is no reason, if the parts are all true, why the pulley should not go on and off as often as you like, but the less this occurs the better. Before going further with the head, it will now be time to fit the six steel guides. These are made out of cast steel and fitted to the end of mandril, and it has a flat bottom, in which a hole is drilled for the same steady-pin to fit into that holds the cap in its place. When fitted they may be turned over in their place without any injury to the mandril if carefully done. The guides are now ready to screw, and as they form the groundwork of producing a true screw, it will be scarcely necessary to point out that they must be perfect in themselves; they are usually screwed with what we term the E, F, G, J, N, and the mandril thread. It is to a certain extent a matter of indifference what threads they are; however, these are the best for the purposes they are likely to be required for. The guides screwed, we have a kind of gauge to screw the metal piece to P, Fig. 5 and 6. It will be seen by P, Fig. 5, that only half of the circles so screwed will be required, as each one is moved into gear with the guide by the eccentricity given to the part R, Fig. 5. This is fitted to the lathe-head on a steel pin, into the end of which is fixed a steel screw S, Figs. 4 and 5, to keep it in its place. It is moved round to its place by means of a lever fitting into the holes seen in engraving; the metal piece that is screwed to fit guides must move freely between the metal block R and steel nut T, Fig. 5; it will then fall into its place, and if sufficiently tight, will insure the correct copy of whichever one it is working into. It will be seen that the portion required P, Fig. 5, is very different from the original casting, P, Fig. 10; but it is made after this fashion to facilitate the working of it; for instance, to screw half or a portion of a circle is not an easy matter, although even that can be done; that under our notice, however, is the most simple, therefore, I will describe it. The casting being turned and faced both sides to the required thickness, and the centre hole turned out to the proper diameter, bring into use the largest



face-plates, and at a given centre—viz., one that will bring each of the six holes to be screwed, concentric with the mandril, fix a piece of metal fitting the centre hole, and when the part to be screwed is concentric fix it in its position with two clamps; turn out the diameter and screw the same to fit the guide; by repeating the operation for each hole this part will be so far ready to cut in half, and to do this bring the centre hole concentric to the mandril, which it will be if fitted to a chuck, and with a thin parting-tool in sliderest, part it off, leaving less than

the half—about one-third will be quite enough—screw to perform all that is required of it. To fix the metal piece, R, Fig. 5, we have now a guide, as by offering the part P, Fig. 5, that is screwed to its place when the eccentricity is at its fullest extent, it will show where the holes should be made in the mandril frame, and a little draw, that is to say, enough to allow of the screws being brought in close contact, should be left. We are now drawing to a close with this part of making a lathe of the kind, and all that remains is to fix the index ball, U, Figs. 3 and

5, in order to get a firm bearing. It countersunk into the head beyond the cut and by doing this a flat face is, of course, obtained. The index point V, Fig. 3, is made of spring steel, and hardened and tempered. It is made adjustable, the latter taking place where the two brass nuts are seen, Fig. 3. This adjustment is a very useful—in fact, a necessary—arrangement, as it enables the workman to start a division at any given point. A plain index can, of course, be made, but should recommend by all means an adjustable one. Having sufficient diameter, it



as well to have as many divisions as possible, as it is never known what may be required. Those upon my best lathe have 360, 192, 144, 120, 112, 96, 80, 12: with these you may get almost any number that is likely to be required. I have, of course, worked a great deal at ornamental turning, and mostly use the 96 or 60 division, unless doing double counting, when the 120 is necessary. In fitting up the poppet head, I have always found the drop lever most useful, especially since I introduced the stop-screw to it. This latter screw enables you to fix it out of the way—many prefer the wheel. Another advantage I find, and that is to have the screw sufficiently long to push the centre out, instead of having to take out the cylinder to remove the centre with a piece of brass. This latter plan is held to be good by some London makers, as they adhere to it still. However, I prefer to add all the most modern appliances to my lathes, and it must be clear to all that to be able to get the centres out quickly, no matter for what purpose, must be an advantage. I have given illustrations of the different parts in order to make the instructions as clear and little complicated as possible, and I hope no difficulty will be experienced by any one desirous of making such a tool, but as I offer every facility, in the shape of personal interviews, with such of our readers as may care to avail themselves of them, the task is rendered more easy still.

THE PARIS ELECTRICAL EXHIBITION.—III.

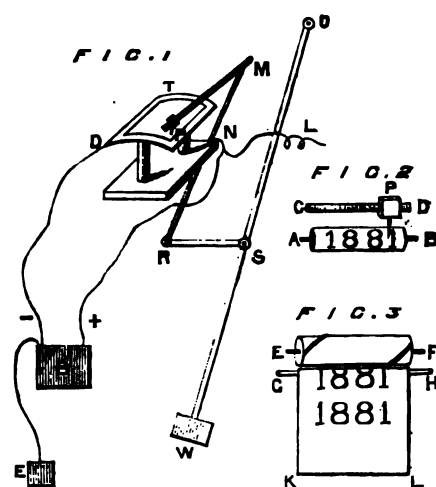
THE Ministry of Posts and Telegraphs has a large and well-stocked exhibition. The instruments used in France are Breguet's ABC dial telegraph, Hughes' type-printer, Morse's, and Wheatstone's automatic. Baudot's type-printing instrument is, I believe, coming much in favour.

The single-needle telegraph is not used over here. Breguet's ABC telegraph is the simplest of these instruments. The manipulator consists of a horizontal brass dial, on which the letters of the alphabet are written; to each letter corresponds a notch on the circumference of the dial. A handle is movable around this dial, and is turned until a stud which projects under the handle drops into the notch of the letter which we wish to send. This handle makes and breaks the current by means of a wheel with curved teeth. The receiving instrument has an ABC dial, whose needle is made to turn round by clockwork, the escapement being released by an electro-magnet each time the current passes. In Hughes's type-printing telegraph, the sending-instrument has a keyboard like a piano, on whose keys are written the letters of the alphabet. The essential part of the receiver is a type-wheel against which the slip of paper is pressed (each time a key of the sending instrument is depressed), and the corresponding letter printed upon the paper. This telegraph has very complicated mechanism, and although at a first glance it may look simple to work, yet it is not; for the type-wheel turning, say, once in a second, time must be carefully kept to this. It is much used in France. Baudot's instrument takes up much less room; but is also very complicated. It will print six messages at a time.

A full description of these instruments would take some pages of "ours."

Among autographic telegraphs, I may mention Caselli's and Meyer's. The annexed diagrams will show their principle. Fig 1, is Caselli's instrument both for sending and receiving. The telegram or drawing is written or drawn upon tin-foil, with an insulating ink, and is placed upon the curved metallic table D T. The iron point P moves over the curved table, being connected to a pendulum OW, by the rods O M, M N R, R S. On the rod P M is cut a screw, so that at every oscillation of the pendulum, the point P is moved a little along the rod P M. It will now be seen that the point P may thus pass over every point of the surface of the table, T D, upon which is placed the writing. The receiving instrument is exactly similar, and upon its curved

table is placed a piece of paper, moistened with ferrocyanide of potassium. Both pendulums are started simultaneously, and are made to oscillate synchronously, the weight W swinging between electro-magnets. Now, when the point P (Fig. 1) touches the slip of foil, the current of the battery may either take the path + N M P D — or the path + N L L' N' M' P' D' E' E — (the accented letters designate the receiving instrument, which I have not drawn in the diagram, since it is exactly similar to the sending instrument). Now, it is clear that the



former path is much less resistant, and will therefore be chosen by the current. If, however, the point P is over any point of the drawing, the insulating ink will prevent the current taking the above short cut, and oblige it to take the latter and longer path through the receiving instrument. The iron point, P, will then leave a blue mark on the paper, impregnated with ferrocyanide. The writing or drawing will thus be repeated, point by point. In Meyer's

Pacific Ocean. If, in the far future, the day should come when such work shall be undertaken, the process of doing so must necessarily be slow, partly for want of proper maps, and possibly in some regions partly for the want of trained geologists. Palaeontologists must always have ample work in the discovery and description of new fossils, marine, freshwater, and truly terrestrial; and besides common stratigraphical geology, geologists have still an ample field before them in working out many of those physical problems which form the true basis of Physical Geography in every region of the earth. Of the history of the earth there is a long past, the early chapters of which seem to be lost for ever, and we know little of the future except that it appears that "the stir of this dim spot which men call earth," as far as geology is concerned, shows "no sign of an end."

THE ADDRESS IN BIOLOGY.

Prof. Owen, C.B., F.R.S., the President of Section D, gave a rather long, but animated, account of the proceedings which led up to the erection of the British Museum (Natural History) Cromwell-road, as it is officially called. He also gave a brief account of the origin of the old British Museum, in Bloomsbury. The extent of space afforded by the latter edifice, in comparison with that of its predecessor, was such as to engender a conviction that it would suffice for all subsequent additions. The Printed Book Department, which took the lion's share of the then new British Museum, found itself compelled, in the course of one generation, to appropriate the quadrangle left by Smirke in order to admit light to the windows of the galleries looking that way or inwards. From analogy he could foresee that some successor of his might exemplify human shortsightedness in his limit of demand to eight acres for the growth of the present Museum. These acres, however, after conflicts stretching over a score or more of years, had at last been acquired for due display and facilities of study of the subjects of their "Sections C and D." In concluding his sketch of the development of their actual Museum of Natural History, Prof. Owen said he might finally refer, in the terms of modern phylogenists, to the traceable evidences of "ancestral structures." In the architectural details of the new Natural History Museum they would find but one character of the primitive and now extinct museum retained, viz., the Central Hall. The Museum, which might be said to have budded off, had risen to a still higher grade of structure after settling down at South Kensington. Its anatomy they found, it was true, the central hall and its long side-lit galleries; but, in addition to these inherited structures, they discerned a series of one-storied galleries, manifesting a developmental advance in the better admission of light, and a consequent adaptation of the walls as well as the floor to the needs of the exhibition. In conclusion he was moved to remark that a Museum giving space and light for adequate display of the national treasures of natural history might be expected to exert such influence on the progress of biology as to condone, if not call for, a narrative of the circumstances attending its formation in the records of the British Association for the Advancement of Science.

In the

Department of Anthropology

Prof. W. H. Flower, F.R.S., Pres. Z.S., presided, and delivered an address, in which, after paying respect to the memory of Prof. Rolleston, he proceeded:—The origin and early history of man's civilisation, his language, his arts of life, his religion, science, and social customs in the primitive conditions of society, are subjects in which, in consequence of their direct continuity with the arts and sciences, religious, political, and social customs among which we all live, by which we are all influenced, and about which we all have opinions, every person of ordinary education can and should take an interest. In fact, really to understand all these problems in the complex condition in which they are presented to us now, we ought to study them in their more simple forms, and trace them as far as may be to their origins. The study of the true relationship of the different races of men is not only interesting from a scientific point of view, but of great importance to statesmanship in such a country as this, embracing subjects respecting almost every known modification of the human species whose varied and often conflicting interests have to be regulated and provided for. It is to want of appreciation of its importance that many of the inconsistencies and shortcomings of the government of our dependencies and colonies are due, especially the great inconsistency between a favourite English theory and a too common English practice—the former being that all men are morally and intellectually alike, the latter being that all are equally inferior to himself in all respects: both propositions egregiously fallacious. The study of race is at a low ebb indeed when we

hear the same contemptuous epithet of "nigger" applied indiscriminately by the Englishman abroad to the blacks of the West Coast of Africa, the Kaffirs of Natal, the Lascars of Bombay, the Hindoos of Calcutta, the aborigines of Australia, and even the Maoris of New Zealand. But how is he to know better? Where in this country is any instruction to be had? Where are the books to which he may turn for trustworthy information? In not a single university or public institution throughout the three kingdoms is there any kind of systematic teaching, either of physical or of any other branch of anthropology, except so far as comparative philology may be considered as bearing upon the subject. The one society of which it is the special business to promote the study of these questions, the Anthropological Institute of Great Britain and Ireland, is, I regret to say, far from flourishing. An anthropological museum, in the proper sense of the word, either public or private, does not exist in this country. What a contrast is this to what we see in almost every other nation in Europe! At Paris there is, in addition to other flourishing societies, the *Muséum d'Histoire Naturelle*, where man, as a zoological subject—almost entirely neglected in our British Museum—has a magnificent gallery allotted to him, abounding not only in illustrations of osteology, but also in models, casts, drawings, and anatomical preparations showing various points in his physical or natural history, which are expounded to the public in free lectures. The influence of so much activity is spreading beyond the capital. The foundation of an Anthropological Society at Lyons has been announced within the present year. After referring to the institutions of other countries, Professor Flower continued: It is true that a very great proportion of the energies of the societies, institutions, and individuals who cultivate this vast subject are, in all these lands, as it is indeed to so great an extent in our own, devoted to that branch which borders upon the old and favourite studies of archaeology and geology. The fascinating power of the pursuits of the earliest traces of man's existence upon the earth, with the possibilities of obtaining some glimpses of his mode of origin, is attested in the devotion seen everywhere in museums, in separate publications, and in journals, to prehistoric anthropology. But, though the study of man's origin and earliest appearances upon the earth, and that of the structural modifications to which in course of time he has arrived, or the study of races, are intimately related, and will ultimately throw light upon one another, I venture to think that the latter is the more pressing of the two, as it is certainly the more practically important; and hence the necessity for greater attention to physical anthropology. In seeking for a criterion upon which to base our study of races, in looking for essential proofs of consanguinity of descent from common ancestors in different groups of men, I have no hesitation in saying that we must first look to their physical or anatomical characters, next to their moral and intellectual characters—for our purpose more difficult of apprehension and comparison—and, lastly, as affording hints, often valuable in aid of our researches, but rarely to be depended upon, unless corroborated from other sources, to language, religion, and social customs. The study of the physical or anatomical character of the races of man is unfortunately a subject beset with innumerable difficulties. It can only be approached with full advantage by one already acquainted with the ordinary facts of human anatomy, and with a certain amount of zoological training. The methods used by the zoologist in discriminating species and varieties of animals, and the practice acquired in detecting minute resemblances and differences that an ordinary observer might overlook, are just what are required in the physical anthropologist. As the great problem which is at the root of all zoology is to discover a natural classification of animals, so the aim of zoological anthropology is to discover a natural classification of man. The difficulties in the way of applying zoological principles to the classification of man are vastly greater than in the case of most animals; the problem being one of much greater complexity. Prof. Flower then gave an epitome of the science of anthropology.

ABSTRACTS OF REPORTS, PAPERS, &c.

Intra-Mercurial Planet.

Professor Balfour-Stewart sent a paper on the above subject, which stated that in conjunction with Mr. William Dodgson he had devised a method which had been applied in order to determine whether there were inequalities of short period in the observed areas of the sunspots occurring on the visible temperature of the sun. They had detected an inequality of this nature corresponding in period to 24.011 days, which when subjected to a certain purifying treatment appeared to them to exhibit the marks of a true periodicity. If there be an intra-Mercurial planet of the period

24.011 days it would have the following synodic periods:—With Mercury 33.025 days, with Venus 26.884 days, with Jupiter 24.145 days. In conjunction with Mr. Dodgson he had applied the above method of analysis with the view of ascertaining whether there be marked sunspot inequalities nearly corresponding to these periods, and he had obtained the following results:—A very prominent inequality of period 32.955 days; a less prominent inequality of period 26.871 days; a less prominent inequality of period 24.142 days. It would thus be noticed that there were prominent sunspot inequalities, the periods of which agreed very well with the synodic periods of the supposed planet with Mercury periods and Jupiter, more especially if they bore in mind that this was only just approximation. Assuming that there was an intra-Mercurial planet of the period 24.011 days, they were as yet unable to assign its exact position in ecliptical longitude of any moment.

Application of Electric Energy to Horticultural and Agricultural Purposes.

Dr. C. W. Siemens read an interesting paper on the above subject, in the course of which he detailed a series of experiments which he had made with the view of showing the influence of the electric light and the application of the electric energy to farming operations. The most recent of these experiments were made between October last and May of the present year, the electric light being in operation from five to six until the dawn of day every day except Sunday. The general result of these experiments was to show that the electric light was capable of producing on plants effects comparable to those of solar variation, and favourable to healthy growth. As to the theory of diurnal rest being necessary to plant-life, Dr. Siemens gave it as his opinion, as the result of his experiments, that, although periodic darkness evidently favoured the growth, continual stimulus of light appeared to promote the healthy development and to accelerate the plant through its different stages of flower and fruit. Dr. Siemens also gave the result of his experiments made in applying the electric light to farming operations, including the pumping of water, the sawing of wood, &c. He had been so strongly impressed with the results so obtained that he thought the electric transmission of power might eventually be applied to thrashing, reaping, and ploughing—in fact that all the work of the farmer might be directed from a central station of electric power.

Influence of Barometric Pressure on the Discharge of Springs.

Mr. Baldwin Latham, M.Inst.C.E., read a paper on "The Influence of Barometric Pressure on the Discharge of Water from Springs," and stated that it was alleged, by some of the long-established millers on the chalk streams, that they were able to foretell the appearance of rainfall from a sensible increase in the volume of water flowing down the stream before the period of rainfall. He had therefore undertaken a series of observations to investigate the phenomena, and he found, in setting up gauges in the Bourne flow in the Caterham Valley, near Croydon, in the spring of this year (1881), and selecting periods when there was no rain to vitiate the results, that whenever there was a rapid fall in the barometer, there was a corresponding increase in the volume of water flowing, and with a rise of the barometer there was a diminution in the flow. The gaugings of deep wells also confirmed these observations; for where there was a large amount of water held by capillarity in the strata above the water-line, at that period of the year when the wells became sensitive and the flow from the strata was sluggish, that a fall in the barometer coincided with a rise in the water-line, and that under conditions of high barometric pressure the water-line was lowered. Percolating gauges also gave similar evidence, for, after percolation had ceased and the filter was apparently dry, a rapid fall of the barometer occurring, a small quantity of water passed from the percolating gauges. The conclusion arrived at was that atmospheric pressure exercises a marked influence upon the escape of water from springs. Professor Prestwich took exception to some of the remarks of Mr. Latham as to the water zones. That gentleman, he said, had treated the subject in a very ingenious manner, but he (the speaker) did not feel they had sufficient evidence before them to determine the question, and he hoped that Mr. Latham would continue his inquiry.

Report on Mathematical Tables.

Mr. J. Glaisher presented the report of the committee on Mathematical Tables. He said it was now about five years since the committee on this subject was formed, and the result was now ready to be published. When this was done it would complete one of the heaviest bits of work which the British Association had yet been the means of initiating. Its importance was very great, as also had been the labour of preparing the voluminous tables and passing them through the press.

object of these tables is to resolve with factors any one of the three millions between 3,000,000 and 6,000,000, and the tables give directly the smallest dividing number within their limits not divisible by 2, 3, or 5, and indicate every number which is a prime number, that is, a number which is divisible by unity and itself only. The calculation of these numbers was undertaken to fill up a gap, which has been wanting for many years; similar numbers for the first three millions were published in France by Burckhart, in 1817, and for 7th, 8th, and 9th million in Germany about 20 years since.

Prof. Hennessey said that of all the works of solid durability which would mark hereafter the work of the Association this would be ranked of high importance.

Report of the Anthropometric Committee.

Mr. F. Galton read a long report from this committee, and some interesting remarks were made as to the heights, weights, &c., of human beings in the British Empire. The increase of stature throughout life is a new and unexpected fact, but it is obviously due to the survival of the taller and better developed members of the population, and elimination by disease or death of the smaller and feebler ones. Quetelet has stated that man attains his maximum height at the age of 30 years and maintains it up to 50 years, after which it begins to recede, and at 90 it has lost 3in. This may be true of individuals if measured from year to year, but it does not appear to be true of the population in the aggregate. The loss of stature resulting from the degeneration and loss of tissues, and the stooping position assumed by old people is more than counterbalanced by the survival of a greater number of individuals who are above the average in height. The uniform increase in the weight and chest-girth throughout adult life also confirms this view. Some French writers (Barnard, Allaire, &c.) maintain that growth in height goes on until the 32nd or 36th year, and Dr. Baxter arrives at the same conclusion from the statistics of the United States Army; while most English writers (Danson, Aitken, Roberts, &c.) regard the 25th as the year of mature growth, and Dr. Beddoe places it as early as the 23rd year, admitting, however, that a slight increase may take the elimination of the weak and ill-developed by death, the difficulty of following the same class, and all the members of the class, through successive years, and the selection of special classes (i.e., recruits whose ages are never certain), invalidate all conclusions as to the period of maturity, drawn from statistics of measurements of many different persons; but, allowing for these sources of error, it is probable that little actual growth takes place after the age of 21, and that it entirely ceases by the 26th year.

The Development of the Colour Sense.

Dr. Montagu Lubbock read an interesting paper on "The Development of the Colour Sense," in the course of which he said that authors had generally considered the point at issue to be this—"Is there sufficient evidence to show that the power of perceiving colour has been acquired by man within historic times?" He would extend the question further, and ask—"Is there evidence to show that the power of perceiving colour has been gradually acquired at any time, not only by man in historic or prehistoric times, but by the animal kingdom at large?" He briefly recalled what had been written on the subject, and the arguments which had been brought forward to prove that the power of appreciating colours had been gradually developed. He said reasons more or less conclusive had been given for believing that, as far as man was concerned, no such gradual development could be shown to have taken place. To what conclusion must we come as to such development occurring in the animals of past ages? They had seen that the power of appreciating colour would become more and more perfect in those animals which lived upon coloured food; the same statement, however, might be made with respect to the power of distinguishing form, and there was no evidence to show that the improvement took place in one direction earlier than in the other. Neither did any proof exist that colour perception had been handed down, with gradually increasing perfection from one species to another of the animal kingdom. If everything had reached its present form, its present condition, by evolution, colour perception must have done the same; but, as yet, there was no evidence to show how and through what stages this evolution took place.

Fluid Density of Metals.

A paper on this subject, by Professor W. Chandler Roberts, F.R.S., Royal Mint, London, and Mr. T. Wrightson, of the Cleveland Institution of Engineers, was read. It was in continuation of the account of their experiments communicated last year to the section at Swansea. They showed, by a delicate appliance, the changes that take place in the volume of metals in passing from the solid

to the fluid state. Perhaps the most interesting of their results were those they obtained on bismuth and on silver. With regard to the former metal, their experiments confirmed the belief that the fluid metal is more dense than the solid, while with reference to silver, the results were important, because the metal melts at a very high temperature, which has been accurately determined to be 940° C. by the late illustrious physicist and metallurgist, Henri St. Claire Deville.

The Function of the Two Ears in the Perception of Space.

Prof. Silvanus P. Thompson read a paper on the above subject. He remarked that the conceptions formed in our minds of the extension of space might be resolved into two parts, (1) the conception of distance, independent of direction; (2) the conception of direction, independent of distance. These conceptions are based upon the perception of three separate senses, (a) muscular, (b) optical, (c) auditory. Those of the first two classes were fairly well known, but the perceptions of space dependent upon the ear had been but imperfectly investigated. Steinhauser and Bell assumed the perception of direction to depend upon the relative intensity with which a sound reached the two ears. Mach and Lord Rayleigh regarded the perception as depending rather upon the relative differences of quality in the two ears, these differences being due to the partial resolution of compound tones, according to Mach, by reason of the ear-cavities acting as resonators; but according to Rayleigh, by reason of the diffraction of sound-waves round the head. He had shown in a former paper that differences of phase were also of influence in the acoustic perception of direction. After discussing the merits of the various theories to account for the facts of observation upon tones of different degrees of intensity, pitch, phase, and quality, the Professor propounded the following theory:—Judgments as to the direction of sounds are based in general upon the sensations of different intensity in the two ears; but the perceived difference of intensity upon which a judgment is based is not usually the difference in intensity of the lowest or fundamental tone of the compound sound (or "clang"), but upon the difference in intensity of the individual tone or tones of the clang for which the intensity-difference has the greatest effective result on the quality of the sound.

The Mode in Which Seed Buries Itself in the Ground.

Sir John Lubbock read a paper on "The Mode in which the Seed of *Stipa* buries itself in the Ground," in which, after briefly recounting the various means by which seeds are distributed, he referred to the remarkable case of *Stipa pennata*. The actual seed was small, with a sharp point, and with stiff short hairs, pointing backwards. The upper end of the seed was continued into a fine twisted rod; then came a plain cylindrical portion attached at an angle to the corkscrew, and ending in a long and beautiful feather—the whole being about a foot in length. That end was supposed by Mr. Francis Darwin, to whom they were indebted for a very interesting memoir on the subject, to act very much in the same manner as that of *Erodium*. He did not doubt that the end would bury itself in the manner described by Mr. Darwin, but he doubted whether it always did so. One fine day, not long ago, he chanced to be looking at a plant of that species, and around it were several seeds more or less firmly buried in the ground. There was a little wind blowing at the time, and it struck him that the long-feathered awn was admirably adapted to catch the wind, while, on the other hand, it seemed almost too delicate to drive the seed into the ground in the manner described by Darwin. He, therefore, took a seed and placed it upright on the turf. The day was perfectly fine, and there could, therefore, be no question of hydroscopic action. Nevertheless, when he returned after a few hours, he found that the seed had buried itself some little distance in the ground. He repeated the observation several times, always with the same result; thus convincing himself that one method, at any rate, by which seeds bury themselves is by taking advantage of the action of the wind, and that the twisted position of the awn, by its corkscrew-like movement, facilitates the entry of the seed into the ground.

Jurassic Birds and their Allies.

Prof. O. C. Marsh (Harvard University, U.S.) delivered a lecture on "Jurassic Birds and their Allies." Just twenty years ago, he said, two very important fossils were discovered in the lithograph slates of America, one of which was the *Archæopteryx*, now in the British Museum, and the other the skeleton of *Consummatus*, preserved in the Royal Museum, Munich. He gave an elaborate explanation and description of the different points of interest observable in the two specimens. If he were asked to state the difference between a bird and a reptile he should be puzzled, for if the bones of each were crushed and scattered together as

they found them, it would be extremely difficult to say which was the bird and which the reptile. That he held to be a point of importance, and one which naturalists who had been engaged on *Dinosauria* would fully appreciate. It appeared to him that feathers might have played a very important part in the transformation of the reptile into the bird. When they came to consider the four oldest known birds, they found them to be as distinct from each other as any of the birds of the present day. That fact of itself, therefore, showed that in order to get at the origin of birds they would have to look further back in the history of the world than previous workers, and thus they could not but feel great encouragement to further explorations.

THE SCIENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING.—IV.*

By Professor W. GYLLS, ADAMS, F.R.S.

(Continued from p. 616.)

Use of Magneto- and Dynamo-Electric Machines for Electric Lighting—Electric Lighting by Means of the Arc.

THE fundamental principles which underlie all magneto-electric machines are the four great principles discovered by Oersted in 1819, by Ampère and Arago in 1820, and by Faraday in 1831. In 1819 Oersted discovered the action of a current of electricity on a magnet. In 1820, Ampère discovered the action of magnets and currents on currents of electricity in their neighbourhood, and in the same year Arago showed that currents of electricity produced magnetisation, thus laying the foundations of electro-magnetism; and in 1831 Faraday showed that induced currents were produced by the motion of magnets. All machines for the conversion of work into electricity are founded on Faraday's great discovery of the induced current, derived from the relative motion of a magnet and a coil of wire.

Magneto-electric machines are divided into two great classes, according as they furnish continuous currents or alternate currents. All such machines are alternate, as far as regards the currents in the coil; but these currents are made to flow always in the same direction in the external circuit, in continuous-current machines, by means of a commutator, which reverses the contact at every half-turn.

The machines of Pixii, in 1832, followed by those of Saxton and Clarke, were the first continuous-current machines. From these we may pass to Wheatstone's introduction, in 1845, of electro-magnets in place of permanent magnets, to produce the magnetic field. In 1854, Messrs. Werner, Siemens, and Halske introduced the Siemens armature, in which the coil is wound longitudinally in a groove. The strength of the continuous current depends on the velocity of rotation, on the length of the wire, and the power of the magnetic field formed by the magnets.

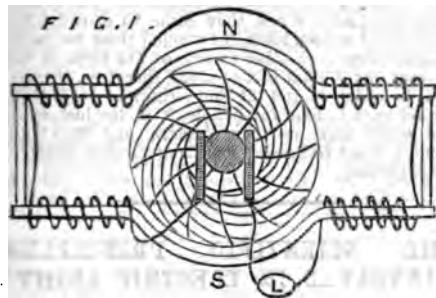
It is remarkable that, in 1854, Hjorth originated an idea which was some 13 years in advance of his time; he patented an improved magneto-electric battery, in which the currents induced in the revolving armature pass round the electro-magnets, and increase their magnetism, and so increase the induced currents at compound interest rate. This was the celebrated principle afterwards rediscovered by Siemens and by Wheatstone simultaneously in 1867, which has formed the basis of all dynamo-electric machines, and which, for equal power, are cheaper and more compact than all other magneto-electric machines.

Dynamo-Electric Machines.

In February, 1867, Dr. Siemens and Sir Charles Wheatstone, on the same evening, presented to the Royal Society their two papers, "On the Augmentation of the Power of a Magnet by the Reaction thereon of Currents induced by the Magnet itself." According to the principle then put forward by Dr. Siemens, the rotating armature, the electro-magnet, and the external resistance, such as an electric lamp, are joined up so as to form one simple circuit. A small amount of magnetism is communicated to the electro-magnet, so that, on rotating a coil, a current is induced alternately in opposite directions, and after being reduced to the same direction by a commutator, this current passes through the coils of the electro-magnet, in such a direction as to make it stronger, so enabling it to react on the armature. Thus the magnet and the armature act and react on one another, strengthening the magnetic field, and continually strengthening the induced currents. Sir Charles Wheatstone put forward the same principle, and called attention to the fact that at the first instant of completing the combined

* A series of "Cantor Lectures" delivered this year before the Society of Arts.

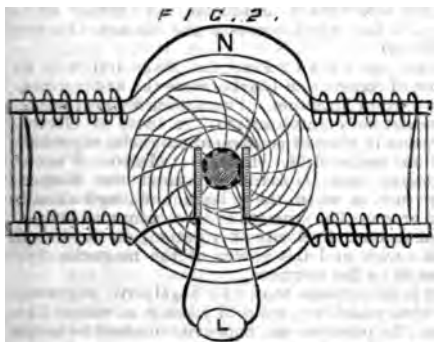
circuit, the effects are stronger than they are permanently. The principle of these dynamo-electric machines is clearly shown in Fig. 1, where N and S represent the poles of the electro-magnet



inclosing the revolving armature, the external resistance in the circuit being represented by an electric lamp. Sir Charles Wheatstone also pointed out that a very remarkable increase of all the effects is observed when a shunt is employed to divert a great portion of the current from the electro-magnet. By that means 4 in. of platinum wire, .0067 in. diameter was made to glow. A certain resistance in the shunt was found to be necessary to produce the best effects, so as neither to weaken the magnetism too much, nor to give the current too much work to do in heating a high resistance.

In addition to this, Sir Charles Wheatstone showed that the effects above described are far inferior to the effects obtained by placing the work to be done in the shunt circuit. Thus seven inches of wire were made to glow in the shunt, when only four inches of the same wire would glow in the original circuit. There is thus a double advantage, for there is no loss of resistance by introducing the shunt, the resistance of the shunt being the resistance on which the useful work is done.

This improvement, suggested by Sir Charles Wheatstone in 1854, and now being adopted by Dr. C. W. Siemens in his latest dynamo-electric machines, is very well shown in Fig. 2, for which



as well as for the other figures illustrating this lecture, I am indebted to the kindness of the Director of *La Lumière Electrique*.

Wheatstone also showed that the effects are much less influenced by a resistance in the electro-magnet branch than in either of the other branches. Thus, with about four inches of glowing platinum wire in circuit, the addition of about five inches of platinum wire in the armature branch, or in the shunt, produced a 4 in. glow, whilst 4 ft. of the same wire was required in the electro-magnet branch to reduce the glow to three-fourths of an inch. Dr. Siemens has shown that, for the greatest efficiency, the resistance of the rotating coil must be small; but the resistance of the electro-magnet may be increased, and that in both cases the wires should not be small, but of considerable diameter.

The Gramme Ring.

In the Gramme armature, coils of wire are wound in sections, all in the same direction, round a ring; and each section, when a current is flowing through it, may be regarded as an electro-magnet. The similar poles of all these sectional electro-magnets will point in the same direction round the ring. Consider only one of these electro-magnets with its north pole directed towards the south pole of another magnet, it will be attracted towards it, and with greater and greater force the nearer it approaches; on passing the south pole, its own south pole will be presented to the south pole of the fixed magnet which it has just passed, and its motion will be continued in the same direction.

Now suppose no current to be flowing in the

ring, then, on applying force to produce the same motion as before, the induced current will be in the opposite direction—i.e., as the coil revolves towards the south pole and past it, the induced current in the coil is round the ring, as we look at it from behind, in the direction opposite to the motion of the hands of a watch.

With right-handed winding of the wire on the ring like a corkscrew, the current is coming towards the observer, or in the opposite direction to the motion of the ring on the side nearest the south pole.

If we consider a section of the ring as it approaches and goes away from the north pole of the magnet, the induced currents in the coil, as the observer looks at it from behind, will be in the same direction as the hands of a watch move, so that the current will be away from the observer, or in the same direction as the motion of the ring on the side nearest the north pole. Hence, currents flow opposite ways round the ring in the two halves of the ring, and meet at points equidistant from the two poles.

Dynamo-Electric Machines.

When the armature of a dynamo-machine is turned, the amount of work which is produced by means of it is proportional to the number of turns of the armature per minute. If the same current passes through the electro-magnet and the armature, then the current in one acting on the current in the other will attract or repel it with a force proportional to the product of two currents—i.e., to the square of the current. The action between the currents is increased four-fold when the current in each is doubled. Hence, when such a machine is used as a generator of an electric current, the external work which can be done by that current in the electric arc or elsewhere, is proportional to the square of the current.

Use of Separate Exciting-Machine.

In all dynamo-electric machines, where the same current passes round the magnet and the armature, any disturbance in the resistance of the outer circuit—in the electric arc, for instance—at once alters the current, and this alters the strength of the magnetic field, which again produces a further disturbance in the current, so that any disturbance is intensified, just as the permanent magnetism of the iron core is intensified by the action of the current in the machine on itself.

To obtain greater regularity, Wilde, in 1863, proposed to employ a separate continuous current machine to give a permanent magnetic field and to revolve the poles of the magnet which is excited by the first machine. In order to find the yield or effective work of these machines, and their efficiency for electric lighting or for other purposes, we have seen, from the laws of Ohm and Joule, that measurements of current, and of the work done by the current, must be made.

In the last lecture I indicated four methods of making such measurements, viz. :—

1. The galvanometer method.
2. The heat method, i.e., by the change of temperature produced by the current in a wire of given resistance.
3. The electromotor or potentiometer method.
4. The electro-dynamometer method, i.e., by the attraction between different parts of the same current.

Efficiency of Magnetic and Magneto-electric Machines.

If we take a battery in a closed circuit, we know, from the laws of Faraday, that the amount of current produced is directly proportional to the weights of the chemical elements decomposed in each of the cells of the battery, the quantity of zinc dissolved in the battery being a measure of the quantity of current which has passed. According to the laws of transformation of energy, the work done in the chemical actions is here equivalent to the work done in heating the circuit. We may express the energy of the work done by electric currents in the same way as we express the energy of a head of water by the pressure multiplied by quantity of water. The electromotive force corresponds to pressure, and the current flowing to the quantity of water, so that the work done by the current is the product of electromotive force by the quantity of electricity.

The work which can be done in the circuit is $E_0 C_0$, where E_0 is the electromotive force of the battery, and this is spent in heating the resistance. Hence, $E_0 C_0 = C_0^2 R$, where C_0 is the current produced through a resistance R . Now, if any portion of the circuit, carrying a current, be set in motion, under the action of exterior magnetic forces, or under the influence of the mutual reactions of the currents in the fixed and movable parts, then the equivalent to the chemical actions in the battery will be spent in producing the heating of the conductor, and partly in doing the work of the electro-dynamic or magnetic forces. Representing the work done in producing motion

by K , and the current in this case by C , we get $E_0 C = C^2 R + K$. The work K is equivalent to the external work done by the current C . Now, this external work K gives rise to an opposing electromotive force in the induced circuit, and the energy of this induced current is $E C = K$: or $E = \frac{K}{C}$ is the electromotive force due to induction.

The efficiency of an induction machine, when used as a motor, is the ratio of the work K to the total work $K + C^2 R$, i.e., the ratio of the electromotive force of induction to the total electromotive force of the battery. The efficiency

$$\rho = \frac{E}{E_0} = \frac{K}{K + C^2 R} = \frac{1}{1 + \frac{C^2 R}{K}}$$

The effective work $K = E C$ and $C R = E_0 - E$. Therefore, $K = \frac{E(E_0 - E)}{R}$.

If, then, a battery of electromotive force E_0 be employed, and an induction machine be employed as a motor, then the effective work depends on the product of two quantities, one of which increases as fast as the other diminishes.

Now, if one quantity increases as fast as another diminishes, their product is greatest when the two are equal. Hence such a machine is most effective when $E = E_0 - E$, i.e., when $E = \frac{1}{2} E_0$, so that $K = C^2 R$ and $\rho = \frac{1}{2}$.

Half the work of the battery is then spent in heating the circuit, and the other half in doing the external work. This corresponds to the case where the strength of the battery current is diminished by one-half through the effects of induction. If the same machine be employed to produce a current of electricity by applying external work to it to turn it, then the energy of the induced current is equal to the work done by the currents during the motion, or $K = E C$. If K is greater than $E C$ at first, then the machine will go faster and faster, and E and C will increase, until the product becomes equal to K , when the motion will remain steady. Hence such a machine should give induction currents of the greatest efficiency when used as a motor.

The above conclusions have been arrived at by considering the attractive and repulsive forces between different parts of a battery current, where the electromotive force of the battery does not change.

(To be continued.)

RAINDROPS, HAILSTONES, AND SNOWFLAKES.

THE usual Saturday evening lecture of the meeting of the British Association was delivered by Prof. Osborne Reynolds, who said that the subject of his lecture had not until recently been the subject of careful investigation, for certain explanations of these phenomena, dating very far back, and he might say founded on guess-work, had never been accepted as satisfactory and sufficient. His object that night was to set before them the definite and rational history of the origin of these objects. He might call it the scientific history, for it was founded on the observation of physical laws, as well as tested by experiments which he hoped to put before them. The origin of his own special interest in this subject was the actual observation of what was open to everyone. It was not till he was of mature age that he knew what really was the form of the ordinary hailstone, and this appeared to have escaped observation previously. He then explained that the form of the hailstone was that of an inverted umbrella, that they were of a definite and exact form, in the shape of a cone having a rounded base and somewhat ribbed side. The lecturer showed a diagram illustrative of this description, and proceeded to explain the natural growth of these bodies. To apprehend that cloud or fog was formed by small definite particles or globules of water distributed through the air required no effort of the imagination. But when they came to inquire into the shape, size, and number of these particles, and as to their manner of suspension there were certain difficulties before them. Let them start, for example, with the air in the hall in which they were assembled, presuming, of course, that it was clear air. In this air, strictly speaking, there was no water in the form of water, but there was water in the form of clear steam—a gas as clear as air. The apprehension of this universal presence of steam in the lower strata of the atmosphere was the very foundation of the knowledge of meteorology. The amount of steam present depended almost entirely on the temperature. At the normal temperature of 60° Fahr., there were about six grains of steam in each cubic foot of air, or about a grain in a gallon. If the air were cooled to 30° there would only be present half as much steam.

and the question was as to what would become of the other half. It would take the form of water, which would be distributed through the room much as the steam was, but not exactly. The change from steam into water meant the congregation of the molecules into masses. It was obvious that a molecule of water, at one end of the room could not get to the other end at once. What happened in the case of condensation of steam by the cooling of the air was very much the same as what would happen in the case of a regiment of infantry, in skirmishing order, being surprised by a regiment of cavalry. They would run into small knots in the best way they could. What happened when the air was cool was much the same. The particles which formed the water ran together into small groups, and formed those larger particles which constituted a fog. It was important to notice that there was a good physical reason which prohibited these elementary particles attaining more than a certain size. What they call the mean path of a molecule, or distance which a steam molecule was moving about, practically limited the size of the water particle which was formed on the first condensation. These congregations of water-particles were for the most part extremely small. He then proceeded to explain what were the causes of cooling air, one of which was the air coming in contact and mixing up with colder air. This was the common cause of dew at night and very commonly of the clouds above. But the main cause of the cooling of the air was the result of what scientists called expansion, or, as he might describe it for his own purposes, the ascension of air from a position near the ground up to higher positions amongst the surrounding air. The summer storms, to which he called particular attention, as affording the best evidence of this phenomena, might obviously be traced to the ascension of a column of air which had been warmed by the ground, ascending much in the form of a column of smoke, and as it rose and expanded it became cool. It was merely the ascension which brought about the cloud, and the conclusion was that if we had layers of colour in the air so as to see what was going to happen, all those white fleecy clouds would declare themselves to be nothing more than the higher points of a lower stratum of air. This was the case with summer storms in particular. In this way huge masses of cloud are formed. These clouds reached several miles in thickness. Indeed, we are apt to take a very poor idea of the size of clouds owing to their height and their distance. As to the particles of which he had been speaking, the first question was why they did not settle down. The fact was, however, that they did descend, but very slowly. He asked them to imagine a particle or two diameters descending, and then to imagine a particle of one diameter descending. They would both descend until the resistance of the air amounted to the same effect as their weight. That fact was pretty well known, but it was not until Prof. Stokes clearly showed that the resistance of the air was proportional to the velocity at which the particles were descending, that it was clear that the particles would descend with the velocities proportional to their diameters. The ordinary size of a raindrop was very small. If they imagined a particle the size of a raindrop, it descended with obvious velocity, but if they took a particle the size of a fog particle, if they diminished the velocity by one hundred, they would get a comparatively smaller velocity. He could not actually show the size of the particles—they were too small to put in his lantern, but he showed them, as an analogous phenomenon, extremely small particles of air ascending in fluid. They were literally like particles of a fog descending. The point to which he next asked their attention was why those particles do not fall suddenly and completely down, or why they aggregated and formed a raindrop. The real point of his lecture had been to explain how it was that those separate particles which they saw in the clouds came together and formed raindrops. The size of a raindrop was usually over-estimated, but it was a large raindrop that was one-sixteenth of an inch in diameter, while an ordinary raindrop was not more than a thirty-second part of an inch in diameter. But as to the question how it was the particles in the clouds came together and formed a raindrop: the larger particles descended faster than the smaller particles, and sweeping them up in their descent, fell to the earth as raindrops. That was the key to the whole subject. If it were not for the large particles descending faster than the others, the whole of the particles would descend like a regiment of soldiers, and though they would never form rain they would come to the earth in a dense and perpetual fog. The manner in which the particles became united was not so well ascertained; indeed, he did not know that electricity might not have something to do with it. This was one of the explanations why clouds sometimes rained and sometimes did not. Cloud particles falling through a dense cloud for 1,000ft. would acquire the size of 1-16th of an inch in diameter, which was the size of the largest raindrops. Enlarging further on this subject, the lecturer said that clouds were often

four or five miles in thickness. He then lucidly spoke on the following topics:—Why do we not have larger raindrops; why do drops take the form of spheres at all; and what keeps them in the form of drops? By experiments, he showed the accumulation of particles into a drop, and the falling of a shower of rain. Some of these experiments, he explained, had never been shown to a large public audience before. The next topic treated of was capillary attraction—that which held the drops together, and caused water to rise up in small spaces. This showed conclusively that the surface of water was of a certain definite tension. The lecturer then proceeded to explain that when a raindrop exceeded a certain size its tension was insufficient to sustain it, and it fell and burst by virtue of the pressure against it. If it were not for this they would have drops amounting in size to the larger hailstones which sometimes fall. It would be a new phenomenon to have raindrops an inch or two inches in diameter, and what would be the result if it did happen might better be imagined than described. The fact that ice particles would stick together was not at first obvious; but a little consideration at once showed that that must be. With regard to the shape of hailstones, he said the conclusion generally came to was that that form was the result of the breaking up of a larger spherical stone having a vertex of the cone in its centre.

PROF. HUXLEY ON PALÆONTOLOGY.

IN concluding his discourse on the rise and progress of palæontology, at the meeting of the British Association, Prof. Huxley summed up the results as follows:—

The whole fabric of palæontology is based upon two propositions: the first is that fossils are the remains of animals and plants, and the second is that the stratified rocks in which they are found are sedimentary deposits; and each of these propositions is founded upon the same axiom that like effects imply like causes. If there is any cause competent to produce a fossil stem or shell, or bone, except a living being, then palæontology has no foundation; if the stratification of the rocks is not the effect of such causes as at present produce stratification, we have no means of judging of the duration of past time or of the order in which the forms of life have succeeded one another. But if these two propositions are granted there is no escape, as it appears to me, from three very important conclusions. The first is that living matter has existed upon the earth for a vast length of time, certainly for millions of years. The second is that during this lapse of time the forms of living matter have undergone repeated changes, the effect of which has been that the animal and vegetable population at any one period of the earth's history contains species which did not exist at some antecedent period, and which ceased to exist at some subsequent period. The third is that in the case of many groups of mammals and some of reptiles, in which one type can be followed through a considerable extent of geological time the series of different forms by which the type is represented at successive intervals of this age is exactly such as it would be if they had been produced by the gradual modification of the earliest form of the series. These are facts of the history of the earth guaranteed by as good evidence as any facts in civil history. Hitherto I have kept carefully clear of all the hypotheses to which men have at various times endeavoured to fit the facts of palæontology, or by which they have endeavoured to connect as many of their facts as they happened to be acquainted with. I do not think it would be a profitable employment of our time to discuss conceptions which, doubtless, have had their justification and even their use, but which are now obviously incompatible with the well-ascertained truths of palæontology. At present these truths leave room for only two hypotheses. The first is that in the course of the history of the earth innumerable species of animals and plants have come into existence independently of one another innumerable times. This, of course, implies either that spontaneous generation on the most astounding scale, and of animals such as horses and elephants, has been going on as a natural process through all the time recorded by the fossiliferous rocks; or it necessitates the belief in innumerable acts of creation repeated innumerable times. The other hypothesis is that the successive species of animals and plants have arisen, the later by the gradual modification of the earlier. This is the hypothesis of evolution, and the palæontological discoveries of the last decade are so completely in accordance with the requirements of this hypothesis that if it had not existed the palæontologist would have had to invent it. I have always had a certain horror of presuming to set a limit upon the possibilities of things. Therefore, I will not venture to say that it is impossible that the multitudinous species of animals and plants may have been produced separately one from the other by spontaneous genera-

tion, nor that it is impossible that they should have been independently originated by an endless succession of miraculous creative acts. But I must confess that both these hypotheses strike me as so astoundingly improbable, so devoid of a shred of either scientific or traditional support, that even if there were no other evidence than that of palæontology in its favour, I should feel compelled to adopt the hypothesis of evolution. Happily, the future of palæontology is independent of all hypothetical considerations. Fifty years hence, whoever undertakes to record the progress of palæontology will note the present time as the epoch in which the law of succession of the forms of the higher animals was determined by the observation of the palæontological facts. He will point out that just as Steno and as Cuvier were enabled from their knowledge of the empirical laws of co-existence of the parts of animals to conclude from a part to the whole, so the knowledge of the law of succession of forms enabled their successors to conclude from one or two terms of such a succession to the whole series, and thus to divine the existence of forms of life, of which, perhaps, no trace remains, at epochs of inconceivable remoteness in the past.

FORMS AND FUNCTIONS OF THE ELECTRIC DISCHARGE.

ON the Monday evening during the meeting of the British Association, Mr. Spottiswoode, Pres. R.S., delivered a lecture on "The Electric Discharge: its Forms and Functions," in the course of which he said:—We may now fairly ask whether the phenomena which we have been studying have any counterpart in the larger operations of nature which are going on around us, and whether the conclusions to which we have been led afford any explanation of observed facts. Many natural phenomena doubtless fundamentally depend upon electricity; how many we hardly yet know. But there are two in particular—namely, lightning and the aurora—which are unquestionably electrical, and whose correspondence with the spark proper, and with the discharge in rarefied gases respectively, has often been noticed. In the thundercloud we have an aggregation of aqueous particles small enough to remain, temporarily at least, suspended in the air. All of these, it would appear, are similarly electrified, and by their mutual repulsion, are restrained from further coalescence. By their presence the ground below the cloud becomes inductively electrified in the opposite sense, and as soon as the cloud by its motion comes within sparking-distance, or by an increase of its charge attains sufficient tension, a spark discharge takes place, which as we have seen above is a flash of lightning. A similar action may naturally take place between two clouds oppositely electrified. The electrical tension required for a flash of lightning is, of course, enormous. It has been calculated that, in order to produce directly from a battery of the most favourable construction a spark of 42in., equal to that given from my great induction coil, from 60,000 to 100,000 cells would be necessary, while for a flash of lightning a mile long not less than 3,500,000 cells would be required. There is, moreover, another kind of lightning to which the discharge in our vacuum tubes offers, to say no more of it, considerable analogy—namely, that commonly known as ball-lightning. The appearance of ball-lightning is described as that of a luminosity or ball of fire moving generally towards the earth, in a direction more or less oblique, and disappearing in most cases before reaching the ground. In some tubes, the exhaustion of which is very moderate, say, having a pressure of several millimetres of mercury, it happens not only that the blocks of light termed entities by Mr. De La Rue, are formed, but also that these entities travel along the tube from the immediate neighbourhood of the positive terminal to a finite distance in the direction of the negative, and then disappear. It would seem not unreasonable to suppose that ball lightning is due to conditions not dissimilar to those of such tubes—namely, to a discharge occurring in the upper regions of the air, at an elevation of perhaps, 20 miles, more or less, where the pressure is very moderate—that is to say, greater than that under which an auroral-like display could take place, and yet less than that which would give rise to a true spark or ordinary flash of lightning. We have not unfrequently present in regions at moderate elevations, say from 20 to 50 miles, all the conditions necessary for the production of an auroral display. And not only so, but our experiments enable us to determine, at all events approximately, some limits of elevation within which this phenomenon can occur and thereby to check the very divergent estimates of those who have observed it. Estimates of the altitude at which the auroral discharge takes place have been made from simultaneous observations at different points, and these have ranged up to 50 or 60, and even to 281 miles. But even the lowest of these appears to be improbable. The pressure at which the resistance of air is least is a little less than 4 of a millimetre of mercury; and the corre-

sponding elevation is about 38 miles. A vacuum tube measured by hundred-thousandths of an atmosphere would correspond to an elevation of a little more than 81 miles. Through a hydrogen vacuum at this pressure Mr. De la Rue failed to obtain a discharge with 11,000 cells; and he adds that 'it may be assumed that at this height the discharge would be considerably less brilliant than at 38 miles, should such occur.' It seems to be a well ascertained fact that in high latitudes there are fewer thunderstorms and more auroras than in lower latitudes. This fact points to the conclusion that, after a disturbance, the redistribution of atmospheric electricity is effected by one process or by the other, according to, or rather in consequence of, the meteorological differences between arctic, temperate, and tropical regions.

SCIENTIFIC NEWS.

CIRCULARS 28 and 29 from Lord Crawford at Dun Echt contain an ephemeris of Eacker's comet, by Dr. O. Backlund, computed for Berlin midnight up to Oct. 26. From these circulars we learn that the comet was found on Aug. 20 by Dr. Hartwig and Prof. Winnecke at Strasburg, and by Director O. Struve at Pulikowa on the 24th ult. Mr. Lobse also picked it up with the Dun Echt refractor on Aug. 28. Its position for Sept. 10, Berlin midnight (11h. 6m., G.M.T.), is R.A. 4h. 59m. 56s., Dec. N., 33° 45' 50".

A telegram has been received from Marlo Clarkson at Kimberley, S. Africa, which evidently refers to Schaeberle's comet, and which shows the necessity for quicker and more extended intercommunication of astronomical news. The telegram runs:—"Seen comet nightly since Sunday, yesterday near ascension thirteen hours twenty, north twenty degrees, lack instrument, send catalogue."

The meeting of the British Association was, this year, an unqualified success, judging by the numbers attending. Next year the Association will meet in Southampton, on August 23rd, under the presidency of Dr. C. W. Siemens. An animated discussion took place on the question of the place of meeting in 1883—Leicester, Nottingham, Southport, Oxford, Birmingham, and Aberdeen being each proposed and seconded. The voting left the final choice between Oxford and Southport, and the result was that the Association will meet in the classic city in 1883. The proceedings of the meeting have been unusually well reported, the local papers having devoted many columns to the papers and lectures. Some extraordinary statements were made—e.g., the alleged discovery of the feathers and hairs of birds and animals in the Laurentian Rocks, and the alleged finding of granite *in situ* about 20 miles south of the Eddystone. An explanation of the latter was found in the fact that the bottom of the Channel is in places covered with granite, which has been thrown out as waste ballast by passing vessels.

A valuable paper on the causes of volcanic action was read by Prof. Prestwich, and a long discussion followed. We have not space to report it this week.

Mr. Spottiswoode's lecture on the "Electric Discharge," of which we gave a brief abstract, has been published with illustrations by Messrs. Longmans.

It is rumoured that Prof. Huxley has resigned the secretaryship of the Royal Society.

Candidates for the Linares Professorship of Physiology at Oxford are to forward their testimonials to the Warden of Merton before the 1st of November.

The Society of Telegraph Engineers will hold an extraordinary general meeting in Paris on the 21st inst.

A special feature of the Electrical Exhibition is the lectures that are delivered by distinguished professors on various branches of electricity, and the inspection by the audience of the instruments and apparatus referred to.

The electric tramway is at work, but it has been found necessary to put up two copper tubes, one for the return current, as it was found impossible (in the time available) to insulate the rails sufficiently.

The Phylloxera Congress has been postponed until October 10.

Dr. Fleitmann, of Iserlohn, in 1880, exhibited some samples of ironwork plated with nickel and cobalt by means of a welding process. Since then the process has been improved, and he now welds any desired thickness of cobalt or nickel, or their alloys, on sheet-iron or copper, the articles thus plated preserving a bright surface in damp weather.

A novel method of repairing the bows of an iron vessel which had been in collision has been adopted in the case of the *Manitoba*. Mr. Condon, of St. John's, N.F., constructed a solid wall of masonry between two closely-fitting bulkheads, and filled the space between them and the part where the stem had once been with cement, &c., moulded to the lines of the vessel. The iron plates were then forced back to their original positions, and held there by strong bolts and clamps, and the vessel having reshipped her cargo proceeded to sea with her bowplates "stitched" together, and backed by a solid bow of concrete masonry.

An observatory of iron is to be erected at Boston, which will, it is stated, be the highest building in the United States. The shaft is to be cruciform on plan, with a well 3ft. square in the centre. The "column" will be secured by "guys" of steel wire, and a couple of cars will be provided for elevating visitors to the galleries, whence they will "observe" the surrounding country.

From recent reports of the sun's condition, issued by P. Tacchini, of the Roman College, it appears that after the secondary minimum of activity observed in the end of 1880, the rise towards the maximum was resumed. The following figures, representing the relative frequency of spots during the first seven months, indicate the course of the phenomenon:—January, 18.22; February, 14.48; March, 25.14; April, 25.03; May, 13.73; June, 22.11; July, 26.90. Thus, after a maximum in March, a minimum occurred in May, then an exceptional maximum in July. In August the activity was anew at a minimum. Throughout this year, one finds well marked periods in which the frequency of spots became more abundant, 17-21 January, 9-20 March, &c. Some were separated by the interval of a half-rotation of the sun. During the last maximum, 24 July to 4 August, P. Tacchini observed eleven metallic solar eruptions and the coronal line 1474 K at various parts of the sun's limb.

A recent accident to the express from Verviers to Brussels is instructive. The train had an automatic Westinghouse brake. A few metres before the station of Ans, owing to rupture of the tubes of compressed air, the train was brought to a stoppage very suddenly, many passengers being thrown down and variously injured. According to *La Lumière Electrique*, the real cause of this accident was the want of simultaneity of action of the brakes on the carriages in front and the carriages behind (a fault inevitable in all systems employing steam, compressed air, or vacuum). The brakes of the front carriages are closely applied, while those of the rear are still free; the after part of the train compresses the front part, and when the rear carriages have the brake applied, there is much strain of springs, shock, and dangerous reaction. The effect would be quite the same if the driver, in face of imminent peril, were to use the full power of the brakes. Thus, the driver using the Westinghouse may have a painful alternative. If he apply the brake in full force, there is the risk of severe shock to passengers, employés, and material; if he apply it moderately, he may fail to avoid a terrible collision. With the electric brakes, on the other hand, these evils are avoided, owing to the action on the rear carriages being simultaneous with that on the front ones. The driver need not hesitate, at full speed, to apply the electric brakes in full.

Experiments with reference to poisoning with carbonic oxide have been lately described by Herr Gruber to the Munich Academy. Some of these were made with mixtures of air and 0.02 to 0.5 per cent. CO acting on rabbits, hens, and white mice, for various periods (10 hours to 3½ days). It appears that while surprisingly small quantities of the gas have a marked poisonous effect (0.06 to 0.07 per cent.), there is very little, if any, increase to the effect when fresh quantities of the gas are supplied, if the concentration

remain the same. In an hour, at the most, the symptoms reach a height, about which they continue for hours and days. CO, in the proportion of 0.05 per cent., did not seem to affect in the least a healthy rabbit during 72 hours. Herr Gruber, on two days in succession, remained 3 hours in atmospheres containing 0.021 per cent. and 0.024 per cent. of CO respectively, and received no injury. On the scale of the lower animals experimented with, symptoms of poisoning might have been expected, and if there had been any considerable accumulation of CO in the blood, severe poisoning would have occurred. It is thought probable that the carbonic-oxide-hæmoglobin is largely dissociated at the temperature of the body; and in less degree, oxidation also doubtless occurs. The limit of injury by carbonic oxide gas lies probably near the proportion of 0.05 per cent., or more certainly 0.02 per cent. Among other results, Herr Gruber finds the sense of smell more sensitive to coal-gas than to carbonic oxide. By Fodor's method, the presence of a fourth of the proportion of CO representing the limit of injury, is demonstrable.

M. Thollon is of opinion, from his observations of the recent comets, that the brightness of the head and tail vary nearly in inverse ratio of the square of the comet's distance from the sun; and should this be rigorously proved, it would follow that the white light of comets (nucleus as well as tail) is almost wholly reflected sunlight. On the other hand, the slowness of variation in brightness of the band spectrum, as the comet moves on, is noteworthy, and hardly agrees with the view that a comet's elements are raised to incandescence by calorific action of the sun. Thus, the light emitted by comets would appear to come from their own heat, or from mechanical or electrical action; probably from all three causes. The idea of a comet having heat and light of its own is not repugnant to science, its matter being subject to action of a central force, and fall towards the centre being possible.

During a recent thunderstorm in Haute-Garonne, M. Larroque heard a dull continuous sound (like that of heavy carriages on pavement), which could not, apparently, be thunder, and which he accounts for thus: The storm was caused by meeting of two currents, one warm and charged with rain, the other cold and charged with hail. They met pretty high up, producing a gyrotory storm centre, a cylindrical vortex, in which the hail was liquefied. The sound is attributed to the hail whirling in this cylinder.

The Weeks rocket torpedo (so-called) was lately experimented with at the Torpedo Station, Providence, Rhode Island. It consists of a float of tin and sheet-iron (eleven feet long) braced internally with wood. There are two rudders, like the tails of a sky-rocket. In the head is placed some fifty pounds of dynamite, which explodes by percussion. The structure is propelled on the surface of the water by a rocket, 3½ feet long. The wonderful speed of about 150 feet a second has been attained, and kept up for four or six hundred yards. The torpedo is aimed at an object, and moves in a straight line, guided by the rudders. The special object of these experiments was to ascertain the torpedo's behaviour in rough weather. Its course seemed quite unaffected by a strong wind. It passed along and over (for it jumped occasionally) a distance of water not less than 1,375 feet in about nine seconds. The roar was terrible, and a dense smoke was given off.

The "Concordia" Society in Mayence offers two prizes of about £60 and £30 for brochures giving the most rational arrangements of dwelling-houses for working men's families, regard being had to the conditions of life in various parts of Germany, both in town and in the country. March, next year, is the time-limit.

The fracture of a shaft of a conveyance through fall of the horse, is a frequent source of trouble, and we are familiar with the sight of the driver strenuously binding a piece of wood along with the broken ends; rather a poor makeshift, and apt to result in wounds to the horse. An invention by M. Poirot, for the case in question, has been reported on favourably in the *Paris Société d'Encouragement*. The apparatus supplied consists of two screw presses, adapted to the size of the shaft, and connected by a movable rod, to the ends of which are attached a belt

A similar result was, however, marked a work of not only the conservation of the greatest and least degree which the water machine in such a scale presents in mechanical efficiency: the time of its running being always being susceptible of equally great variations. The full theory of the idea, however, is a very intricate subject, and one best left to mathematicians completely, and is by no means to be mastered by a few hours' superficial reading. It is not, however, mathematicians he might say be "dear it is a mass and a mass," in the "Encyclopædia Britannica," and Mr. Haughton's work is a "A. J. of the Philosophical Magazine in

The manuscript is again exhibited in query 1458. I have said, I think, that I understand in the Library Examination generally assumed the question that I was a writer of fables, who was not metaphoric for a mass of potash. Seriously, though, I mean to have jumbled two or three things by accident. I imagine, he would agree to repeat the names of the Moon's Orbit as kind; and in the next place, although he speaks of eclipses being, I have an idea that the last word is inserted in the place of the Eclipse. Perhaps in a second, I will not fail to add to it another. That there must be a solar eclipse every time the Sun crosses a Moon's node," the word "the Moon being simultaneously in conjunction" is new to that node. The orbit of the Moon is inclined to the ecliptic. Hence it may be now nearly above or below the Sun; and in its first or last quarter when in either of her nodes. When, though, the line of her Syzygy is coincident with that of her nodes an Eclipse of the Sun, or Moon, as the case may be, is inevitable. It, however, I will remark, that for an Eclipse of the Sun to happen at all, part at least of the Moon's globe must be within the lines which are axial tangents to the spheres of the Sun and Earth, so will see that the extreme limit to which the Moon can be situated north or south of the Eclipse is such any part of the Sun, must be equal to the sum of the apparent semidiameters of the Sun and Moon plus the difference of their horizontal parallaxes. Now, if we take this quantity to amount to 1' 28", we shall find that should the Moon be in conjunction within 15" of either node, she will be so near to the Eclipse that she must Eclipse the Sun. Into the minutiae of the matter it would be as needless as would be impossible to enter here. I have said nothing of the regression of the nodes at the rate of about 20" annually, or of the changes which the Moon's orbit is perpetually undergoing, but have confined myself to a bald enunciation of the elementary facts of the case. This, I may add, I have done on the supposition that I understand your correspondent's question; but, upon re-reading it after writing this, upon my word I am anything but sure now that I do so.

In the first place, I would ask "I. H. I." (query 44567, Vol. XXXIII., p. 606), to procure, if he can, Vol. XV. of the *ENGLISH MECHANIC*, on pp. 661 and 629 of which he will find as plain and intelligible a description of the construction, use, and adjustments of an equatoreal as it is in my power to give (the numbers containing my essay are 386 and 389). Pending his consultation of this, I would say shortly in answer to his questions, that (1) the Declination Circle and the tube (in the almost universally adopted German form of mounting), are placed parallel to each other at the opposite extremities of the Declination Axis. The Declination axis is itself carried in Y's at right angles to the Polar axis, to which the massive arm carrying the Y's is very firmly attached. (2) The hour circle is placed at the lower end of the Polar axis, with which it is concentric. The verniers of the hour-circle are fixed to the mounting in a way concerning which five minutes' inspection will tell more than a column of description: those of the declination circle at the extremities of arms fixed to the framing carrying the Y's. The readings for which my querist asks would depend wholly on his latitude. Suppose this, for illustration, to be $52^{\circ} 10'$, then the instrument, being in the Meridian, his telescope being horizontal, and the equator N., the declination vernier should read $37^{\circ} 50'$ South. Elevating it $37^{\circ} 50'$, it will be on the Equator, and the Declination circle will read $0^{\circ} 0'$. Continuing to elevate it until it points to the south, the vernier will obviously read $52^{\circ} 10'$ N. Turning it over and depressing it until it reaches the Pole it will read 90° , and, finally, when the object-glass is directed to the North point of the horizon, $37^{\circ} 50'$ North. I hope that this will answer the purpose of "I. H. I." If not, I shall be very glad to answer any further question he may put, or deal up any difficulty that admits of solution within the limits of a paragraph in these columns.

"A. A." says that Vol. XXXIII, p. 605
 might I think carry the 4th proposition of the 1st
 Book of Euclid with advantage.

Let us thank Mr. "A" and "G. & H." for
 their kindness in so promptly answering to letters
 from my library in the matter of handling

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"I would have everyone write what he desires, and to send it to his pastor, not his church, and that not in this only, but in all other respects. For with a genuine heart there comes an intense earnestness and eagerness to be obedient to all things which a pastor or brethren say, and in all other things, however small, that which is right, and to keep a silence when that silent discipline of the Lord will work better, to write that which truly is a gift, and to give thanks, and thanksgiving, and to be thankful." — *Monks of the Abbey.*

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Another very important addition to our existing information with regard to cometary physics is made by M. Ch. Fizez, the Assistant Astronomer at the Royal Observatory at Brussels, and appears in "Tome No. 13" of the series of the "Bulletins de l'Association Royale de Belgique" for 1881. M. Fizez, employing the great 11-in. Merz Equatorial, appears to have made a most valuable series of observations, both polarimetric as well as spectroscopic, during the time of its greatest brilliancy. For examining the polarization of the light of this body, he used a double-image prism, with two separated places of quartz. For the spectroscopic observations, he employed a spectrograph, a Malouin spectrograph, an instrument by which, combining a compound prism giving an inverted spectrum, equivalent to three prisms of

[illegible]

On reading the extract in your "Scientific News" (on p. 593 of Vol. XXXIII.) from the *American Journal of Microscopy*, apropos of the scale of inches, &c., in the advertisement of the Messrs. Berk, bound up with the *Journal of the Royal Microscopical Society*, it occurred to me to test a copy of this scale, which I have pasted into a book for reference. As far as I can determine with a pair of hair dividers and a standard steel rule, it seems to be rigidly correct. This appears to afford a good illustration of the soundness of your own explanation of possible discrepancies in different copies of this scale; as I suspect that the pasting of my own originally perhaps unduly expanded it, and that then, by a curious chance, it shrunk again in drying to the precisely proper length.

I think it very probable that the double star observed by Mr. Denning (letter 19112, Vol. XXXIII., p. 595) in the immediate neighbourhood of Jupiter on July 20th, was ϵ 383. Struve describes this object at the Epoch 1830-35 thus: "dist. 5-68", position 120-12", and magnitudes 8 and 9. Its R.A. and Dec. for 1875 are given in Lord Crawford's summary of the "Mensure Métrique" as 3h. 17-1m. and 17° 5' N. respectively.

quer 44555, Vol. XXXIII, p. 630) with
gives a general account of the tides in almost every
book on astronomy that has ever been published.
Perhaps I may refer him to Becker's "Astronomy
without Mathematics," published by the S.P.C.K.,
which contains a most popular account of this phe-
nomenon. If he knows a little elementary inter-
mediate algebra, he may read the article "Wave"
in the 1901 Penny Cyclopaedia with advan-
tages. A visit to any watering-place or port will
show him that on the sea or harbour walls in such

Oxford frames. I have very little doubt that they have earned the gratitude of many other readers besides myself by the hints they have given.

With reference to the query put by "Os" in letter 19143 (Vol. XXXIII., p. 619), I may say, first, that the Moon must necessarily give off two sorts of heat. The first, reflected solar heat, reflected in the same way as the Sun's light; and next, heat acquired by itself under the sun's rays, which we may call dark heat. Now, we know, from the familiar example afforded us by conservatories and greenhouses, that Sun-heat passes through glass with ease, and warms the floors of such buildings; but that the glass is impervious to the dark heat-rays radiated by their interiors, which thus become (to coin a homely expression) a species of heat-traps. In precisely the same way, the Sun-heat, merely reflected from the Moon's surface, will pass easily through glass, while her radiated heat will be stopped by it. This, then, enables us to compare the quantity of heat reflected and radiated by the Moon, and thus of determining the extent to which her surface is heated at any given instant. With this preliminary explanation, I may say that during the lunations of March and April, 1869, Lord Rosse succeeded in obtaining unmistakable evidence of the existence of obscure heat-rays increasing in amount with the phase of illumination. The instruments employed in his experiments were the 3ft. Parsonstown reflector, a thermopile, and one of Sir Wm. Thomson's reflecting galvanometers, in connection with which was another thermopile, to compensate for disturbing effects. Using a vessel of hot water as an intermediate standard of reference, it was found that the relation of Solar to Full Moon radiation is as 89,819 to 1; and by the use of such a cistern, with a blackened exterior, exposing it to the thermopile under identical circumstances to the moonlit surface of the 3ft. mirror, it was found that the Full Moon caused the galvanometer to deviate to an extent showing that the Moon's surface must have been itself heated to 500 degrees Fahrenheit. I do not quite see what "Os" means by an atmosphere acting as "a conducting medium" of heat. On the contrary, air is one of the worst possible conductors; our own atmosphere being nearly diathermanous to solar heat, and being warmed, not by conduction, but by convection. It is the Earth's surface which is really first heated by the rays of the Sun, and then the heat thus absorbed warms (as dark heat) the layer of air in contact with the ground; this rises, and a cooler stratum descending, becomes heated—and so on. The vapour in the atmosphere, however, does act as a blanket, and keep the terrestrial heat from being radiated into space; and there can be little or no doubt that the heat accumulated during the 14 days' uninterrupted sunshine on the Moon's surface, must be radiated at an enormous rate during the 14 days' perpetual night which follow. It is this astonishing alternation of temperature and the concomitant expansion and contraction of the solid materials of the Lunar Crust which it must cause, which I believe to be at the bottom of everything that has been observed in the shape of changes upon the Moon's surface.

"Os" (loc. cit.) is quite right in his supposition that it is now only a decrease in Solar temperature that can involve the destruction of animal life upon our own Earth.

The difficulty of "Amateur," 44612 (Vol. XXXIII., p. 629), arises from the fact that the cell of his object-glass is tilted in the tube. He will find that it is fastened to the tube with four or five screws. Let him carefully loosen them with a sharp screwdriver; and then, while looking through the telescope, tap the side of the object-glass cell on which the rings appear, so as to drive it inwards (in his own case the left side). This must be done very gently and carefully. When the star is seen surrounded by one or two absolutely concentric rings, he may tighten up the screws of the cell again, being very careful to do so a little at a time, and not to (what workmen call) "hug up" one while the others are not yet home. Vide pp. 525 and 526 of Vol. X.

I am not sure whether I understand what it is that "Paugul" asks for in query 44638 (Vol. XXXIII., p. 629), but I may say provisionally that we know by experiment that a body falls about 16 ft. in one second at the Earth's surface. As it starts from rest, g must pretty obviously = 32-2ft., and this varies inversely as the square of the distance from the centre of the Earth. In the case of the planets which have satellites, we know the diameters of their orbits, as also that of the orbit of our own Moon. We further know the times in which such orbits are described, and consequently the rate at which these bodies respectively travel. Hence we get the quantity by which they appear to fall towards their primaries in one second, and from that the gravity of the satellite towards the body of which that element is to be ascertained. Let r = the Earth's radius, E her mass, and g terrestrial gravity. R the radius of an orbit (supposed circular) described by a body of mass m about

a larger body of mass M , with velocity v (feet a second). Then the gravity of m towards M = $\frac{v^2}{R}$

and the mass $M + m = E \cdot \frac{v^2 R}{g}$. If (as in the case of the Sun and Earth) m is relatively very small, and the radius of the larger mass is ρ , then gravity at the surface of the larger mass = $\frac{v^2 R}{\rho^3}$

(vide Proctor's "Sun," Chapter II.).

And I am assuredly puzzled by the succeeding query 44639 (same page), for what in the world "Paugal" means by "the headings above table IV." I have not the most distant conception. Disregarding, however, his reference to this occult table, I may say that in virtue of the conical motion of the Earth's axis about the Pole of the Ecliptic, which gives rise to the familiar phenomenon of the Precession of the Equinoxes, that axis does vary its position, so that it takes 25,817 years to return to the position which it occupies at any given epoch. At present the North Pole of the Earth is tilted towards the Sun when we are in aphelion, and consequently our summer occurs in this hemisphere under those conditions. But 12,900 years hence the South Pole of the Earth will be inclined towards the Sun when we are in aphelion, and of course the North Pole away from it, and then our northern winter will occur in aphelion—a condition of things at present obtaining at the Southern Hemisphere; and, as a necessary consequence, curiously aggravating and exaggerating the seasonal changes there. It seems difficult to conceive that my querist can be ignorant of precession and of its physical cause; but should he be, he will find it explained in every moderately good book on astronomy, and in a very lucid form in the well-known "Ipswich Lectures" of Sir George Airy.

I must refer "Tyro" (query 44614, Vol. XXXIII., p. 630) to my reply to "I. H. I." in paragraph seven above.

The fossils found by "Onward" (query 44657, Vol. XXXIII., page 630) are Belemnites. This is the osselet or skeleton, so to speak, of an extinct form of cuttlefish. It was imbedded in the lower part of the animal. Into the funnel-shaped opening fitted a chambered-shell or phragmocone, and in a cavity of this lay the "ink-bag," with the contents of which the animal clouded the water so as to escape from its pursuers. Outside of all this was the soft, fleshy body terminated by eight arms or tentacles. Belemnites are almost the commonest chalk fossils that exist.

A Fellow of the Royal Astronomical Society.

IAPETUS AND MR. MARTH'S EPHEMERIS.

[19162.]—THE following observations of Iapetus will dispose of the doubt alluded to by Mr. Marth, on page 547, and prove the great accuracy of his valuable ephemeris:—

1881, August.	Observed difference of R.A. of centre of Saturn and Iapetus.			Discrepancy.
	Observed difference of R.A. of centre of Saturn and Iapetus.	Diff. of R.A. according to Marth's ephemeris.		
14th, 11h. 10m., G.M.T.	+ 9-2s	+ 9-19s	0-01s	
18th, 11h. 40m., "	- 2-1s	- 2-00s	0-10s	
19th, 11h. —, "	- 4-8s	- 4-74s	0-06s	

The observed differences are the resulting means of ten transits on the first occasion, and of seven and ten on the second and third.

The discrepancies are small, and are doubtless due to errors in my observations, and not to Mr. Marth's ephemeris.

Obviously the places of Iapetus given in the almanac which Mr. Marth alluded to, are very largely erroneous. Henry Pratt.

18, Preston-street, Brighton.

JUPITER.

[19163.]—MR. BARNARD (letter 19137) gives two transits of a white spot observed on August 3 and 5, which he notes may possibly be identical with the one so frequently seen last winter. It is not, however, the same object, though undoubtedly of similar character. It follows the old spot by about 1h. 20m. Mr. Barnard gives the times of transit of the new spot on August 3 and 5 as 20h. 29m. and 21h. 33m. respectively, but the white spot now visible (which by its position and appearance is obviously the same object as that detected during the last opposition) came to the central meridian at about 19h. 7m. and 20h. 17m. on the dates mentioned. These transits occurred

too late to be visible in England; but the times cannot be far wrong, because on August 2 the spot was seen on C.M. at 13h. 36m., and on August 4 at 14h. 47m.

The conspicuous belt situated some distance north of the planet's equator is really double, as depicted by Mr. T. P. Gray (letter 19003, p. 499) and confirmed by Mr. Williams (19056, p. 548). Mr. Barnard fails to show the double form of this belt in his sketch on p. 523. The division is always plainly shown in my 10in. reflector, as an irregular grey line with faint light and dark markings upon it. Mr. Williams recently remarked that this belt had "split into two very close together," but this may convey a wrong impression. The north side of the double belt is really the same object as that visible in a similar position in October and November of last year, but the south side was formed by the distribution of the dark spots which, appearing first chiefly as projections from the S. border of the old belt, showed an evident tendency to develop in this direction. A series of sketches which I made at the time, exhibit many detached spots lying on the S. border of the old belt, and their subsequent development and ultimate resolution into a dusky band can be well traced from the later drawings.

Bristol, Sept. 3. W. F. Denning.

SELENOGRAPHICAL.

[19164.]—THERE is one subject for amateur astronomers, especially for those of them who are anxious to undertake work which may be of real use now, or in the future, to some portion of their favourite science, who are really enthusiastic in the study of the heavens, but who, from want of time (or some other reason) are compelled to shrink from any of the abstruser portions of astronomy; and this department is the close examination of the minute details on the surface of the Moon.

At first, it will appear that an indispensable feature in the successful prosecution of this study is a telescope of very large aperture; this is a mistake. The one thing which is needed is continued perseverance, enabling the observer to work on, not looking or caring for immediate results, convinced that his labours will some day prove to be of value; for the present, amply rewarded by that thought. Nor do we hesitate to affirm that one difficulty after another having been surmounted, his work will, in the end, meet with its reward. As a secondary matter comes the telescope. A moderate aperture, if a refractor, from 3½ or 4 to 6in.; if a reflector, from 6 to 10in. will be quite sufficient; but it must be a good instrument. One thing must be clearly understood; if the small objects on the Moon are to be observed, a very small portion of the surface must be chosen, and kept to. After a time new features will show themselves as the observer becomes better acquainted with the region, so that, at length, he will himself be astonished at what he is able to discern in a tract where others, with larger instruments, can see little or nothing. So remarkable is the change, that one can hardly refrain from believing that the telescope, not one's own eye, is actually increasing in power.

From the many formations which would repay examination, the following have been selected as possessing, from their peculiarities of outline or colour, an especial interest, and have been arranged in order of size, the first being the smallest, and, consequently, the easiest for thorough and attentive search.

AUTOLYCUS γ .—A curious cross-formed mass, situated S.W. of Autolycus.

A remarkable formation W. of Fontenelle, consisting of a perfect square, inclosed by long straight walls, sixty-five miles in length, with interior intersecting ridges; the whole was once thought to be of artificial design. Adjoining it is the similar formation, Birmingham, the interior of which is crossed by four ridges.

The great Alpine Valley, connecting the M. Frigoris with the M. Imbrium.

The great rill near Ariadeus.

The streak systems of Aristillus, Anaxagoras, Kepler, Olbers, Byrgius, Alfraganus, being of medium size, would each form a suitable study for two or three observers.

There are also many ring-plains, such as Capuanus (light streaks), Ptolemaeus (craterlets), each of whose floors would prove a new and interesting subject for close observation.

This list, compiled from Mr. Neison's very excellent work, "The Moon," is necessarily brief and incomplete; but I feel that I have already occupied too much of this journal's valuable space. If in my attempt to show the need we have of assistance, and the easiness with which it may be given, and to suggest the best manner, in so far as I am capable, in which any help may be rendered, I may persuade but one owner of a telescope, hitherto lying idle, or nearly so (and there are, doubtless, many such in this country alone) to turn it towards the Moon, and, as often as convenient, to draw and redraw a formation such as I have mentioned above, lunation after lunation, until the

region has been thoroughly investigated, then shall I be more than repaid for the slight trouble I have taken.
A Member of the Selenographical Society.
August 29th.

δ CYGNI.

[19165].—I see, from "M. B." (letter 19114) that the star δ Cygni has given him considerable trouble, and that with 8 $\frac{1}{2}$ in. mirror he has not, so far, been able to perceive the *comae*. As this star interested me much for some seasons past, and was observed by me on all suitable occasions, I can speak with confidence with respect to it. If "M. B." would select a good evening, and, stopping down his 8 $\frac{1}{2}$ aperture to 6 $\frac{1}{2}$, look at δ Cygni between sunset and total darkness, he cannot fail to detect the *comae*, knowing where to look for it.

Then let him remove the stop, and if his mirror is a good one, even though there may be some flare from the principal star, the small green *comae* will still be even more distinctly visible.

My first view of δ Cygni as a double was with my 4 $\frac{1}{2}$ in. equatorial. With that instrument and aperture I saw the *comae* on several nights in the early twilight, and always lost it when I observed later on in the night. With a 6 $\frac{1}{2}$ in. Calver, the *comae* was distinctly visible at any time of the night, but easier to see in twilight. With 7in., 8in., and 8 $\frac{1}{2}$ in., when atmospheric conditions were favourable, I had no difficulty in at once perceiving the minute companion, either on or immediately under, the first ring. Probably during the last four months there have not been many nights in which the best observing results would be obtained, and δ Cygni, as a double, is as much a weather-test as anything else.

Droylsden Rectory. Samuel Mills, M.A.

THE LATHE.

[19166].—I was much pleased to see in "ours" of the 15th ult., "O. J. L." mentioning "Gilray's Universal Lathe." I was greatly interested (and no doubt many others were) with his description of it in Vol. XXIX, but I always thought he left it unfinished, and that he could have told us much more. If so it was a pity, because he brought us in contact with the work, I had almost said the mind, of an original worker. If it is so, can we not induce our friend to resume his description. Will he pardon me if I mention some of the points I particularly want clearing up? and some of these he promised to refer to again. I am at present designing a lathe to consist of as many arrangements as I can usefully apply to it, so that he will understand why I wish to have information.

1st. The cleverly-designed self-acting index mentioned page 534, Vol. XXIX. And as "O. J. L." proposes using the screw-cutting change-wheels for the rosette apparatus, say what pitch most convenient to answer both purposes for a 5in. lathe, and would the ordinary numbers of wheels do—say, two 20's, then rising by 5's up to 120, largest wheel? This I wish to know, as the wheel U on mandril shaft, page 637, has fifty-four teeth. Description of the part on which 54-wheel is fixed, same page. Also guide-screw mentioned page 637, and shown at M, page 533, together with worm-wheel, E, same page, with tangent screw, were left unfinished. Number of teeth and diameter of worm-wheel P on rosette shaft, page 637. And if he has succeeded in finding out the several uses of the three rubber carriages, see page 560, or can give any further information about the use of shaft Y and wheel Z, for segment engine, same page. I trust our friend will not think this list too formidable; but that, on the contrary, he will kindly oblige us. I may say that I think I can add another movement to his rosette shaft. If I succeed I shall be happy to send it for his criticism. I cordially endorse what "Safety" says on Mr. Evans's articles, in letter 19100, and hope that Mr. Evans will be able to gratify us with description of all the apparatus mentioned.

E. P. Aintree.

KENNAN'S LATHE-TOOLS.

[19167].—I HAVE a full set of Kennan's beautifully-designed and admirably-constructed tools, and shall be happy to show them to any reader of the ENGLISH MECHANIC who wishes to take the patterns. My set includes a 6in. back-gear'd traversing mandril lathe, independent overhead apparatus fixed to ceiling, and independent treadle and fly-wheel. The treadle and fly-wheel are upon friction-wheels and separate standards, so that they have no connection with the lathe-bed, except through the catgut driving-band, as also is the case with the overhead apparatus. The result is great freedom from vibration in the mandril and lathe-bed, when doing ornamental work at high velocities. Among the accessories are ornamental slide-rest, spherical slide-rest, ellipse chuck, eccentric chuck, a long set of other chucks, ellipse and epicycloidal cutting frames, drilling, eccentric, crown wheel, and various

other cutting instruments, enormous numbers of drills, cutters, ornamental slide-rest, and other tools; grinding instruments, goniometers, saw-bench, and other accessories, all of which seem to work as charmingly as when they left the loving hands of this splendid workman. On Tuesday, Friday, and Saturday afternoons only can I make time for such things; but I shall do my best to offer an appointment to any one who may write to me.

James Edmunds, M.D.

Grafton-street, Bond-street.

BOILERS FOR AMATEURS—TOOLS AND MOTIVE-POWER.

[19168].—I AM glad to note that "Sunlight" has given the readers of E. M. what I am unable to do—the results of actual experience of tube and coil-boilers on a small scale. I've not had much to do with such boilers, but that little has not left a very favourable impression on my mind. On the whole, I think they are troublesome and dangerous. Nothing is more likely than that the pump or injector might fail at an unlucky moment, and then the consequences might be very awkward. I give this opinion for what it is worth; but "Sunlight" is a much better authority than I am on this subject.

I notice that "H. C. B." has tried putting a plate beneath the crown of firebox in his vertical boiler, and am not surprised that he has found it advantageous. I was ignorant of the fact that such a plan was in use when I wrote Chap. XI. of "Tools and Motive-power." Apropos of these articles, those readers of the E. M. who have done me the honour of following me so far, will think that I'm giving them plenty of time to digest what has already appeared. My excuse must be that I have had the fortune to be very full of business, and the misfortune to have been very unwell. I shall hope to send a continuation of the series almost immediately.

W. S. Brown.

BEVELLING OR CHAMFERING OXFORD FRAMES.

[19169].—HAVING made a few Oxford frames, I gladly offer my mite to "F.R.A.S." and other readers of ours. I must say that I am not a professional, but an amateur at it. Having cut the frame together at the corners, and formed the rebate (which I always cut out with a chisel, not having a circular saw), I number the corners so as to be able to put them together in the same way again, take the frame to pieces, gauge down fronts and sides of pieces, the size of chamfers, put the frame together again, then with a sharp-pointed marker and bevel (a slip bevel preferred), mark off the bevel of the stops on the front of frame. I set my bevel generally at angle of 45°, but this is not particular, except for producing certain patterns at the corners of frames. Take to pieces once more—then for chamfering; for this I use a tool called a draw-knife or wheeler's shave. Hold the pieces firmly in a vice, then with the draw-knife held very firm, proceed to cut out the chamfers; this must be done a little at a time, taking care not to strike the blade in too deep, and gradually working it down to the gauge marks. I use a small plane when pieces are long enough to work it, but, with practice, you will find you can make a very good job of it with the knife; take care not to cut too deep when setting down the stops. For finishing, I use an old hand-saw file to smooth the chamfers; after that, very fine glass-paper. I hope I have made it plain; if not, shall be pleased to answer further.

S. C. W.

[19170].—I SHOULD gauge the distance I wished the bevel to extend on the two sides, then take as much out as possible with a small spoke-shave, and finish with a rasp and scraper. If the frames are too small to admit of the spoke-shave being used, all should be done with the rasp and scraper, finishing the ends with a chisel.

S. Tavenor.

[19171].—I WAS surprised to see in the answers to this query the use of the chisel advocated. It is, I think, a slow and difficult tool to use. The plan I adopt, and I think the usual one, is to cut the chamfers with a carpenter's draw-knife. By a little practice it can be done well and quickly. A little difficulty arises in holding the piece of wood, which I surmount as follows:—Along the edge of, say, a lin. plank, held in the jaws of the bench, I cut a V-groove, in this the job fits firmly, and is held in position at each end by a bench-knife—bits of an old table-knife blade do well. An important point is to mark down each edge of the frame the distance to which the chamfer is to extend. To do this, I nail together two thin slips of wood, so that in section they form the letter T; the end of the upright portion of the T is rounded off according to the shape you desire the ends of your chamfer to be; place the T in position and mark the curve with a pencil, and then, holding the pencil firmly against the T, slip both together,

down the frame and you have your line accurately marked. If you are working in dark-coloured wood which does not show the pencil-marks clearly, then chalk your wood.

F. H. R.

POTATO-DISEASE.

[19172].—IN reply to "Dagbert's" question (letter 19040), I planted my potatoes every alternate year in the same ground. I am quite sure, from what I have seen, that it is not a good plan to put anything in the same ground year after year except onions, and with them it doesn't seem to matter. The great thing is to get a spot which suits them and keep to it, if properly managed. The quantity of seed I used was a 3in. flowerpot full emptied in a heap on the ground; put the potato on it, and cover with the same quantity, unless the potato was of an extra size, and required more to cover it. I dug very deep, and managed so that the ground was not trodden upon afterwards. I always loosened the ground between the rows after eaching up, which I only did once.

The potatoes grew in a lump, and to take them up I put the spade below them and lifted the whole together. Sometimes it was quite enough to do to lift the lot. I have very few stray ones. It was quite a sight to see the potatoes shaken off. The manure I used was simply composed of the rotted vegetables and dry privy manure. I never put any weeds amongst it, so that there were no seeds; and the ground was remarkably clean in consequence. I gave no great amount of manure, and spread it over the ground previous to digging. Numbers of people put the manure in the trench and the potatoes on the top, a bad plan, and only poisons them. It is as bad as cramming a baby. I never put the rows closer than I mentioned: the plants can neither dry nor get air. I doubt very much if a yard apart would be too much. At the distance I put them the roots would meet. I don't think that you do any good by too-close planting of any thing, be it flowers, vegetables, or anything else. The farmers sadly err often in this. If they get four, six, eight, stems to a corn, they think it well, whereas they may get 14 or 15. I think the commonly-received theory is that a fungus occasions the disease. I only have my own fancy about this, and by no means feel capable of arguing the point. Storing in pits might do when there was no disease; but as I and many others have found, it is often a very bad thing now. Straw over potatoes is not good, any more than it is over apples. While mentioning it, I would say putting carrots in earth or sand to keep them utterly destroys their flavour.

Edwd. Thos. Scott.

TRICYCLES.

[19173].—AS for several weeks past various friends have had a word to say on this subject, it would perhaps not be quite out of place for me to briefly state one or two facts on the question, and also to formulate a plan I have in hand in the matter of driving gears. In the first place, from actual experience, I have satisfied myself that as yet, makers have failed to recognise certain laws that are of great importance to easy travelling. If we examine a series of lists of the various makes, we find that the size of wheel differs greatly. For instance, we have the "Coventry Rotary" with a 50in. driver, and the "Excelsior" 54in. as the best of greatest size, whilst as the minimum diameter we have the "Meteor" and the "Coventry Perfection" with as small as 40in. wheels. There are, of course, many others, but I am simply quoting from two of the largest and two of the smallest wheel machines, from a list before me, as examples. Now the point I wish to make clear is this: A machine with a 50in. wheel, for instance, as a rule is driven with level gears, or, in other words, the pedal-shaft revolves the same number of times per minute as the main drivers.

The result is that the machine when running at a slow speed (as, for instance, up-hill) runs terribly heavy, as the driver is revolving so slowly that every little stone or obstacle tends to bring it to rest, and it has not in itself sufficient centrifugal power to carry it round and help it over as when elevation. On a dead level, also, I cannot get the machine to run as freely either, even with the wheels making its maximum speed per minute. Therefore, as far as I have personally ridden, a machine with a 50in. wheel is simply the worst possible means to get speed on a level, to say nothing of its inability to climb a hill.

Now, I am going to speak of the smaller wheels—say, 40in. to 42in. Owing to their small diameter, they are geared up so that they run at a speed which carries the machine along; say, to the 50in. wheel. But they consequently run faster than the pedal-shaft, and the centrifugal force stored up in them acts as a flywheel, and trifling obstacles are not felt, owing to the speed of the wheel. And further, at hill-work, the pedal shaft goes but the same speed as the 50in. wheel, yet your 40in. or 42in. ones are spinning round at a sufficient speed.

speed to enable you to ride up the hill minimum of exertion. In both these exams, of course, supposing the rotary mounted, and not the lever of any kind. After all, in my opinion, the rotary gives an advantage which is simply immense over the lever of

after carefully testing all varieties practical, myself, a machine with double 6in. only in diameter, and the machine, open-fronted one, consequently steers from

With it I find I can ride hills which I can't on a 48in. wheel; and not only so, but the machine spins along with the least motion, certainly much less than a 48in. wheel, up-hill, there is no comparison at all; the machine is all best steel, and is geared a 50in. driver.

On this machine, which has one or two gears not universally used, gives me great fun; yet I have for some time been considering odd moments the application of a fly-wheel gear for steep hills, or to strain on a long and tedious incline. My idea is to use two pitch chains, one for slow up-hill, to give the power; the other chain at the same speed as now.

As I have it as follows: Each driving-wheel, of course, have its pitch-wheel, and these would be the wheels on the pedal. These latter wheels would have long bosses on them, so that they would run through which now carry the pedal-shaft—the being enlarged to allow this; inside these would run loose the pedal-shaft. We have the gears, whilst to use them we have a pair-pin clutch, which, passing the chain-wheel bosses, take into the aft. These clutch-pins being carried are opened by a cam connected to the lever for altering the speeds, the action being that by moving the lever slightly one way releases the one set of clutch-pins, so that the pedal-shaft comes round they slip into gear. Instead of throwing in one set of course throws other. By this means the rider has a full control on his wheels at either speed, and is able to pedal when desired; at the same time that the clutches out of gear, the pedal-shaft, and can, therefore, be used as a foot-rest downhill for instance. This arrangement is easily applied to the open-front machine, fully believe to be best type for tri-cycles. The machine, with spoon-brakes on the two wheels, I believe, be found as good as any in the market, as it would carry the same fair speed on a level fully as well as the others; would be a good hill-climber, and minimum of extra parts to carry out the requirement to perfection. Sunlight.

THE EVOLUTION OF THE MOON.

[19176.]—THE portion mentioned of the secular motion of the Moon's motion is probably 4 of time in a century, and "Dublinensis" that I have really used the factor $\frac{2}{3}$ diminution of the Earth's rotation period as I stated, 2 minutes in fifty million years, 720th of the whole.

Upon reflection, that "Dublinensis" will be his reasoning about the increase of the Moon's distance diminishes does not the connection he has used it.

Supposing, for the sake of argument, that, since with the equation of moments, as Darwin, a decrement of the earth's period will be accompanied by a corresponding increment in the moon's revolution period or axis. Now, the decrement of Earth's period in the time considered is 1-720th of the whole, and if we even adopt the extreme supposition that the whole of this is due to tidal action we have from the equation of moments a decrement of distance in the same, which will be a small fraction of the whole of the same order of magnitude as the above. (It will, I believe, be less.) Therefore, the increase of the tidal action, varying inversely as the third power of time, &c., will be so small in the interval of fifty million years as not to affect the question to a considerable extent, so that any hypothesis that we have it as a consequence that the Moon's distance fifty million years ago was, or might have been, much greater than it is at present, appears a contradiction with what we know.

W. C. E.

Have no further space to devote to this subject.

SCOPE ACCESSORIES.—ERRATA.

[19175.]—I NOTICE the following errata in my 139.

I made to say I placed a long stick (which I used with a "white paint"); it should be white point. This error is in the second place. The next is in the fourth, where "the

side of the telescope below the pivot," which should be below the first. The other two are also in this paragraph, near the end of it, where I am made to say "and the cross of the lower tube kept on the top," should be tape. The star is pretty surely "focussed," should be found.

Philip Vallance.

LIGHT-DRAUGHT STEAMERS.

[19176.]—YOUR correspondent, Mr. Peal, will not have so much difficulty as he anticipates to obtain a steamer which will fulfil all the conditions he lays down. But in the first place I will refer him to what has been done already. Some years since it was desired to design a boat to carry considerably more than the weight named, and a steamer was built 130ft. long, 25ft. beam, and not to draw, when fully loaded, more than 12in. of water, the displacement being just over 70 tons. The cargo carried was, I think, about 50 tons.

Why, therefore, should not a reduced model of the above be suitable for the requirements—say, a boat 50 by 16 by 3ft. 6in. and not to draw more than 12in. of water loaded? And I am of opinion that it would be quite possible to carry 30 tons of cargo instead of 16 or 18 tons, on that draft of water. The propelling power must be undoubtedly a stern-wheel, as was the case of the larger boats. They had cylinders 14in. bore, and 60in. stroke, the wheel being 10ft. diameter, and when loaded a speed of 11-25 miles per hour was exceeded. The boiler must be one suited to burn either wood or coal, so that the latter, when not obtainable, need not prevent the boat being run from want of suitable fuel. In fact, the requirements named are fairly easily met, and I have not the least doubt that such a boat could be constructed at a moderate cost. Not only so, but a very fair speed could be got, as the large 130ft. boat had to steam against a current of 5 miles an hour, whilst in your case the current is but three miles an hour. Anything I could do to assist you in the matter I should be most happy to do. Sunlight.

STATICAL PROBLEM.

[19177.]—YOUR correspondent, "H. E. I. C. E." (19151), after making use of eight equations, has produced a ninth, which is exactly the same as the one with which I commenced my calculations, and which I obtained directly from a well-known theorem in statics. The only difference is in the symbols used. This does not help us much. I am interested in the problem, as it puzzled some of us engineers in India, and a good deal of midnight oil was burned over it.

If any of your readers can hit upon a shorter way of solving the problem, I shall be glad to advertise my address if they will kindly communicate with me. M. I. O. E.

C.R. ENGINES.

[19178.]—I NOTICE your correspondent "Carstairs," let. 19042, p. 526, on C.R. engines, says the 305 and 294 classes are both the same, and built by Sharp, Stewart, and Co., Manchester. Now that is a mistake, only 300 to 305 being built by that company. The other class, 294 to 299 and from 306 to 309, being built by the Scottish Central Company. Both these classes have double firebricks. He also says the 319 class were original Scottish Central, whereas they were Scottish North-Eastern, designed by Mr. Yarrow when he was locomotive superintendent for that company. They were built somewhere in Manchester. Perth.

THE GERMAN BRAKE TRIALS.

[19179.]—IN my letter, page 236 of Vol. XXXIII., I mentioned that important experiments were about to be made with various continuous brakes by the German Government.

The trials were originally announced to take place in July, but the commencement will be made in a few days. The brakes to be tried are the Westinghouse Automatic, Sanders and Boltho, Smith-Hardy, Heberlein Automatic Friction, Steel, and Carpenter. The programme which has been drawn up is subject to alteration and extension if found necessary.

The first series of trials is at present intended to consist of making "quick stops" with very short trains.

Each train is to be made up of six carriages, and only four of these are to be fitted with brake-blocks; and brakes upon the engine-wheels are not to be used. This arrangement of allowing only a very low percentage of braked weight, is the same as that adopted at the former trials which took place near Cassel in August, 1877 (details of which were published at the time in the ENGLISH MECHANIC).

It will be remembered that the object of the German experiments was to ascertain the efficiency of each brake in reducing the speed of the train and abstracting the foot tons of energy

during the first part of the stop; this information is very valuable, and furnishes data upon which other calculations can be based; but a serious objection is that a standard of brake-block pressure must be fixed, and the performances of each brake must be reduced to this standard. It is a well-known fact, and also has been most clearly set forth by Mr. James Dredge in his useful work, "The Pennsylvania Railroad," that this system "does not allow each brake to stand on its own merits," because it does not represent the actual performance of a brake in every-day service.

For instance, if a train runs off the line, or a collision between trains is imminent, the one important point is, in how short a distance can the train be stopped? Not how much energy can be abstracted in a certain time with a fixed standard, or with a certain proportion of carriages unbraked.

The trials are to be made for the information of the German engineers, and, therefore, they have most certainly a right to conduct their experiments upon their own system, but it is nevertheless a fact that engineers, in all other parts of the world where brakes are known, always object to trials with short trains, and to what is technically called "diluting the brake power by the addition of unbraked carriages."

We all know that it is upon heavy express trains that efficient continuous brakes are so very much required, and numerous experiments have proved that to obtain the best results, brake-blocks must be applied to every wheel in the train, and most especially to the driving wheels of the engine. It should also be pointed out that brakes cannot be thoroughly tested upon such short trains as four fitted carriages, because it is a fact that some brakes will act quickly and well upon three or four vehicles, and yet if applied to a train of ordinary length, will give results but little better than those which can be obtained by hand-brakes.

The series of "quick stops with short trains" is intended to occupy only two or three days, after which other carriages are to be added, and the trains will be put into daily service for three months, between Berlin and Breslau. Government inspectors have been appointed to ride with the trains to note every circumstance that may arise, and full details of their reports will be published.

It is fair to suppose that railway traffic in Germany will increase, and thus necessitate the running of trains of considerable length, and as the programme is open to extension, it is to be hoped that the German Royal Commission will follow the advice of foreign engineers, and conduct an extra series of quick stops with long trains, consisting of from ten to twenty-four vehicles, all fitted with brake-blocks, upon severe gradients, and with all states of the rails. The publication of results obtained under these conditions would be most valuable, not only to the German Government, but to the locomotive world in general.

The practical working of continuous brakes upon the Main Weser, Hanover State, Niederschlesisch-Märkischen, and Frankfurt Bebra lines has long since convinced the authorities that "ample retarding power" is one of the greatest safeguards which can be applied to passenger trains, and, as mentioned in my former letter upon this subject, the brake which proves itself to be the best will be adopted for all the trains upon the State railways.

The German trials of 1881 will therefore be watched with the greatest interest, and although the experiments will not be carried out upon the principles adopted by engineers in other countries, still there is convincing proof that a very useful and instructive addition will be made to our knowledge relating to the very important subject of continuous railway brakes. Clement E. Stretton.

Saxe-Coburg-street, Leicester, August 27th.

GRINDING AND POLISHING GLASS SPECULA.

[19180.]—SUPPOSING that since my last, some one of "ours" will have rounded his disc, assisted by the instructions I have given, the first thing that follows is to carefully clean down, treasuring every particle of the used emery he scrapes and washes off like gold, and taking care, if he values his lathe, to clean all parts thoroughly. The emery must be kept in a vessel of water, and added to the used emery that will be produced in the process of "roughing out" the curve. For this process, a pair of gauges will be wanted in the first place. The simplest way to make them is to use glass, selecting a nice straight piece, and as thin as can reasonably be handled, say, for 12in. diameter, 1-16in. Measure off the radius wanted on a pine rod, 3in. thick, and 1 1/2in. (about) wide, leaving it a few inches longer than the required radius. Pierce a hole exactly at the length wanted, measuring from the centre of hole to end of rod, less the cut of a glazier's diamond, usually 3/4in. Stick a bradawl or prick through the hole firmly into a table, place the glass where the rod describes an arc across it, equally dividing it, hold the glazier's diamond through and square

against the end of the rod, and cut the glass as you sweep across it. Grind the edges with flour-emery, as the gauges are held down on a flat board; reverse ends until the curves are touching all along.

It is usual in the trade to have special tools for roughing out, and it is the better plan where a quantity of work is done; but, as these instructions are for amateurs, I will describe how one pair of tools will answer the purpose of roughing and smoothing too. The tools may be iron or yellow brass; the latter metal certainly the most economical, and producing the best surface to polish from. For brass—to lessen the expense—one wooden pattern will do for both concave and convex. The tools should be lin. at least greater in diameter than the speculum. The top of wooden model should be turned out of sound pine, concave on one side, convex on the other, to the gauges, and ribs, six in number, $\frac{1}{16}$ in. thick, and $\frac{1}{16}$ in. high, radiating from the "boss" in the centre, to give it strength and avoid flexure. When one is cast, the boss can be reversed, and the ribs to the other side, and then the other tool cast from it; thus, one pattern does for the pair. The boss should be screwed with a coarse thread, ten to the inch about, or better, to the nose of the lathe, and the surfaces of the brass tools turned as true to gauges as possible. Finish truing by scraping and grinding tools together on a post, or bench screw. The bench-screw is more suitable, I think, for the amateur. I send sketches of tools and screw. If the



speculum is under 8 in., it can be roughed out without any addition by spreading the hands out, one over the other, and working with straight and round strokes alternately, using 60-hole emery; but, for larger sizes, a mahogany ring should be stuck on with pitch, the ring two-thirds the diameter, 2 in. high, and 2 in. broad for a 12 in. Forty-hole emery should be used for larger than 8 in. In roughing-out do not work more than ten minutes with the speculum at a time, grind the emery down very fine, wipe the margin of the tool with a wet sponge, leaving only $\frac{1}{16}$ in. or $\frac{1}{8}$ in. of emery in the centre. Then true up your tools together, grinding them with short, straight strokes, and rubbing the emery as black as ink. A wooden knob must be made to screw into the boss of your tools, for convenience of holding for this process.

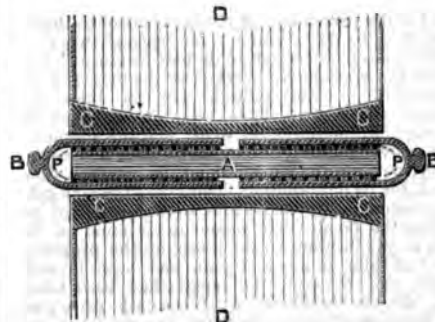
Prismatique.

ERRATA.—Letter 19090, page 572, No. 856, 12th line from the top, for "flushing" read pushing; and 24 and 25 lines from the top, read coarse-threaded, not "headed."—PRISMATIQUE.

INDUCTION-COILS.

[19181.]—In looking over back volumes I occasionally see reference made to "Appa's" system of winding the secondary wire in sections, insulated

laterally, by vulcanite partitions. Will any one be so good as to give the date of Mr. Appa's device, as the celebrated instrument-maker, Ritchie, of Boston, Mass., U.S.A., has been following same plan since 1857, being, indeed, the first man to greatly improve Ruhmkorff's original form. Ritchie also introduced the making of the poles of the bobbin the thickest, to counteract the danger existing chiefly at the ends of the secondary current breaking through into the primary. I inclose sketch. References: A, core, insulated from P,

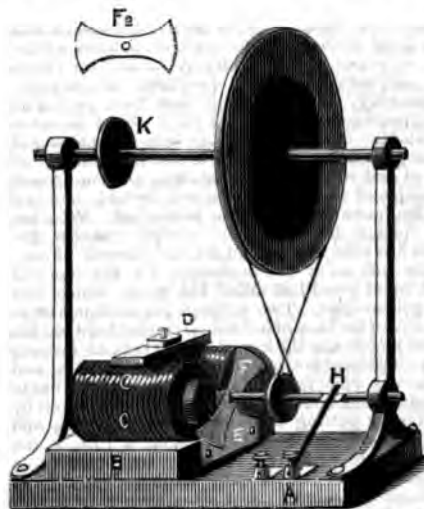


primary. B B, heavy glass tubes closed at outer end and meeting at centre of bobbin, effectually insulating P. C, bobbin, thickest at poles. D, sheet vulcanite portions, very numerous indeed. His coils are efficient; that at the Stevens Institute, Hoboken, N.J., has 195 ft. of No. 6 primary, and over 50 miles of 36 secondary. Core, bundle No. 20 wire. With 3 bichromates, gives 2 in. spark, going through 3 in. glass.

Roi Ne Puis, Souza Je Suis.

ELECTROMOTOR.

[19182.]—According to your note to 44525, p. 604, I send design for electromotor to drive a small



drill or other light work. It will be found in practice the easiest and cheapest for an amateur to make, and will give results equal to any other electromotor, either with the galvanic battery or a dynamo-electric machine:

A A is the base of wood 20 in. $\times$ 9 in., and 2 in. thick.

B Block of wood to support the electro-magnet.

C Electro-magnet.

D Brass clamp and nut to secure magnet to the base A A.

E Brass bearing for the armature-spindle to run in; the bearing has a steel-plate at back for the spindle to run against.

F Flat iron armature, 2 in. wide 6 in. long and $\frac{1}{8}$ in. thick, fixed on a spindle to revolve about 1-30 in. distant from the flat ends of the magnet; F₂ shows the best shape.

H Contact-breaker and spring.

K Driving-pulley 3 in. dia.

The magnet must be charcoal-iron $\frac{1}{4}$ in. dia. and 24 in. long before bent; when bent the ends must have $\frac{3}{4}$ in. of space between them. They must also be flat and truly squared; the magnet must be wrapped with 20 lb. No. 12 or 14 covered copper-wire, and the engine will work with three to twelve cells Bunsen's, and one to five cells Planté's secondary battery; the machine will lift $\frac{1}{2}$ to 2 lb. per second 1 ft. high, and drill holes in brass 1-16 in. dia., or propel a small boat. A sewing-machine wants double this power.

J. Sutcliffe.

ASTIGMATISM.

[19183.]—A FEW weeks since some letters upon astigmatism appeared in the ENGLISH MECHANIC, which led me to examine the effect of looking at light through a pinhole in a dark plate. The result is as sketched; the bright portion being evidently



formed by the intersection of several circles of light. My left eye only was used, the right having been injured by bad glasses at sea. If any of your readers can explain this, they will oblige your obedient

Buntain.

MEDICAL REPLIES.

[19184.]—SEWER GAS IN HOUSES (44596).—This query has already been usefully replied to, but not completely; and as the query is one of great practical importance, I venture to sum up the points in question.

1. Disinfectants are not the remedy, and should never be used in a house except for such purpose as to neutralise discharges from typhoid or other infectious patients. Sewer-air must be kept out of a house; not admitted in order to be run after by disinfectants, and the only practical result of chasing sewer-air with disinfectants inside a house is that the inmates are poisoned sometimes with sewer-air, sometimes with chloride of lime. The disinfectants, moreover, corrode all the metalwork about the house. For disinfecting air an aerial disinfectant, such as chloride of lime, must be used. All others are delusive. For typhoid discharges a cupful of Condy's fluid or of chloride of lime, with water, should be put into the utensil into which they are received, and the utensil then covered over. If such discharges be kept for doctor's inspection, lute over the vessel a disc of glass by means of putty, which can be done in an instant, and will preserve the atmosphere of the bedroom from contamination.

Infectious linen, if put into chloride of lime or Condy's fluid, may as well be burnt at once, as it comes out rotten and useless. Such linen should be put directly into a solution of carbolic acid (one part of acid in 20 of water), and allowed to become saturated. A pan of the solution will serve for a good deal of linen, and after thorough saturation the linen should be squeezed out and rolled up in mackintosh. It may then be sent, without danger, to the laundry, to be boiled and returned clean. It comes home as good as ever. For disinfecting the air of an infected house, burning sulphur is cheap and effective. The windows, fireplaces, doors, and all crevices of the room must be pasted up with slips of paper. Roll-sulphur in an iron dish having been placed safely in the centre of the room and set fire to—the door should be closed and the room left for five or six hours. After the room has thus been fumigated, its ceiling should be lime-whited, all paint-work, door-handles, finger-plates, &c., well washed with soap-and-water, and the wall-paper renewed. Carpets, &c., should be sent to a steam-laundry.

2. "Anxious Father" does not say how his house is supplied with fresh air, or whether this has to be met by a supply through the drains. This is an indispensable preliminary, and will be fully understood on perusing my letter on "Taking Cold" (E.M., No. 851). In one recent reply the term "convection" is wrongly used. When an upper window is opened, the atmosphere of the house is renewed by displacement, not by "convection": the cold outer air flows down into the house, and the warm inner air flows up out of the house. "Convection currents" carry heat about from one part of a room to another, as when the air next a thin window or skylight is chilled and made heavier it falls, while warm air from other parts of the room takes its place near the glass, and so a continuous current is kept up. This is a circulation of stale air by the process of chilling, not a renewing of the air from without; the two processes should be carefully distinguished.

3. Being clear as to the proper function of disinfectants, and as to the necessity for a proper inlet of pure outer air to meet the suck of the chimneys—we are in a position to consider the sewers. A perfect drain carries off promptly all matters that fall into it, and allows no reflux of air from the outer sewer or cesspool into which it discharges.

ain needs flushing with water, and nothing flushing, a distasteful of water, allowed away through the drain will not flush it—it be momentum or velocity in the water into the drain, or no flushing takes a few gallons of water discharged instantly drain washes everything through and perfectly. The flushing-pipe must be in.), as far as practicable free from bends, a proper head of water behind it. A few hen flushes the drain perfectly, and economise regard to the expenditure of water. our's heavy rain makes London a different ply because it has flushed the drains. laden soil-pipes that are soldered are un-ly when they have stood twenty-five years. ot leak water, but their upper sides, where a touch, become corroded and perforated. It is, that sewer-gas escapes under the floors ous the household. "Anxious Father" therefore have the pipes examined for per- along their upper portions, and not hat his soil-pipes are sound because they ak water, and because there is no ob- . Soil-pipes that are burnt together older, or are cast, will last for a century. pipes should never be used inside a

soil-pipe should be carried up its full size parapet of the house, to some point where t discharge into an attic window.

soil-pipe, where it discharges into the ust be so trapped that it allows of no gas from the sewer into the soil-pipe.

stack-pipe must be so fitted that the of an upper closet cannot siphon out : from the trap of a lower one, and leave ped until again used. Pipes from wash- ast be all trapped, and so that their traps siphoned out.

drains that run inside the basement of a -house should be glazed 6in. pipes, laid in of hard puddled clay, and luted together smooth clay. Junctions should always -angled, and the pipes require a proper

se in which these points are all properly have immunity from sewer-air, and save bills from doctors and undertakers. Unless is Father" is a greater genius than I take be, he will do wisely to offer his local officer of health a couple of guineas to is house and certify that these things are done.

James Edmunds, M.D., M.R.C.P.
n-st., Bond-st.

ETIC SANITATION—THE HOUSE YOU LIVE IN.

.]—THE house you live in may be your o persons living in their own houses, I hing at present to say. This communi- to persons living in houses belonging to whom I at once say that you, living in r person's house, have at your command own present use the value of the house erty attached, and the rental you pay is ast of the cash value of the house to you, the interest of the value of the house on by some special cause, such as affect le commodities on special occasions, or it ult of changes from general uses to special . A house near whence I write was let at he landlord spent £100 in alterations, and stting £100 per annum. But the butcher rent, and is making capital out of his n the premises—an instance of the change erty to special purposes. Then, in some urhoods, a demand may be set up for and the demand is made the occasion for ase of interest on the value, or the increase at may be through what I may call the f circumstances." Suppose some company, ent cash on mortgage to the speculating the builder fails in his payment, the mort- foreclosed, and streets of houses become erty of the company. Now, this company its own legitimate business—that is the of cash on good security—to transact, ad a sort of white elephant in the and has not known exactly what with it, for although being shrewd to get the houses at a nominal leading spirits of the company have not ow to manage the houses without a loss; ng comes some enterprising genius, in e speculative propensity has largely de- and offers to take a street of houses on lease at a fixed sum; the offer being g, and the security good, the affair is closed, perhaps, this genius is at once the nominal , say, 200 houses. Now notices are imme- isued for an increase of rent, which, if roperty, may be two or three, and some- ur, shillings per week. The Genius takes a house in the suburbs of London, sculates in a farm in the country, or,

if he have a taste for the sea, he buys a yacht for his pleasure with the exorbitant percentage of the force of circumstances. Now, generally speaking, persons, such as the butcher, have long leases on their places of business, and, being not altogether the most pleasant of occupations, as a rule, the drains and the water supplies are efficient, so you may not apply to the butchers for very awful instances of defective domestic sanitation. In the demand and supply cases we come at once to the speculating investment method of operation, and are in the very middle of all the matter, at the extremities of which, on the one hand, is the person having charge of his own house, on the other hand is the person having charge alone of the house belonging to the Genius; for special work is at all times bad enough in its best instances; but, when the speculative work is at the mercy of the Genius, it is bad indeed. Let us take 200 houses whose rents have been increased on an average two shillings per week, and the amount is £20, or over £1,000 per year, drawn from house property, not for its improvement, but, on the other hand, for its depreciation. Think you the man getting cash so easily spends it to advantage? Not he. Before the Genius had made up his mind on the sum to pay in lump on the leases on the property, the full value in loss and gain had been investi- gated, and the costs for repairs had been taken out, also the consideration of the cash price paid for the property in the first instance, whilst every- thing which would show in his favour would be set in the most plausible manner for his benefit; yet, after the whole thing is put in the most favourable working order, it does not pay, or it has not paid. A short time ago Mr. George Genius had so arranged the tumbling out of other persons' goods, and had involved himself to keep up his appearances, until on one fine morning his own goods were found in the fore-garden of his suburban mansion, and Mr. Charles Genius has sold his yacht, whilst streets and terraces and rows of houses have been announced as for auc- tion, which were formerly in the nominal possession of the Genius family; whilst Mr. Thomas Genius has lately been seen peeping out from behind the curtains of his drawing-room to watch the trades- man away from his door to whom for weeks before it has been all work and no pay. Appa- rently this method of obtaining possession and living out of the increased rent, or, in other words, the increase of the interest under the force of circumstances, is a profitable investment; apparently, also, it is not so profitable as appearances indicate, but yet it might be made profitable; it requires for the good management some good managers, and it is also necessary to set out at first with the ideas of working out some sound principle of action, for common benefit, and not for the mere benefit of the individual. Why has the Genius family failed?—simply because the affair has been worked out for the benefit of one, under each set of circumstances, for the one has with great greed just killed the goose which laid the golden eggs. Two shillings per week put on to the rent of the class of individual coming between the upper middle and the lowest class of persons, means a very considerable alteration in domestic affairs; and if through some pressing cause the individual has to remain in the house, it most frequently is set off by the family putting themselves into less room and letting extra apartments. This, as a rule, is the beginning of strife, for generally such persons as are on the look-out for extra apartments are "un- welcome customers"; but what are people to do? Every Monday morning the agent calls for the rent, with a broker's man behind him, so the rent must be paid, even at the expense of domestic peace, with the aid of the "unwelcome customer," who has no knowledge of the object of the doormat, and for whom the stair-carpet must either be removed, or else renewed, or dispensed with alto- gether; whilst the appearance of the room in occu- pation of the lodger is quickly altered from general tidiness into general dilapidation, and then the lodger leaves—perhaps having been five weeks in possession, and the apartments must be "done up" at an expense amounting to the sum received since the introduction of the "unwelcome cus- tomer" into the house. The agent is applied to for assistance; but the stock answer to the appeal is "If you have lodgers you must do the repairs." This reply begets on the part of the tenant an apathy and general disregard for personal effort, and ends probably in a moonlight trip on the top of a van, leaving the Genius short of one week's rent with the cost of decent endeavour to make the house habitable and loss of probably a month's rent before another tenant is found, to whom the same routine of domestic discomfort comes with the same certainty as the certainty of the agent coming on the Monday morning for rent. Is there any wonder the Genius family fails? Let me contrast this method of dealing with house-property with the method of a gentleman I know, to whom be- long about eighty houses, of which I know some- thing, and say, that on none of these houses have the rents increased over one shilling per week, which increase was put on to meet the heavy ex-

penditure consequent on the constant supply of water, and which increase the tenants readily pay, and are glad to pay, for I know it is seldom he has rent in arrears, and seldom has a house to let, for as soon as it is known one tenant is leaving, another is ready in a sort of a "ring of families" to step into possession. Now which of the two methods of dealing with property is the better one, and the more profitable one?—but, then, the gentleman is content to live gentlemanly on the rents of his property, and allow his tenants to live comfortably in his houses.

I have, in this letter, written upon what I may call the lower stratum of social life and its sur- roundings; but I am conversant with the upper so far that I have confidence in applying the same arguments, and for the same reasons, to the upper as I have applied to the lower, and conclude with including all in one class as being bound to con- sider that, in respect to the object in view, the tenant of every house who pays rent—i.e., the in- terest on the value of the house, has other duties in connection with his possession beyond the mere payment of rent; and that the owner of the house has also other duties than the receiving the rent, of which I consider the first to be the seeing to the fact that the tenants be not burdened with a onerous a duty in paying the rent as to prevent them attending to the other duties in connection with their possession, for I look upon this to be the letter A in the alphabet of domestic sanitation.

Jo Boomer.

REPLIES TO QUERIES.

* * In their answers, Correspondents are re- spectfully requested to mention, in each instance, the title and number of the query asked.

[43883.]—Official Spelling of Indian Names. —Many thanks to "Paugui," "Saul Bymes," "Calcutta," and particularly to Mr. S. E. Peal, for their useful replies, which are a further example of the ubiquitous circulation of the ENGLISH MECHANIC. May I further trespass on the good-nature of Mr. Peal? Will he kindly complete his answer by a few words on the rules for accent in Indian names, as in Mandavi, Aravali, Tipperah, Peshawar, Nilagiri, Sabarnati, &c.? Are "g" and "gh" always sounded hard; "Nagpur" used to be spelt generally with a "j," and Ganges still retains the soft "j" sound. What is the official law on the sounds of "y" and "ch," as in Mhye, Wyne, Gunga, Trichinepoli; and on double letters, which, he says, are unnece- sary: they are retained in a number of words, as in Salsette, Pennar, Nellur, Mannar, Laccadive, Allahabad, Fattygar, Jullundhur, &c. Our alphabet is certainly redundant, and defective too; but I don't see that the Sanskrit, with e like a, i like e, u like oo, ai like i, au like ow, is quite perfection, either. Still, if the sounds are invariable, that is a great point in its favour.—DAGHERRET.

[44260.]—Caledonian Bogie Express En- gines.—Such a long time having elapsed since I had last seen any of the above class of engines, I had almost forgotten what they were like. They never run on the Carlisle section now. I had an opportunity some weeks ago of examining one of these massive engines, and on returning home I made a drawing of one from memory, and which I beg to inclose for the benefit of "H. J. A." or any Southern readers, who have few, if any, chances of seeing them. Owing to the circumstances under which the drawing was executed it can have but few pretensions to anything like accuracy, and I hope, moreover, that correspondents who are familiar with the appearance of these engines will pardon any faults I may have unwittingly allowed to creep in. I regret to say that I cannot accom- pany the sketch with dimensions. They are said to weigh about 70 tons with tender. The Caledonian passenger-engines are painted a deep ultramarine blue, lined with black, and picked out with white, except, of course, the smoke-box and chimney, which are black, and also the finished ironwork. The goods and mineral engines are painted black, and lined in same style as L. & N.W. engines. I was told lately that there are two of the old Scottish N.E. single engines at Carstairs. I gave all the single engines at Carstairs in letter 19042, and am quite at a loss to know which two they can be. They certainly are not 294 and 304, as S.C.R. is distinctly marked on castings, &c., of those engines. I always under- stood, too, that Nos. 312 to 319 were S.C.R. engines. The popular name by which these engines are known here is the "Highlandmen" (Highland- men). Since my last I have seen S.C.R. singles, 299, 300, 306, 307, and 723—the last having apparently 5ft. wheels. This year Dubs and Co. have turned out some fine mineral engines. These engines have, like their predecessors of same class, leading and driving wheels coupled, and have a

very large percentage of weight resting on the coupled wheels. The cylinders are placed horizontally, and are 18in. diameter and 22in. stroke; the coupled wheels are 5ft. 2in., and the trailing

point, such as BC. This pressure can be resolved into vertical and horizontal pressures, such as BA, AC. As this triangle of forces can be drawn to any scale, we can take the radius BC to represent

$$C \left(t - \frac{t^2}{2r} + \frac{t^3}{3r^2} - \frac{t^4}{4r^3} + \&c. \right) = pr$$

$$\text{or } p = C \left(\frac{t}{r} - \frac{t^2}{2r^2} + \frac{t^3}{3r^3} - \frac{t^4}{4r^4} + \&c. \right)$$

The same series could be obtained by expanding $\log. \left(1 + \frac{t}{r} \right)$ by Taylor's theorem. Now it will

be seen that so long as t is less than r , the series is convergent, and when t is much smaller than r , for instance, if t is $\frac{1}{2}$ in. and r 12in., the whole of the series after the first or second term may be omitted, the terms being too small to affect the result, hence the equation will differ but little from $p = \frac{Ct}{r}$ or in

other words, the bursting-pressure will vary almost directly as the thickness of tube, so long as the thickness is considerably less than the radius.—M.I.C.E.

[44286.]—Hand-Pump.—To THOMAS HARRIS.—Many thanks for drawing of pump. This seems more easily made than that so kindly sent by "Sunlight." Will T. H. be so good as to give me the best size to produce more effect without too much exertion being necessary—i.e., a pump which can be easily used by any ordinary person without fatigue, and which will throw from six to eight gallons a minute, 35ft. high. The measurements I require would be length and diameter of each tube, and I should be much obliged for details of the top part through which the plunger passes, so as to make it, as I presume it must be, quite water-tight. I intend fixing the pump inside an iron bucket.—M. B.

[44289.]—The Ratio of Inertia to Weight.—This question seems to originate from the error of supposing that inertia is a force. Inertia is merely the name given to the incapability of matter to change its own state of motion or rest.—THE TITANIC.

[44306.]—Delicate Test of Energy or Strength.—What test of nervous energy is possible with the spirometer or dynamometer? If it is possible to test the nervous energy at all, I suppose the sphygmograph would give the best, because most trustworthy, results, showing as it does the force and frequency of the heart-beats.—ESSAY.

[44308.]—Nickel-Plating.—What sort of a shower of rain was it that turned nickel-plating "black"? What was the locality, for there must be some cause for so remarkable an effect?—J. T. M.

[44313.]—Green-Bronzing Iron.—There are many recipes in back volumes; one which may perhaps suit on p. 228, Vol. XXXI., a recipe which will probably be found in earlier volumes, as I find it has gone the round of the Press, and is quoted in a well-known book. I suppose it to be a good one, therefore; but do not know.—E. G. M.

[44327.]—Portland Cement.—I cannot give your correspondent "Os" the methods of analyzing Portland cement; but if he will get Spon's catalogue of books, and refer to the works on cement, by Reid, he will be consulting the best literature in book form on the subject.—ESSAY.

[44331.]—Black Jewellery.—I suspect it is a specially prepared asphaltum varnish.—C. K.

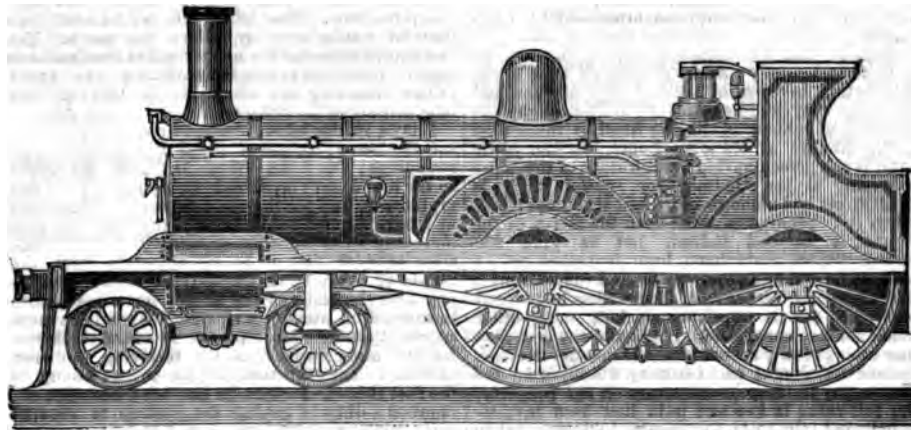
[44338.]—Pharmaceutical Society's Exam.—Replies to this question appear on p. 72, Vol. XXV., in the shape of two separate recommendations to apply to the Registrar, 17, Bloomsbury-square, W.C., when a pamphlet giving full information will be sent.—T. J. M.

[44346.]—Electric Gong.—Why not put in a larger bell or a gong. If the hammer already strikes the small bell it will strike the larger, but of course may need to be heavier.—L. J.

[44393.]—Vermifuge.—In reply to "Chiretta," I may perhaps say, the "Worm Tablets" I had in view were Keating's.—LIZZIE.

[44400.]—Lantern-Screen.—You can get linen 8ft. wide from almost any linendraper, and then, after well scalding it, have it made up into a sheet 16ft. square, this makes the best screen you have. Usually, in this size screen, there are two seams, and invariably there is a series of awkward frills running down from bottom to top of the screen at each of the seams. You can get linen made 16ft. square without a seam. For transparent purposes there is nothing better than tracing-cloth, a square 4ft. square of this material is at once smooth, clean, and portable; always ready for use; requires no wetting; so that as soon as a lecture is over, the screen may be rolled up and carried away.—W. J. LANCASTER.

[44423.]—Photographic.—You can do with a studio 12ft. long, if you can run out a sort of ladder for another 3ft. for the camera-stand to go in. There is no necessity to have the whole of the studio as wide as the end where the sitter is to be placed. The studio could be, say, 16ft. long in all,

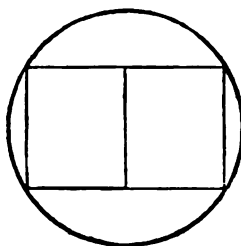


wheels 3ft. 9in. The distribution of weight is as follows:—

	Tons	cwt.	qr.
Leading Wheels.....	14	5	1
Driving ".....	15	16	—
Trailing ".....	4	9	3
Total Weight.....	34	11	0

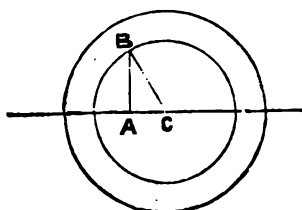
Thus it will be seen that out of 34½ tons 30 tons rest on the coupled wheels. Five of these engines are at Edinburgh, where, I believe, they are doing good work; they are numbered 700—704. The finish of the engines reflects great credit on Messrs. Dübs and Co. The slide-bars are same as on L.S.W. express engine, illustrated on p. 192, Vol. XXXIII., and valves are loaded with a working-pressure of 130lb. per square inch.—CARSTAIRS.

[44268.]—Stereoscope.—You can easily make a stereoscope when you have the right kind of lenses, and these you can either buy or make; but to grind a lens for making a stereoscope would be, I think, too much labour lost. Now, you can have a pair of stereoscopic lenses for 1s. 6d., or you can have a lens 6in. focus, out of which you can cut two pieces, as per sketch below; the square portions to



be cut out as marked, the edges smoothed on a flat-iron or stone, with emery-and-water, and then they must be mounted with their thin edges together. It is better to have about 1½in. adjustment, so that it will suit all who may wish to use it.—W. J. LANCASTER.

[44273.]—Strength of Tubes.—I see that some doubts have been expressed by a correspondent as to the truth of my theorem on this subject, viz., that the strength of a tube (where the thickness of metal bears a small proportion to the radius of the tube) varies directly as the thickness. And, if I am allowed space, I should like to give a reason for the faith that is in me. The diagram represents



a "slice" of a tube, the width of the slice being taken as 1in. Suppose the pressure to be applied internally, and that P represents the pressure per square inch, the direction of the pressure at any point will be represented by the radius at that

point, such as BC. This pressure can be resolved into vertical and horizontal pressures, such as BA, AC. As this triangle of forces can be drawn to any scale, we can take the radius BC to represent the pressure per square inch. BA and AC will, therefore, represent the vertical and horizontal components. Now, without making use of the calculus for finding the sum of all these pressures, we can divide the inner circumference into inches, also the diameter into inches. Having done so, draw a series of triangles for each inch in the semi-circumference; then it will be found that the sum of all the BA's = the sum of all the CA's; also, that either of these sums is equal to BC multiplied by the number of inches in the diameter, or $p \times d$, that is to say, the sum of the vertical pressures tending to separate the two halves of the ring = pd , or half that amount at each end of the diameter, or the strain on the tube at any point will be the pressure per square inch in the tube, multiplied by the radius in inches. So long as the tube is perfectly cylindrical, the tension at any point will always be at right angles to the diameter at that point; but, in the case of an oval tube, there would be a "bending moment"; in this case, therefore, corrugated plates would add greatly to the strength; but, in the case of the cylinder, the advantage of corrugating the plates is not so apparent. If the tube were made of some inelastic material such as stone, which would break with a tension of C lb. per square inch, and suppose t = thickness of the tube in inches, Ct will be tension required to burst it at any section. $\therefore pr = Ct$ or $p = \frac{Ct}{r}$ which

gives us the pressure required to burst a tube made of inelastic material. Iron, however, is an elastic material, and the strains will not be the same as in the last case. Or, to make it more clear, suppose we consider the tube to be made up of a series of rings of indiarubber, the inner rings will be more strained than the outer. Now it is a law of elastic bodies that if we have two strips of elastic material of different lengths, and each is extended say an inch, the strain on each of the strips is inversely proportional to the lengths of the strips, or if l_1 and l_2 represent the lengths, and S_1 and S_2 represent the strains, we have the equation $\frac{l_1}{l_2} = \frac{S_2}{S_1}$.

Now, suppose the inner ring to be stretched by the pressure, so that the radius is increased by a small quantity a ; let us see what amount another ring, at a distance x from the inner surface, would be stretched. The inner ring would be extended

$$2\pi(r+a) - 2\pi r = 2\pi a$$

the other ring at x would be stretched

$$2\pi(r+x+a) - 2\pi(r+x) = 2\pi a$$

showing that the two rings are equally extended, therefore the strains on each are inversely proportional to the lengths of the circumferences or to the radii of the rings, so we have strain of ring at

$$x: \text{ditto at inner surface} :: r:r+x$$

when the strain at the inner surface is the maximum that the material will bear (call it C lb.) we get the equation: Strain of ring at $x = \frac{Cr}{r+x}$ and the strain on all the rings will be

$$\int_0^t \frac{Cr}{r+x} = C \int_0^t \frac{1}{1+\frac{x}{r}} = Cr \log. \left(1 + \frac{t}{r} \right)$$

This can be equated to pr as before, from which p can be found. I have not got a table of Hyp. logs by me, but the expression $\frac{Cr}{r+x}$ can be expanded

$$\text{into a series } C \left(1 - \frac{x}{r} + \frac{x^2}{r^2} - \frac{x^3}{r^3} + \&c. \right)$$

When this is integrated and t put to x we get

but 8ft. could be, say, 8ft. wide, and the remaining 8ft. need not be more than 4ft. wide; this would save timber, and still make a studio long enough for good work. The windows should begin 3ft. from background, and go to the end of large part of studio.—W. J. LANCASTER.

[44448].—Electric Bells.—You will find lots of information in back numbers about electric bells and the fixing of them; but the matter is so very simple that it is hardly worth your while to look over back numbers. Now having a bell, Leclanché cell, guttapercha-covered wire and a push, you must first make up your mind where to put the bell so that it may be heard best; then screw it up in place and bring a guttapercha-covered wire down from one of the binding-screws and carry it to the zinc wire of the cell. Then take another wire from the other binding-screw on bell up to the place from which you wish to ring, and fasten the wire to one of the pieces of metal in push. To the other piece of metal in push, connect a second wire and carry this to the nearest gaspipe, soldering it to any part out of the way. Then, to finish all, connect a wire to the binding-screw on the top of the porous cell and carry it to the nearest gaspipe and solder it to it. The whole is now complete, and with battery charged, will ring for probably twelve months or more. You can run a second wire in place of gaspipe connection if you like, that is, where it is impossible to join up to gasfittings.—W. J. LANCASTER.

[44449].—Induced Currents.—The rapid breaks will produce greatest currents much more than the change in polarity alone; this of itself will produce very little current.—W. J. LANCASTER.

[44452].—Reclaiming Land.—Our correspondent does not state at what height the 500 acres of land is situated above level of nearest river, and the distance. Supposing the river-bed to have a good fall, an outlet might be made from lowest part of land so as to enable all water to be discharged into river; care should be taken to place all of sluices below level of lowest point. For flooding another channel could be made from river, provided with sluices placed upstream at a sufficient height above land to enable the water to flow on to the land. Should the topographical position permit such works as I have proposed being carried out there is no difficulty, and it is a question of first cost only; but if, on the other hand, the relative levels do not permit of a natural drainage and irrigation, such as has been just pointed out, recourse must be had to mechanical means for freeing the land from water, and I should recommend a portable engine and centrifugal pump as the most effective means of raising the water; it also remains to be seen whether the land could be flooded at will at all seasons by a channel from a higher part of the river. If not means must be provided for pumping up water also. For rice-cultivation it will not do merely to flood the land and form a stagnant pool. A constant stream of water is required. Windmills could be used to advantage, always provided that there is sufficient wind at all times to work them, and naturally they would be cheaper than steam-power. The most effective arrangement for raising water by wind-power is the Nozia, and is extensively used in India, Persia, Egypt, and other Oriental countries. Provision might be made for steam-power when the wind fails, and such an arrangement would be found extremely economical, as fuel would be only consumed whilst there was no wind. Windmills can be made self-regulating, and require but little attention. The steam-engine might be used for thrashing and grinding when not required for pumping. For lifts under 10ft. the dash wheel offers considerable advantage over any system of pumps; but over 10ft. I should give the preference to the Nozia; but when the lift is of considerable depth force-pumps are the most suitable. If Mr. Bond likes to advertise his address in the Sale Column, I shall be happy to give him further information.—ETNA.

[44450].—Non-Conducting Material for Stoves.—I should think pumice would be the best material you could use. Asbestos would be better, but the cost would be, perhaps, too great; pumice broken small would be the most effective material you can get at an ordinary cost.—W. J. LANCASTER.

[44460].—Eczema.—There has been much written about the methods of curing the eczema, mentioned by "Carlo"; but there has been no mention of zinc ointment, made up with vaseline. This is the finest thing I have seen. I know of several cures of obstinate cases of eczema effected by this ointment; any chemist will make it up for you. There is one thing that should not be overlooked in cases of eczema, and that is, that very often if you get rid of the eczema, you get something worse in exchange. I know a case (a doctor's daughter) in which, when the eczema goes, convulsions come, and this alternation has taken place, in spite of every treatment, arsenic, &c., &c., all giving same result; so that, if the eczema in "Carlo's" case

does not yield easily, he had better, by all means, consult a good medical man.—W. J. LANCASTER.

[44464].—Chloride of Zinc Battery.—To Mr. LANCASTER.—I am sorry I am unable to tell you how to make the chloride of zinc cell. I have not made any of them, and, in fact, have not seen one, that I can just now remember.—W. J. LANCASTER.

[44475].—Violin-making.—In answer to G. Fryer, I may say that I made a violin, and one or two old fiddlers say I have succeeded very well; but, before I commenced, I read up what books I could get—viz., "Sketch of the History of the Violin," "The Violin," by G. Hart, "Otto on the Violin," G. Dubourg's work on the Violin, and all the information I could gain in other ways, and I find the making of the violin very pleasant occupation, and enjoyed it much more than buying one.—E. P. AINTREE.

[44477].—Electric Battery.—I am afraid it would be more trouble to carry the battery and coil than to stop the horse kicking. A magneto machine would be of little use unless you had an assistant with you to turn the handle when required. A good form of battery would be a bottle bichromate in a box with a small induction-coil, and from it wires carried to the horse's mouth, and connected to the horse's tongue. The moment the horse commenced kicking the zinc could be pushed into the cell and withdrawn as quickly. This could be so arranged as to be connected with a lever for the foot with a spring to keep lever always up, and of course battery out of action, and then pressure from the foot would close circuit and keep it closed as long as wanted; then the removal of foot would break circuit.—W. J. LANCASTER.

[44489].—Pressure of Water.—The pressure at the foot of a column of water is proportionate to its height, and the height in feet multiplied by '4327 will give the pressure in pounds per square inch for water at a temperature of 62° Fahr.; therefore, the pressure due to six feet head = $6 \times '4327 = 2.5962$ lb., to one foot = '4327 lb., and to one inch = $'4327 = '036$ lb. Has "G. J. H."

(reply 44189, p. 603), seen the extract from "Montaigne's Essays," which heads the Letter column every week?—OAKLAND.

[44490].—Spring Mattresses.—I have used for many years the ordinary "German" coiled springs, with hair top-stuffing; and also the "Excelsior" patent (spring-chain) mattress, made by Chorlton and Dugdale, Manchester; and I have examined several others, including the "wire-woven" ones. I give the decided preference to the Excelsior, as the easiest, cleanest, lightest, and most durable of beds. There is perfect adaptability to the form of the sleeper, and it is without hillocks, and without that depression in the middle of the bed which so often rolls the two occupants into too-close proximity to each other. It is made on a solid pitch-pine frame, to fit any sized bedstead, or combined with an iron bedstead, in which form, instead of being one of the most cumbersome articles of furniture in a house, it is one of the most portable; and occupies, when not in use, less store-room than a clotheshorse. No palliasses nor feather beds should be used with the Excelsior mattresses—only a thin hair or wool mattress. Indeed, a friend of mine has banished even that, and prefers two or three pairs of blankets folded to size of mattress, and laid thereon with a single piece of felt carpet interposed to receive the friction of the springs. The top blanket is periodically washed (no trouble in a washing machine), and relaid at the bottom; thus, as he triumphantly explains, making a "perfect bed," from the luxurious, hygienic, economical, or housemaidly point of view. To invalids, bed-sores, which are due to constant pressure on prominent parts of the body, are almost impossible on such a balmey couch.—DAGHERT.

[44490].—Spring Mattresses.—I have sold hundreds of mattresses, including many kinds that are not now being manufactured. That most to be recommended for use in a sick-room is certainly the patent woven wire. They are cleaner; vermin cannot get in and live about them. They are very durable, and much cooler than the old-fashioned hair or wool, easily put together, and just as easily packed up. If after using for some time they get a little slack in centre, just tighten up with key that is sent with each. Another great thing in their favour is the price. For a 4ft. 6in. about 60s.; but this varies according to the business-place you may go to. I use one with only a double blanket under me, and feel not the least inconvenience.—FURNISHING SALESMAN, Liverpool.

[44497].—Electric Lamp.—You cannot at present do all you wish, but in a very short time you will. There must be a lot of improvements made in Faure's condenser before it will become a saleable article. I have made a number of experiments with different forms of condenser, but at present have not been at all so satisfied as the glowing accounts of innumerable foot-pounds!

&c., led me to believe I should be.—W. J. LANCASTER.

[44503].—Removing Old Lacquer from Telescope.—Take the telescope to pieces, then get some spirits of wine, and having heated the parts as hot as you can make them, so as not to be unbearable, rub off the old lacquer with a cloth, or a tuft of cotton-wool, dipped in the spirits. You may have to warm the several parts over and over again; but this is the easiest method you can adopt. After removing the whole of the lacquer, then clean and finish in the usual way, and lacquer.—W. J. LANCASTER.

[44505].—G.W.B. Narrow-Gauge Engines.—I can add a few more to "E. P.'s" list of 7ft. express engines—158, 161, 163, 164, 165, 1127, 1129, 1130, 1133, with cab, no dome; 472, 478, 479, with cab and dome. All fitted with Sanders' vacuum brake.—N.W.

[44505].—G. W. B. Engines.—Cylinders, 18in. by 24in.; cylinder centres, 2ft.; thickness of cylinders, 3in.; steam-ports, 1½in. by 16in.; exhaust-ports, 3½in. by 16in.; length of boiler, 10ft. 6in.; inside diameter, 4ft. 1½in.; thickness of boiler-plates, 7-16in.; thickness of tube-plates, 3in. Firebox (outside), Lowmoor iron, length, 6ft. 4in.; breadth, 4ft. Firebox (inside), copper: length, 5ft. 9½in.; breadth, 3ft. 6½in.; top of firebox to grate, 5ft. 9½in. Grate area heating surface, 133 square ft.; tubes, No. 230; material, iron: length of tubes, 10ft. 11½in.; diameter outside, 1½in. Injectors, two No. 8; blast orifice, 6½in. Leading-wheels, 4ft. diameter; trailing-wheels, 4ft. ditto; driving-wheels, 7ft. ditto. Weight of engine empty, 28 tons 10 cwt.; full, 32 tons 10 cwt.—CARSTAIRS.

[44510].—Interference of Coloured Lights.—Have not what artists call the "complementary colours" something to do in this problem? You constantly observe that in a room where green blinds are used to the windows, a red shade falls upon the wall; this is because red is the "complementary colour" to green. And herein also lies the wonder of change of colour in "Pears' soap" coloured advertisements.—H. O'B.

[44512].—Varnish for Rusted Iron.—If the articles are not large, you can make up a varnish that will stand for a long time. First, use a mixture of French polish and vegetable black; let this dry, and paint over with any cold drying varnish.—W. J. LANCASTER.

[44513].—Deafness.—Be it observed that the audiphone is of no use to any one who has lost his natural teeth. Will any clever fellow invent a something to be held to the temple or the forehead, whose nerves often retain their sensibility when those of the ear have become injured?—H. O'B.

[44523].—Driving Clock for Telescope.—You can use almost any clock-train for driving telescope, so that the power is strong enough to work without jerks. The main thing is to see that the tangent screw is so driven as to move the telescope exactly round in 24 hours. I have seen telescopes driven with all sorts of primitive movements, that really did the work very well indeed. It will be much simpler for you to drive a tangent screw than to put a toothed wheel on bottom of polar axis. A movement with good spring can be converted into a driving-clock with but little trouble.—W. J. LANCASTER.

[44524].—Evolution.—Darwin, in an early chapter of his book, answers very ably the common objections which "J. S. C." has brought forward, and I am of opinion that "J. S. C." should have studied the book before writing his queries. I protest also against the astonishing gratuitous assumptions disguised in the form of questions, which "J. S. C." in the unscientific spirit, brings forward. Even if evolution from primitive material is going on in the same manner now as always, that does not mean that a regular series of forms of life "ought" to appear, without gaps. The existence of any one form of animal means simply a series of previous favouring or allowing circumstances, geographical or otherwise. The non-existence of intermediate forms means simply that at some period the race of animals which would have led to such forms became extinct through unfavourable conditions, or were slain in the struggle to exist. Cut down a primeval forest, and an entirely new vegetation immediately springs up in its place. Exclude cattle from a heath, and trees, formerly kept down by the cattle, spring up. All forms of life war with each other and with themselves; the strongest conquers, and the weakest are annihilated. Why wonder at gaps? "J. S. C." says that fresh evolution ought to supply all gaps. As well might you expect, in the case of parallel ranks of soldiers charging the enemy, and each man keeping the same pace throughout, that gaps in the front rank caused by the fire of the enemy, would ever be filled up. If a decree went forth to-morrow to slay, say, all donkeys in the world—which is quite possible to be done—we should see "J. S. C." aghast that evo-

lution did not immediately fill up the gaps so caused. KKRUA.

[44525.] **Battery for Electric Motor.**—It does not depend altogether upon the number of cells you use, but also on the size of electro-magnets. A very simple and efficient motor consists of a wheel having a number of armatures, and about four electro-magnets, so arranged as to give a short, but strong pull. I have electro-motors of this kind that work very well indeed with low battery power. Bunson's and Grove's cells are the best to use. W. J. LANCASTER.

[44526.] **To Mr. Lancaster.**—The thinner bags keep much better than the thick, and with care will last quite as long as the thicker ones, besides folding so much easier and packing up better than the thick ones. I have had all kinds of bags, but prefer the thin ones for my own use, although one does not care to let anybody use the thinner ones. If the front lenses are achromatic, then they could be used for taking photographs. Let me know how the fronts are composed, and I will at once tell you the best method of using them. —W. J. LANCASTER.

[44529.] **Meteor or What?**—Most probably you saw the track left by a meteor that had just exploded before you saw the light. Most large meteors leave a kind of phosphorescent track. I have sometimes seen a beautiful line of phosphorescent light after the extinction of the meteor. —W. J. LANCASTER.

[44531.] **Electric Contact.**—Permit me to thank "Sunlight" and Mr. Floyd for their advice and suggestions with regard to my inquiries; and, in answer to "Sunlight," I should be glad if he would inform me what quality gold he would suggest for the contact; 22 carat gold being rather soft, I am afraid it would show signs of wear in a short time; 9, 10, and 15 carat, of course, would be more subject to oxidation; but are they likely to prove better than platinum, which is generally understood to be so unsuceptible to the action of atmosphere and heat? Mr. Floyd's suggestion (if I understand it correctly), that my secondary clock should have a pendulum, struck me as rather curious, as in all my experience, which I confess is but small, I have never heard of nor seen a secondary clock with a pendulum which has been worked by a primary clock (that is, a secondary clock which only receives the current every minute). Cannot Mr. Floyd, who seems to know something about mechanism, or "Sunlight," inform me of one or two of the very many automatic contacts that must be in use all over England, France, and many other cities, abounding in electrical scientists? There must be a lot of different reliable contacts. The mechanism of any, no matter how complicated, would not debar me from trying their merits, I having a fair knowledge of tools and how to use them. —S. B. MCCLELLAN.

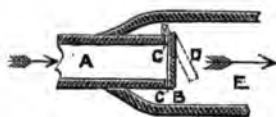
[44537.] **Geraniums.**—I think I may say I used to be very successful with my geraniums and other greenhouse flowers, at least, so people seemed to think, so I will merely tell "H. G." how I managed those in the garden. I took them up some time in September or October, as the season might be, without disturbing the roots more than I could help, and put them into pots with some fresh earth, and well watered them, putting the pots in a board to keep away the worms. For two or three days they had plenty of water, and plenty of time to root before putting in the greenhouse. I never cut them till spring: I think it a bad plan to do so in the autumn. From November to February I gave the plants next to no water. If you cut them back in the autumn, you get a number of young weakly shoots, and are very likely to lose your plants. I very seldom let any. People give their plants too much water during the winter months, and strive to keep their plants alive by warming the greenhouse, which ought to be kept as cool as possible with plenty of fresh air. Of course I am not talking of a hothouse, where you want to get flowers in the winter time. In cold or at all frosty weather I used to hang a sail-cloth in front of the greenhouse, and when I had not that, at all winter I made to fit the windows. Newspapers will do very well. If a hard frost came, I put a small portable stove in the greenhouse at night. Early in the spring I cut the geraniums back and saw potted them. They were mostly in this manner before they were potted out. Any seedlings I wanted I put in a sheltered spot and let them take their chance. —EDWARD TAYLOR.

[44538.] **Scarlet Geraniums.**—Your geraniums may be from any of the following causes, or probably from a combination:—Want of ventilation, insufficient lamp, misfire, or frost. When the outside temperature is over 50° Fahr. ventilate: this will prevent over-ventilation and damp; but if the day is long and foggy keep the house closed. If misfire appears at the part of a sprinkler it will show signs of misfire; but better get rid of the part or use the whole plant, than for the disease to be communicated to others. With regard to

your questions (a) the soil need not be removed from the roots; (b) cut them back to 6 in. or 8 in. a few days before removing them; (c) shorten the roots with a sharp knife. Water them after potting them, but afterwards keep them dry, and unless the leaves flag don't water them till March. As soon as they begin to grow, turn the pots on the side to keep them dry, and as the season advances put them under the shelter of a tree till there is danger of frost, then bring them in. If you mind this, success is certain. I have kept hundreds of cuttings and old plants in ordinary garden frames during the winter—even when there was 20° of frost, and have never lost more than one-third of them. Remove every decaying leaf. If you spill water, dry it up at once. If the roof leaks repair it at once.—X.

[44549.] **Cement.**—If "M. B." will refer to Vol. XXVIII, page 63, also to letter 16482, Nov. 14th, 1879, he will find some good information as to the preparation and mixing of plaster of paris—especially in the latter. Solutions of alum or sulphate of soda (Glauber salts) cause the plaster to set with great rapidity, but if mixed with weak gelatine or glue, or with a certain unnameable fluid, commonly used by stucco-men, the setting is delayed for time sufficient for ordinary working, say twenty minutes or so; in the latter case, the cement becomes very hard and tough.—B. F.

[44550.] **Outlet.**—Will the following arrangement suit? A is the pipe or tube for conveying the air and water, B is a hinged door, C an india-



rubber ring, so as to make the door air-tight when shut. D represents door open, and allowing air and liquid to pass, E is a pipe or tube for conveying the mixture away. If the diameter of A is not too great, it could be totally made of india-rubber, and strengthened with crosspieces on the side E.—CARBONITAS.

[44551.] **Floorcloth.**—If "Friar Bacon" will put his floorcloth in a baker's oven, after the bread has been drawn, he will find it will become soft and pliable, and can be opened out with a little care without cracking. If an oven cannot be obtained, keeping it in front of a hot fire will do, turning so that it will heat through evenly.—FURNISHING SALESMAN, Liverpool.

[44554.] **Hydromotor.**—This appears to be merely the injector principle: the water passes along a pipe through the vessel, and is assisted out at the stern by a steam injection, much as bilgewater is sometimes got rid of. It is not a bad method for very small boats, but I can't think it will be of any use for large boats, to say nothing of ships.—PAUGUL.

[44559.] **Staining Ivory.**—To "Os."—"Delos" finds that ivory can be nicely stained by the simple application of nitrate of silver, though not exactly black. What he wishes to know is the rationale of the previous application of a "lye." If, however, it is found necessary to give the ivory a wash in the first instance, whether a subcarbonate of soda will do as well? for the "lye" is a very strong liquor containing pearlash, he thinks.—DELLOS.

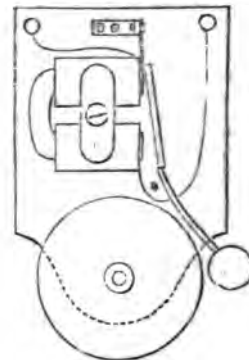
[44566.] **Iron Core in Metal Tube.**—If you refer to the brass-cased iron tube frequently used for cornice-poles and rods where the strength of iron with the appearance of brass is required, you will find it is not worth your while to extract the iron lining. It will occupy much more time than the job is worth, and even then in getting it out you would be pretty sure to spoil the brass casing.—SUNLIGHT.

[44567.] **Electric Bell.**—Please correct the error in the 8th line of reply on page 627. It should read thus: "And the wire that went to it, join to the other one, that is," &c. The full stop should be after "altogether"; as it is, the querist will not be able to understand how to alter his connections.—J. J. G.

[44567.] **Electric Bell.**—CORRECTION.—"And fasten the wire to the wire that connects the contact piece of breaker" should read as follows:—"And fasten the piece of wire to the wire that connects the contact-breaker with the coil."—CARBONITAS.

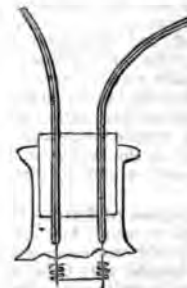
[44567.] **Electric Bell.**—You can easily alter your bell by removing the pin against which the spring on the armature is in contact; and fitting up the bell as per sketch, you will see that the current passes through the coils to the binding-screws. It will be necessary to place a pin for the bell-hammer wire to strike against, so that the

hammer, by the impulse given by the making circuit does not remain in contact with the bell. The armature spring holds it off the magnets until the circuit is closed, when the hammer being quickly



made to move from right to left; the hammer gives one stroke on the bell and is then held by the magnet. On the circuit being opened again, the armature and hammer again spring into the original position as shown in the sketch.—SUNLIGHT.

[44568.] **Blasting Rods.**—If there is any hole or orifice in the rod you wish to blow up you can manage it easily enough with gunpowder. If the surface be smooth comparatively, then nitro-glycerine would be best. You can easily make an efficient fuse by passing two stout copper wires through a thoroughly-sound cork (these being guttapercha-covered). The ends where they project through the cork must have the covering stripped off for a 1/2 in. or so, and a piece of very fine iron binding-wire (what is known as jeweller's binding-wire is best) carried across from the one copper wire to the other. Next fill your bottle with gunpowder and secure the cork, with the wires through it, in the neck with sealing-wax. Being, of course, sure that the wires project into



the explosive. You will now have the fuse and charge ready. To fire if you don't need the induction-coil at all; but simply the batteries used for the coil are to be connected with the one wire passing through the cork, and when all is ready carry the wires to a safe distance and touch the remaining battery terminal with the other wire-end from the fuse, and an explosion will at once take place. Be sure that the cork is thoroughly water-tight, or leakage will occur and your charge will fail to explode.—SUNLIGHT.

[44569.] **Yellow Dye.**—Probably solution of burnt sugar or caramel might suit this querist. French brandy entirely owes its colour to this substance.—L. W. STANSBELL.

[44575.] **Malt Extract.**—This is most probably prepared by concentrating malt wort either in a vacuum pan, or by the aid of a steam-bath, until of the proper consistence. Malt extract can be readily preserved in a diluted state if proper precautions are observed. To prepare the wort, the crushed malt is treated with water at 140° to 160° Fahr. for two hours or so, until the starch has been converted into dextrine and glucose; the liquid is then strained or filtered, being received hot into bottles, which are immediately securely corked and tied down; the separate bottles are then exposed to steam for half an hour, taken out and allowed to cool. In this state their contents will keep perfectly good for months or years, but when the cork is removed, air enters laden with germs, and the ordinary fermentation is at once set up.—L. W. STANSBELL.

[44585.] **Photographic.**—It is not very difficult to coat plates with emulsion. You must guard against light, dust, and dirty plates. My chief difficulty is to get chemically clean plates, so, after getting them as clean as possible, I always coat with a substratum, same as I described in (44349), Aug. 5. You will be sure to get directions with

he emulsion. Remember rapid plates will fog if exposed to even red light for any length of time.—E. F. C.

[44588].—**Deflection of Magnetic Needle.**—Suppose that the wire is in the magnetic meridian, but the length of the needle is $2l$, and that the distance of the centre of the needle from the wire is s , then $x = \frac{l \sin^2 D + a^2}{a} \tan D$, where x is the strength of the current, and D the deflection. The above formula is for a wire of indefinite length. It is assumed that the needle is long, compared with its thickness, and that it is uniformly magnetised throughout its length. There is no simple formula for the other case.—G. J. BURNS, B.Sc.

[44592].—**To Mr. W. H. Davies.**—The action of the guitar-pedal, to which I understand Mr. Wallis is good enough to allude, is fairly described in the circular he probably received at the stand—viz., it "controls the vibrations of the strings such as the mute does on a violin," that is to say, it causes a lever, or rather a series of levers, to press on the belly-bridges, and by acting as a lamper on the fundamental allows the 2nd harmonic (or 12th above) to slightly predominate, this effect being again increased by a further damping of the strings caused by passing a slip of soft felt between them and the hammers, or, in other words, by the action of the Expression pedal.—W. H. DAVIES.

[44593].—**Propellers.**—To find the pitch of a propeller by any suitable method, form a right-angled triangle on the blade to be measured at a given radius from the centre of the boss or shaft. The hypotenuse will represent the breadth of blade. One side must be at right angles, and the other parallel to the centre of shaft. Divide the circumference of the given radius by the side at right angles, and multiply by the side parallel, and the result will be the pitch of the propeller. The method of transferring the pitch and preparing a mould to cast a new one would take up too much space to explain in these pages; but the whole thing is explained in simple terms in a small book called "Drawing and Rough Sketching for Engineers," to be had from any scientific bookseller.—HELIOS.

[44595].—**Dryness of Skin.**—This is caused through a torpidity of the sebaceous glands. The application of a weak acid irritant, a common lemon cut in half, and the parts rubbed with one of the halves nightly, and allowed to dry on, at the same time taking acid drinks, ripe fruit, and keeping the bowels open with some saline purgative, washing the parts with cold water, bathing, and a simple vegetable diet. Sulphur ointment rubbed on the parts, and sulphur taken inwardly, is also a good remedy.—G. H. WILKINSON.

[44595].—**Dryness of Skin.**—Do not taste beef for the next three months; buy a cake or tablet of the very best French cosmetic soap, and use it to face, neck, and hands, with tepid water only, once daily, drying gently with a fine towel. Avoid the use of acids, and also wine of every description: dress warmly, and wear fine flannel or silk next the skin. If these changes be not beneficial in three months' time, do not tamper with your health, but put yourself, as soon as possible, under the direction of a clever doctor at an hospital for skin-diseases.—H. O'B.

[44596].—**Sewer-Gas in Drains.**—Many thanks for replies to this query. The house and foundations are everything desirable. The stench suits when the plug of water-closets is drawn up, and the flush of water has passed, filling the vacuum of pipes, up comes the gas in question. Now, I have had the containers seen to, how can they be kept clean and sweet, and the pipes close to the same? If they were washed out with lime every three months, would that be sufficient? There is a small hole on the top of container; this the plumber rattled up;—is this correct?—AN ANXIOUS FATHER.

[44596].—**Sewer-Gas.**—Away at once with your stinking closets. Replace them all with valve-closets of approved make, and provide the means of no common flush of water over the whole of the inner surface. See also that they are provided with the means of ventilation close up to the valve, and let the ventilating-pipe be of the size of the full bore of the soil-pipe. Don't let your plumber—pointing to your neighbour's house as an example—persuade you that a 1½ in. or 2 in. pipe will afford sufficient ventilation; and see that a tube of the size I have mentioned be carried up the outside of the house to some three or four feet above the parapet without a bend or hood, or any sort of cover at all at the top of it. To remove the stench yet existing in your old pan-closets and the soil-pipes therewith connected, throw into them plenty (by pailfuls at a time) of any solution that will arrest unpleasant or noxious decomposition or deodorise. Use Condy's fluid, carbolic acid, chloride of lime, coffee and coffee-grounds, charcoal, or, indeed, any of the numerous sub-

stances, simple or manufactured, which are known to have these effects. If you don't succeed in this way, then remove the whole lot of apparatus and substitute at least new of any sort by all means.—J. W. WILKINS.

[44596].—**Sewer-Gas.**—I would advise "Anxious Father" to have the drains themselves examined, as too frequently the pipes are put in without being properly secured at the joints or sockets. I had a case of that kind some short time since. The pipe, at first appearance, seemed all right; but on close inspection I found that only the top part, or about half-round, had been clayed, leaving the other half for the gas to escape and permeate through the whole house and the adjoining one; through the foundation of the parting wall. I would have the soil-pipe ventilated at the head, just under the trap of the container, with a 3 in. pipe carried above the roof. By the side of the chimney-stack is a good place for it to terminate, and, if it is possible, I would have the house-drain trapped outside near the junction with the common sewer, and use carbolic acid freely. I shall be pleased to give any further assistance I can, either direct or through the E.M.—SANITARY INSPECTOR, CREDITON.

[44602].—**Friction.**—The relation one or more wheels bear to the power required to move a weight on wheels, furnishes an answer of—Why it is harder for a horse to move two lorries one behind the other than one on the other? From many years' experience with almost every description of vehicle for horse-draught, and many experiments to lessen draught, I have been able to tabulate the following results:—

1	Wheel requires	1	power.
2	"	1½	"
3	" somewhat less than	1½	"
4	" require	1½	"

Thus, the draught of two lorries would be $1½ + 1½ = 3½$ powers. Now to augment the load on a lorry by another lorry would add to the power required half more—

1½	power
2	"
2½	"

One lorry behind the other would require $3½$ powers to move them, or $½$ more power than if loaded one on the other—the reason being the resistance of 8 bearings on the axles and ground instead of 4. Suppose two two-wheel drays of the same weight instead of lorries: one on the other would require $1½$ powers; one behind the other, $2½$ powers. In this form two drays would resemble one lorry, but with a loose connection between them instead of the rigid platform. This, and the unequal distribution of weight too much over the front wheels of a lorry accounts for the difference of $½$ power between two drays and one lorry.—J. CHARLES KING.

[44609].—**Harmonium Pan.**—CORRECTION.—On p. 629 of last week's number, instead of "the clarion and bassoon set need not be voiced," read that "the bassoon set need not be voiced." The term clarion was unintentionally put in, and merely a slip of the pen.—G. FRYER, Swansea.

[44610].—**Canvas Boat.**—The canvas is best made water-tight by painting it inside and out with several coats of paint. I should give the first coat with red-lead paint, the following ones of either white or the colour you want the hull when finished. The stem- and stern-posts should be cut to an angle to coincide with the lines of the boat, and the longitudinal should be nailed on with either copper nails, or, what I should use would be rivets and burrs. This last would be the strongest way by far. Where the canvas is nailed to the keel should be all copper nails as well. When you have everything finished a coat of carriage-varnish would be found to improve the appearance and at the same time protect the paint.—SUNLIGHT.

[44610].—**Canvas Boat.**—I used ordinary white-lead oil-paint with quite satisfactory results. I should think almost any good paint would do, as canvas is nearly water-tight itself. To fasten ends of longitudinal laths, cut a rabbet on each side of the stem in which they can be nailed, so that their outer surfaces are flush with that of the stem.—J. BROWN, Belfast.

[44610].—**Canvas Boat.**—Having made two of these, I can give "Nauticus" the benefit of my experience. First procure of some tent and rick cover-maker the requisite quantity of best canvas, say, weighing 16 ounces to the square yard; nail this on the frame to fit as nicely as possible, then warm some size, and whilst warm, give it a good coating all over with a paintbrush. Let this dry, then give it three coats of the following: best double-boiled linseed-oil, with sufficient vegetable black mixed with it to about the consistency of ordinary paint, and he will find it perfectly water-tight. If yours is a folding-boat (you do not say

which it is), do not size it, but give it four coats of the oil with a little less black in, as then it will fold without cracking. After you have used the boat, before putting it away for the winter give it a coat again; then it will last for years.—M.M.I.Sc.S. AND A.S.T.E.

[44610].—**Canvas Boat.**—If "Nauticus" has an opportunity of seeing the "canoes" used on the west coast of Ireland, say, at Port Magee, Valencia, or at the mouth of the Shannon, county Clare, he will find the best examples of canvas boats in the kingdom—some of them 25ft. to 30ft. long, 4ft. to 5ft. beam, and pulling four or six oars. The best coating is well-boiled tar and Stockholm pitch, not coal-tar pitch, laid on as hot as possible; these canoes have no proper stem, the longitudinal laths are nailed on to a small semi-circular piece of wood at the fore end, which, like a Norway pram, projects above the water; the stern-board is large and flat, set with a slight rake, the said laths are nailed to it, and of course are outside the ribs, which are of similar scantling to the laths; there is no rudder, steering entirely by the oars, which are about 3 in. square scantling (three cut from a 12ft. by 9 in. by 3 in. deal), rounded for the hand, and little more than the arrises taken off the blade being left thick and narrow. On the Clare coast, they use the square scantling, with little or no faying to make a blade, as they have a rocky coast to deal with. These oars have a cleat nailed on, with a hole for the single thowl-pin, on which they hang straight along the side of the canoe when the man is tending his lines. These canoes are splendid sea boats, and will stand worse sea and weather than large yawls. It is an interesting thing to see the men managing them with great skill.—R. J. LECKY.

[44613].—**Hydraulic Organ-Blower.**—If you want your engine to work a shaft, you must have either a flywheel or two cylinders. But the best plan is to connect piston-rod direct to feeder and work the valve with tappets so that the water is shut off and exhaust opened before the piston gets to the end of cylinder. Hydraulic organ-blowers generally have but one cylinder.—E. F. C.

[44615].—**Sash-Weights.**—There are many ways of making sash-weights, and I do not know which method is really the best. If "Cast Iron" has only a few tons to make, I think a turnover-board and ordinary patterns would be the best. If, however, you are going in for a large quantity, I think the quickest way would be to make them by having interchangeable "boxes," and have one half of the patterns fastened on a planed plate. By having two plates one man could ram up bottom parts and another the "tops"; some makers cast them in "chills," others make them on end, and cast in small staples at the bottom for the cord.—J. N. O.

[44621].—**Sulphur Moulds.**—Prepare a few strips of paper, such as writing-paper, each about 1 in. broad, and long enough to go once or twice round the medallion. Soak the back of the medallion in a plate containing a little water, not enough, however, to come over the face of it, and here let it rest, until half a minute or so; you will perceive that the water will be absorbed so as to just show itself on the face of the medallion, making it more shining. When this is the case, take it out of the water directly, fold the slip of paper round it, and hold it between the thumb and finger of the left hand. While this is doing let there be melting on a slow fire some roll-brimstone in a pipkin or patty with a handle. As soon as ever a small quantity of the brimstone is melted, pour it carefully upon the face of the medallion, which you may turn about a little that the brimstone may flow over the whole face equally. Place it now upon the table, and pour more brimstone in, until you consider it of sufficient thickness to be strong, and this will be about ¼ in. When crystallised, which will be in a minute or two, the paper may be untwisted, and the medallion and its mould separated from each other. If a second mould be wanted dip in water the back of the medallion as before, but more slightly, and proceed to cast again in the same manner (Francis).—ACONTITE.

[44621].—**Sulphur Moulds.**—In preparing casts with sulphur I have not found any special precautions needful, as the procedure is the same as for wax or plaster moulds. A strip of paper or thin card is tied round the object—a medallion or coin, for instance, thus forming a shallow circular-vessel about ¼ in. deep. Sulphur is melted in a clay or other crucible, allowed to partially cool down, and then carefully poured into the paper mould upon the face of the coin. When quite cold, which takes some time, the solid casting is easily separated. In copying articles of silver or copper the resulting sulphur-cast has a black surface, due to a film of sulphide. I have not hitherto succeeded in coating these sulphur moulds with copper, my experience being that when immersed in the copper sulphate-bath the surface of the mould is rendered crumbly and friable, and peels off. The impressions obtained with sulphur will be found to

[44650.]—**Faulty Castings.**—I should recommend "Working Tom" first, to introduce a greater percentage of soft iron into his mixture, say

No. 2 pig to 6cwt. of good scrap. I continue making the cupola-spout of, and use red in the same manner as he ladies. I am inclined to think that the pipes are somewhat at fault. See that properly mixed, and that it has plenty of it. Mix the blackening for the good clay-wash, and let everything be before using. There should be a large for the air to get well away from the very careful, and see that the core is by larger than the core-print; if it is so it a "crush," and so introduce particles in the mould, which will distribute them in the metal is poured in. Blow well when you have lowered the core into the to the slogging, see that you have tending, and do not use too much, as it and produces a porous casting. I must words as to the melting of the iron. Do not melting it thoroughly. Use plenty and a strong blast; this cleans the iron and other impurities, which, if they do out of the slag-hole, will rise in the ladle and skim off. Sooner let the metal too hot, and purge itself of remaining in cooling down to the proper temperature, than let it run from the cupola too have to run it the instant it comes out.

Foundry Limestone in Furnace.—is used as a flux, that is, it is a good the impurities of the iron. It forms a he silica or sand, and helps to dissolve urities as phosphorus, sulphur, &c. If cess it is very injurious to the cupola nister is nearly pure silica. The best it is to scatter about half a shovelful arge of coke at intervals, regulated ac the work the cupola is doing.—NIGHTS.

Gas Purification.—I use an alborer with another ordinary one. The ed have an excellent effect. The alborer is very good, but throws rather a dark some purposes.—J. D.

Air-Vessel.—The air-vessel on the a pump acts as an elastic spring reserve off the shock for one thing, and for causes the water to be delivered in a stream, instead of intermittent flow; if the column of water on the delivery is able height, the air in the air-vessel considerably compressed, and hence a e would show the vessel apparently of water. On the other hand, on a low air would be less compressed, and the would show apparently nearly full of an air-vessel is placed on the suction-pars full of air, as the contained air is state of some little tenuity. There is the air being let in or out if the vessel s to books, there are many that treat You would find much rudimentary in Tomlinson's "Pneumatics."—SUN-

Condenser.—A condenser will not as high as an ordinary pump, because says vapour of steam and air present, ents a more than partial vacuum being till, you should be able to lift the conter, say, 12ft., if the joints were all ght, both of condensers and the pipes t. Your best way would be to place a ump driven by the engine, which would a small tank (which might be of wood ss) of such capacity that it would hold e than the maximum quantity of water y the engine. And if this tank was round the condenser, if practicable, all The excess of water supplied by the l be carried off by an overflow-pipe. If et the condenser into the tank, the uld be a little improved by the cooling e water on the outside of the condenser.

Fossils.—A similar query to this was page 600. The fossils are not "tusks" air very nature will show, but the inaths" of an extinct molluscous animal e existing sepia. The conical cavity chambered shell, and the whole was the body of the animal. It captured means of claws fixed to the head, and upwards from the bottom of the sea, lly darting down again. These fossils alled "thunderbolts" of many parts of nd they are sometimes found 18in. in G. F.

Bottle Prism.—Have you used best for the purpose?—SUNLIGHT.

Bottle Prism.—The instructions is for use in the Physical Laboratory, ington, specify either glue or isinglass i acetic acid, together with glued paper. ANSELL.

[44659.]—**Steam-Gauge.**—It is a good plan to fill the siphon of the gauge at starting with cold water, as it prevents the possibility of the steam reaching the working parts. But in a few minutes the steam would be sufficiently condensed by the cold tubing to fill the bottom of the bend with water at a temperature too low to do any damage, even supposing that the air which must be imprisoned above it could find an outlet.—SUNLIGHT.

[44661.]—**Hair-Spring of Geneva Watch.**—"Milo's" experience with hair-springs is evidently rather small, as what he inquires about is a very frequent occurrence with the general watch-jobber; however, presuming "Milo" knows when the watch is in beat, let him pin up the spring; then, should the hair-spring cock up, take a pair of fine flat-pointed tweezers, and take hold of the spring close up to the stud, and bend it down gently until flat. This operation is a very delicate one, and ought only to be performed by some one used to such work, as good timekeeping depends largely on the adjustment of the hair-spring. If "Milo" would like to know the cause of what he inquires about, I shall be pleased to inform him. There are many reasons, which would take up considerable space, and unless really necessary, I do not wish to encroach upon our Editor's leniency.—S. B. McCLELLAN.

[44665.]—**Telegraph Wire.**—To go into this subject fully would occupy too much space; but if the querist has Culley's "Telegraphy" he will find much information in detail upon pp. 225, 226, and 303; or in Prescott's "Electricity," p. 299, he will find the various mechanical and chemical tests. I have somewhere read in Culley that copper from Lake Superior is the best for telegraphic purposes. Anyway, the purest obtainable should always be used, as its conductivity is so much higher than the commoner qualities.—M.M.I.Sc.S. AND A.S.T.E.

[44667.]—**Concertina Reeds.**—It is possible that something might be done by twisting the reeds of an English concertina to soften and round the tone: but I don't think I should like to attempt it. A really good English instrument, not merely of English pattern, scarcely deserves the name of "screamer"; but the construction of the instrument is not adapted for much display of the art of voicing.—SAUL RYMEA.

[44669.]—**Astronomical.**—"An Inexperienced Astronomer" has good reason to complain of the performance of his telescope. From what he says, it seems to me his prism must be in fault. The deterioration of the silver film would merely cause a loss of light, and would not cause the glares and rays on stars of which he complains. The companion of Vega is always conspicuous in a mirror of this size, and I never failed, unless the moon was very bright, to see the faint pair between ϵ^1 and ϵ^2 Lyra, with the addition on fine dark nights of the three faint stars preceding, as shown in the diagram on page 595 of last week's E.M. As to the Pole-star, the belts of Jupiter, and the division in the ring of Saturn, they would all be plain enough if his telescope were in anything like good order. As he appears to live in London, if he will advertise his address in the "MECHANIC," I will try and call on him if he is anywhere near me, and do my best to put him right. He and his friends must have come across some very bad specimens of reflectors, or they would soon be convinced of their power, and that a 6in. reflector is not to be compared to a 2in. achromatic, as I could soon show him by an inspection of my observing-books for more than 20 years past.—CHARLES GROVER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

- 44083. G.W. Engines, p. 411.
- 44093. Turnpikes, 412.
- 44100. Cape, 412.
- 44118. Model Yacht Clubs, 412.
- 44119. Meidinger's Cell, 412.
- 44129. Bee's Proboscis, 413.
- 44136. Magneto Machine for Medical Purposes, 413.
- 44137. Voas's Induction Machine, 413.
- 44139. Velociman, 413.
- 44296. Curve for Ribs of Model Vessel, p. 509.
- 44298. Milling Flour, 509.
- 44301. Indigo Blue, Woollen Vats, 509.
- 44305. Smelting Furnace, 509.
- 44311. Small Self-Acting Piano, 509.
- 44312. Curing South American Hides, 509.
- 44316. Bicycle Tour, 509.
- 44324. Colour Testing, 509.
- 44330. Amber, 510.
- 44334. Papua or New Guinea, 510.
- 44339. Measuring Wind from Fan Blower, 510.
- 44342. Canary-cage Partitions, 510.
- 44347. Friendly Societies, 510.
- 44351. Removing Aniline Stain, 510.

QUERIES.

[44670.]—**Tricycle.**—I am about to construct a tricycle for two riders: the one to sit behind the other. Diameter of driving-wheels to be 50in., to be driven by two separate cranks, one to be about 18in. behind the other, connected by a pitch-chain; the driving-wheels to be driven from each end of the rear shaft by pitch-chain also. Would it be practicable to speed the above wheels to 60in.? What diameter of tube would I construct a frame to be of sufficient strength? And, what size of wire would I require to build the wheels of?—ANXIOUS INQUIRER.

[44671.]—**Punching-Machine.**—Will any correspondent of the ENGLISH MECHANIC inform me how the disengaging motion of slide in punching-machine is designed so that you may stop the punch without stopping the gear?—V. R. R.

[44672.]—**Condensation of Steam.**—Will "Sunlight," or any other of our valued readers, answer the following?—I want a 24 horse-power high-pressure engine to work at a distance of 600ft. from the boilers. Which is the best size of steam-pipe for the above? whether a 12in. pipe in diameter or less—with regard to the least condensation of steam?—C. M.

[44673.]—**Child with Perpetual Cold.**—To Dr. EDMUNDS.—I have a child about four years of age, who is nearly always suffering from a cold both in the head and from cough. The child is quite stout and healthy-looking, and, in other respects, a strong child. Has once had an attack of spasmodic croup. Will any reader kindly oblige me with the best course to pursue in such a case? One older and less healthy-looking child under exactly same conditions is much more free from attack.—B. D.

[44674.]—**Small Boiler.**—May I ask "Sunlight" to shine on the following?—I am thinking of having a boiler made for a 2 h.p. engine. How would a cylindrical one do with two cross tubes set vertically in brickwork? Would you recommend a welded or a riveted boiler? What would be about the dimensions and thickness of plates, &c.? A ray of light on the subject would oblige—ONE WHO IS TIRED OF TURNING A CRANK.

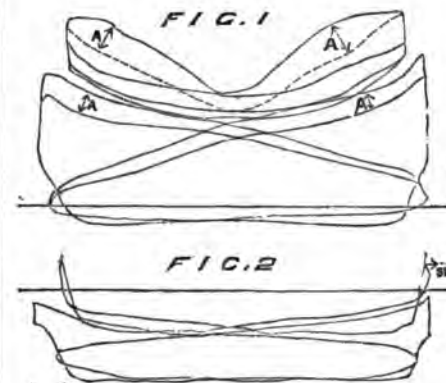
[44675.]—**New Pivot to Verge Watch.**—Will any kind reader of the ENGLISH MECHANIC tell me the best way to fit a new pivot to a verge watch escape-wheel? Is it necessary to remove the wheel off the pinion? Also, the best way to centre the hole on the pinion's end to receive the pivot.—D. L. J.

[44676.]—**Japan and Japanning.**—Will any subscriber explain how to make black japan—the genuine article? how to japan lathe-heads? how many coats? at what heat to bake, &c.?—E. C. R.

[44677.]—**Drawing Maps to Scale.**—I have drawn a map of a town, showing the forms of the streets and roads, on sheets 11 $\frac{1}{2}$ by 8 $\frac{1}{2}$, so that I visited each street and road to get as near as possible the correct form. Now I have completed the map, which is on twenty-eight sheets, I should be glad if some correspondent would tell me the simplest way of drawing the map to the scale of 5ft. to the mile, or 6in. to a mile. I have shown main roads $\frac{1}{16}$ in. wide, and other streets, &c., $\frac{1}{32}$ of an inch.—E. J. BEDFORD.

[44678.]—**Crank-Shaft.**—Will any of your readers inform me how to line off and proceed with a crank-shaft with five centres in disc? It is only the lining off and setting disc that beats me; the turning I can do easily.—W. T.

[44679.]—**Non-Economical Compound Engine.**—I now send diagrams taken off high- and low-pressure cylinders, also, steamchests. Fig 1. H.P. cylinder, 58lb. pressure; a a a a, show variations. Fig. 2



L.P. cylinder. I would like to know if there is any improvement in the cylinder diagrams. The variations in the high-pressure cylinder and steamchest seem very great. Is this a bad sign? Does it only show wire-drawing? Is there too much compression in either of the cylinders? How can those diagrams be improved? I am much obliged for all the trouble you have taken.—YOUNG ENGINEER.

[44680.]—**Swelling.**—To Dr. EDMUNDS.—For the last eight months I have been bothered with a slight swelling of the right cheek. During that time it has kept the same way, getting neither larger nor smaller, and, as yet, shows no signs of going away. Many were the causes given for its presence: some said it was gumboil, others said the cheek-bone was bad, and a doctor thought it was caused by a bad tooth which I had, so I got it removed, but to no purpose, for the swelling is the same.—J. GROVEDALLS.

[44681.]—Honey-Slinger.—Will any of your readers, or Messrs. Abbott, give a drawing of the honey-slinger as mentioned in Vol. XXVIII., p. 389?—A CONSTANT SUBSCRIBER.

[44682.]—Enlargements of Photographs to be Finished in Oil Colours.—Will Mr. Lancaster, or "Sunlight," kindly inform me how to construct the instrument for throwing a life-sized fac-simile of a carte-de-visite (not a glass negative) on to the canvas on which a painting is to be executed?—J.

[44683.]—M. R. Engines.—Can any reader give me the class and date of M. R. engines?—200, 203, 210, 212, 213a, 214a, 299. If rebuilt, please state where and when. An answer would greatly oblige—MEXTON.

[44684.]—Aneurism.—Would Dr. Edmunds inform me what medicine is generally taken in cases of aneurism?—NEX.

[44685.]—Turner.—Would any reader kindly inform me how to turn those round valve-balls? and oblige—SUSSEX.

[44686.]—Even Temperature.—Will one of my brother-readers help me out of my difficulty? I want to keep pitch to an even temperature by steam after being heated by fire to almost boiling-point. I have tried (iron) steam-coil in a furnace with steam all round, but that is not hot enough, as it goes thick. What is meant by "super"-heated steam? How is it done? Would it be of service to me?—COUSIN JACK.

[44687.]—Pannikins.—Will any of our readers inform me the best way to go to work to make pannikins in large numbers (pints and half-pints)? What is the best machine for putting the wire in the edges? I also for turning the edges over for jointing the bottom and sides. Any information respecting the manufacture of the above will oblige.—ENGINEER.

[44688.]—The Waste of Soap and Soda.—I am connected with a large laundry using about half a ton of soap and soda per week. The dirty water, when done with, runs into the drains. Could I in any profitable manner, by running it into a tank, extract any of the washing properties from the dirty water? Shall be grateful to any who can assist me with any information or suggestion.—ENGINEER.

[44689.]—Ligure.—What is the "Ligure" spoken of in the Bible as being one of the stones in Aaron's breast-plate? Is it known nowadays, and, if so, under what name?—FOURBERS.

[44690.]—Bookbinding.—I have a light green calf. Will any reader kindly give me a simple recipe to make it several shades darker? Can anyone suggest a simple press to letter cloth with printers' types?—NO SIG.

[44691.]—Lenses.—To Mr. LANCASTER OR OTHERS.—Will Mr. Lancaster, or any other optical correspondent, kindly answer the following? I have three magic-lantern lenses, two 8 in. focus and 1½ dia., the other 5½ focus and 2½ dia., all double convex. I have also a double concave lens of splendid clear crystal-like glass; never been edged or centred yet; about 2½ in. dia., one side deeply concave, the other rather shallow. Could I make any of the above into a camera-lens, and what size plate would it cover? How to get the focus of a double concave lens.—COLLONIX.

[44692.]—Substitute for Glass.—Is there any jelly or other substance with which I can try the optical properties of certain curves which cannot be cut or ground, but must be moulded or pressed? I want to obviate the expense of metal moulds for the glass experiments.—A. THORNTON.

[44693.]—Moulding Glass.—I hear that cast iron and copper are used for moulds for pressed glass. Is the former chipped and polished, and may the latter be thin and backed up?—A. THORNTON.

[44694.]—Perspective.—Would any of your correspondents oblige me with a practicable method of placing architectural objects in perspective on a large scale, in cases where the vanishing and measuring points are at a considerable distance outside of the sheet of paper?—J. D.

[44695.]—Cement for Glass and Brass to Stand Chloroform.—My best thanks to those kind friends who have replied to the above query. L. W. Stansell's formula does not meet my requirements. It is too troublesome to have to mix it for every little odd job, and takes too long setting. What I require is, a poor man's cement (like fine plaster of Paris and alum) that will set in a quarter-of-an-hour sufficient to clean off, and will harden while you are taking the work home; but this, unfortunately, will not stand continual moisture. Can anyone, from actual experience, give me the correct method of making and using the cement as follows, taken from the work "Iron": "Stock Solution": Resin, 3 parts; caustic soda, 1; water, 5. When required for use, three parts of this solution is to be added to one part of plaster of Paris. I have completely failed with it, mixing it in the order given, and taken "parts" to mean by weight whether fluid or solid. I see "H. A. S." says the whole is to be boiled. Has he tried it, and with what results, as I am heartily tired of trying "book" receipts? I have also tried the plaster and gum-arabic, but it will not stand continuous moisture.—S. J. M.

[44696.]—Microscopic.—I want to make some sketches of low forms of animal life for lecture purposes. As I am not an artist, will someone kindly say how I can enlarge the sketches I have already in my biological books?—ESTRAC.

[44697.]—Seals.—Seal-engravers make very sharp impressions in wax. It is easy enough to apply the vermilion-dust, but not at all easy to make a beautiful impression. Perhaps some one of your correspondents will kindly put us in the way of doing this properly. I have a few fine cameos, and would like to take thoroughly good impressions, so as to make them acceptable to friends in the shape of seals.—ONEIDA.

[44698.]—Novelty.—Will "Sunlight," or any other competent correspondent, tell me if it is possible to construct on a small scale a kind of—shall I say musical instrument, consisting of a series of steam-whistles arranged in chromatic order, and actuated by a kind of

pianoforte action with keys? I have long been desirous of knowing how to do this, but I do not know where to obtain the whistles or how to apply the steam to them. Any information on the subject will be of great interest to me. I remember seeing some account of such an arrangement in some scientific publication.—G. FARR, Swansea.

[44699.]—Paper Trade.—Could any of our readers give me some idea how to get the percentage of gelatine in tub-sized or animal-sized paper?—A YOUNG PAPER MAKER.

[44700.]—Cement for Pearl Sleeve-Link-Clock Cleaning.—I wish to thank "Alfojoe" for his excellent articles on hard and soft soldering, and I hope other amateurs have found it as useful as I have. Since they appeared in columns of the E. M. I have been able to repair many small articles that had been cast aside as useless. Will "Alfojoe" kindly say what cement is used, or how the metal eyes are fastened in the back of pearl sleeve-links? I would recommend amateurs not having a self-acting blowpipe to purchase one of Mr. Cohen (who advertises in this paper), and, by following "Alfojoe's" instructions, they will meet with more successes than failures. Would our obliging clock-making correspondents kindly say what are the most necessary tools for amateur clock-cleaners? And, is there any cheap work with the different parts of clocks and watches named and illustrated?—HORAVOL.

[44701.]—Strength of Tubes.—Can "Boiler Inspector," or some other correspondent, say why the strains on a tube, when subjected to external pressure, should be so different from those when the tube is subjected to internal pressure? The formula quoted by him show that in the former case the resistance varies as the square of the thickness, whereas, in the latter case, or with a bursting pressure, the resistance varies directly as the thickness of the tube. I notice that the third formula, quoted by your correspondent, gives twelve times greater value for P than does the first. Which is correct? The formula given for strength of corrugated iron is for transverse strains. There are no such strains in a circular firebox; the strains are always in the direction of the tangent to the curve at any point.—M.I.C.E.

[44702.]—Burning China-Painting.—Will any of "ours" tell me how to burn china after I paint it? I cannot get it done here, and I have been a month waiting for a piece sent away. Now, I am a fortnight without another that I want most particularly, and do not know when I shall get it. Also, is any preparation passed over the painting to bring the glaze?—ANNEETTE.

[44703.]—Charcoal Siftings.—Can anyone enlighten me as to the most profitable way of using up charcoal siftings which have come through a sifting-screen, the wires of which are ¼ in. apart? I have about 50 tons annually, and am at a loss as to how I can bring it to some practical use. The charcoal is from pine, spruce, and birch, but only a small proportion of the last mentioned. Any information will greatly oblige—BRUKSEGAARD.

[44704.]—A Process for Rendering Chalk Non-Effervescent.—Can any of the E. M. readers inform me of a process to render ordinary powdered chalk non-effervescent when placed in contact with an acid? An answer will greatly oblige—E. F. H.

[44705.]—Bending Wood.—Can anyone kindly instruct me as to the easiest way of bending a piece of wood for making a tennis racket with? Can any kind of wood be bent to such a curve?—ALADDIN.

[44706.]—Saturn's Satellites.—In using the valuable tables furnished by Professor Marsh, and printed in "ours" during the past thirteen months, I detected a singular recurring period or relation subsisting between the five inner satellites occupying about 883½ days to complete a cycle, viz:—

	ds. hrs.	revs.	ds. hrs.
Mimas	0 24 614	× 407	= 383 11 9
Enceladus ...	1 8 9	× 280	= 383 30 0
Tethys	1 21 3	× 203	= 383 3 9
Dione	2 17 68	× 140	= 383 3 2
Rhea	4 12 4	× 85	= 383 22 0

in which the first column of figures gives the sidereal periods; the second the number of revolutions of each during the cycle of 883½ days. May I ask Professor Marsh, or "E. R. A. S.," if they can easily supply me with the exact number of revolutions of each, and all of Saturn's satellites in one sidereal revolution of the planet?—WM. LONDON, JR.

[44707.]—N. E. R. Engines.—Will J. T. Lawrence give the dimensions and class of the new N. E. R. engines, which, he says, can compare with any?—E. P.

[44708.]—Plumbing.—Will Mr. Davies kindly say how a small tap may be put into a lead pipe always full of water? I thought of making a boss into which tap could be screwed, then solder the boss on the lead pipe and bore hole through latter. Is there any better method?—CONSTANT SUPPLY.

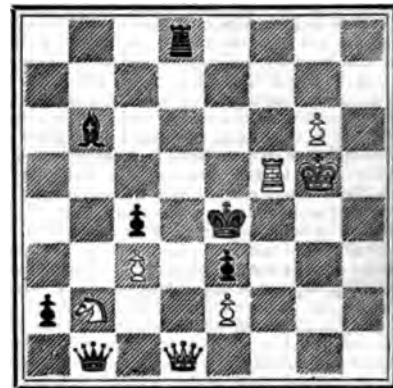
[44709.]—Analysis of Ores by the Electric Method.—Will any practical chemist give me instructions for making a battery suitable for the precipitation and estimation of copper? Also, explain whether the method may be considered accurate. What metals present in solution at the time would be precipitated before, after, or with the copper? Also, whether the same battery can be utilised for three or four assays or one singly. Any hints as regards preparing solutions, &c., will be thankfully received. Ore, copper pyrites 12 to 16 per cent.—AMERICAN.

[44710.]—Violin-making.—Can anyone kindly tell me how to get the true intonation of the back and belly (separately) of a violin? And, also, how to get it when the two are fastened together? Also, how to obtain the intonation of the mass of air in a violin? I have heard that there is an instrument made for the latter purpose. Is it so? In selecting wood for a violin, how should it be tested so as to give the correct sound when worked up into back and belly? Any information will oblige—A. E. T.

CHESS.

ALL Communications for this department must be addressed Chess Editor, 22, Chancery-lane, W.C.

PROBLEM DCXCIII.—By J. PIERCE, M.A.
Black.

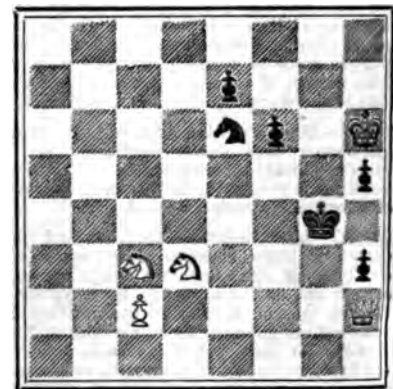


White.

White to play and mate in three moves.

PROBLEM DCXCIV.—By FR. KLETT (from his collection.)

Black.



White.

White to play and mate in three moves.

SOLUTION TO 689.

- | | |
|-----------------------|--------------|
| White. | Black. |
| 1. B to K 4. | 1. Any move. |
| 2. Mates accordingly. | |

SOLUTION TO 690.

- | | |
|------------------------|--------------------------|
| White. | Black. |
| 1. Kt to K B 4. | 1. K to K 5, or (A). |
| 2. Kt to Q 3 (dis ch). | 2. K moves. |
| 3. Mates accordingly. | (A) 1. K to B 7, or (B). |
| | 2. K moves. |
| 2. Kt to K R 3 (ch). | (B) 1. K to Q 5. |
| 3. Mates accordingly. | 2. K moves. |
| 2. Kt to Q 3 (dis ch). | |
| 3. Mates accordingly. | |

NOTICES TO CORRESPONDENTS.

CORRECT SOLUTIONS TO 689 by W. J. Jubb, S. L. W. W., and A. E. Wilson; to 690 by W. J. Jubb, S. L. W. W., A. E. Wilson, and "Nosif Sorb."

A. E. W. (Birmingham).—Your solutions to 685, 687, and 688 are quite correct.

NOSIF SORB.—Solutions to 685 and 687 are correct.

A. W. F.—Your proposed solution to 684 we do not think will work. If 1. ... there is ... B takes Kt (ch).

mate. The only defence you give, you will see, is ... Black's best reply.

W. A. B. (Pontypriid).—Yours to hand. Will write you.

NOTE.—Problem 683 was composed in accordance with the stipulations and conditions that were given for the Huddersfield College Magazine, third Problem Tournament, viz., that certain given pieces were to be employed both White and Black. It will be remembered the author took the third prize with another ingenious problem.

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The English Mechanic

AND
WORLD OF SCIENCE AND ART.

FRIDAY, SEPTEMBER 16, 1881.

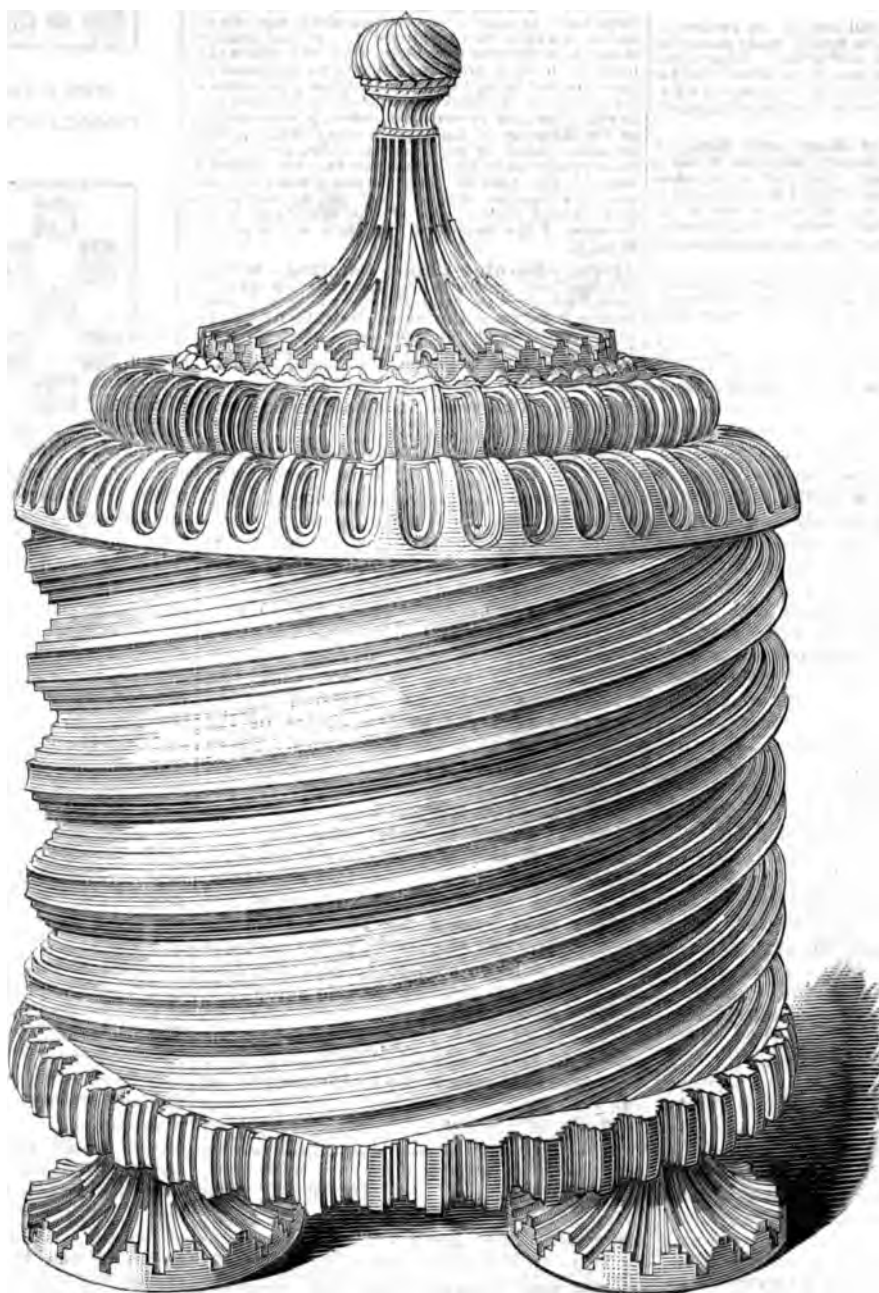
ORNAMENTAL TURNING.

By J. H. EVANS.

I AM induced to make this my next subject, although parts of it will refer to the spherical sliderest. The main portion—viz., the body, however, will bring us to some-

Clarke, who gave me the idea, arranged it in a most satisfactory way to work at the rear end of the headstock. There are very many points in favour of this latter arrangement—one in particular, and that is the facility of being enabled to use the oval chuck in conjunction with the spiral apparatus; as far as simply cutting a screw on an ellipse is concerned, there is no advantage mechanically speaking, although one of my clients did argue that he could screw an oval box together, and was some little time before he could see the obstacle to it. For ornamental purposes it is most useful, as I have altered the arrangement, viz., from front to back, and the latter is preferred by most turners; it is that which I will briefly explain. The radial arm then extends to the front, being fitted to the

arbor and intermediate one, to reverse the direction; and 16 change-wheels and pinions;—this is really all that the apparatus consists of. I have lately introduced a very convenient joint, by which the sliderest is attached, and as it admits of the rest being put to almost any angle, it has been very much appreciated by a number of amateur turners who have tried it. I have said sufficient about the apparatus for this paper, as I say it will be more fully illustrated and treated shortly. I will now proceed to explain how the box, our present illustration, was made. The material is ivory, and the body of course made from a hollow. I need scarcely say it was a fine piece, seeing that it is now, when finished, nearly 4½ in. diameter. Such ivory, and so near a circle, is not always to be obtained, and I should



IVORY POWDER-BOX.

thing quite different in the shape of the spiral apparatus. This is one of the most useful and effective additions an amateur can make to his lathe. A brief explanation here will be of much service, but in a future edition I intend to give illustrations of the whole apparatus itself. It consists of a radial arm extending from the front of the lathe-head: this was its original form; but I have now, through the courtesy of General

circular grooves seen in illustrations on Lathe-making, and work within the same, being held where required by a screw with hexagon head, the plain part working in a semicircular slot and screwed into the headstock. A second straight arm will be also necessary for this apparatus, in order to carry a connecting rod to attach the apparatus to the sliderest; a spiral chuck with tangent wheel, single and double

strongly advise anyone about to buy ivory not to pass over such a piece, as it will be found most advantageous to possess it. It is different with material that is required for oval work, as most elephant's tusks are of the latter shape, more or less.

Having selected the ivory for body, I cut the desired length off, and chucked it by the outside in a boxwood chuck, fearing that anything in the shape of

a jaw-chuck would pinch it, and so cause it to be out of truth when released from the same; then with a strong metal-turning sliderest soon turned out the inside, and finding it sound, put it aside, and select all the ivory for the other parts that I required. The lid being made in six pieces, it was no very difficult matter, except for the largest piece, which forms the first curve; fortunately, I secured a piece off the same tusk as the body, which was obliging enough to hold up a little larger, and so give me sufficient stuff to work upon. Having the inside turned out and polished, I had something to work from. For instance, the bottom was turned in the first place to fit it, and the fitting then formed a means of holding it (the bottom) while the cutting was effected. It will be seen that the base is a very slight curve. It was, however, done with the spherical sliderest, with a drill spindle and step tool, using 96 division on dividing plate advancing 2 holes for each cut; consequently 48 cuts must be the result. Although this was cut as I say with the spherical sliderest, a pattern might be substituted in its place that can be done without such an instrument, and so in the case of the lid; but having the rest handy when I turned this particular box, I brought it into use. What I wish to imply is that this specimen may be copied to a certain extent without the spherical rest; it is the spiral part that is the feature to be studied in this illustration. Having cut the bottom, the four feet were next set about; here I had four pieces of ivory prepared, a recess being turned in the bottom of each, to receive a piece of cork: this is to keep it from scratching a polished table. This recess formed a means of holding the ivory on the chuck, and with the help of a little glue they were each secured on a boxwood chuck exactly the same length; the spherical sliderest was used to turn and ornament them, a step-drill being used, and the division of 60 advancing 4 each cut, which will leave 15 cuts in all. It will be seen that at the larger diameter the top step is cut off to a point. This is caused by the wide difference in diameter and depth of curve. The four feet finished, we will proceed to turn the body and cut the spiral. The inside having been turned out and polished, a large boxwood chuck must be selected and the ivory carefully fitted to it, and then a little thin glue will again be a safeguard against its becoming loose, as the process of cutting the spiral is rather a long one, especially when as deep as that now under our notice. The work then being turned and polished, it is ready to cut, and the first thing to do will be to arrange the spiral apparatus. First place on the lathe-head the radial arms, and spiral chuck, on which place the 144 wheel. This wheel must now be geared into a pinion on double arbor with another wheel of 120 teeth also on the same arbor. The straight arm is now put into its place, and on the revolving arbor which is upon it, a pinion of 24 teeth is fixed; the sliderest must be brought into its position, and with the universal joint before mentioned it is connected to the spiral apparatus. As the spiral chuck will be where the divisions are taken, it should be carefully set at zero before anything in the shape of cut is taken; the radial arm may be now lowered, so that the wheel with 120 teeth will gear into the pinion upon the arbor through which the connecting rod passes. This done, it will be at once seen that by turning the sliderest handle the work will turn round while the rest traverses along, so forming a spiral or Elizabethan twist. As the pattern is cut clean out at each end, there will be no necessity for fluting-stops, and care must be used, as the drill comes out at each end. The step-

drill for this was an extra large one, and to cut the whole depth it took about six cuts, and when all four were done the drill was carefully set and sharpened for each one to finish with. In dividing for the four cuts, it must be the spiral chuck that is used, as the mandril revolves, and the dividing plate could in no way be of service. Of course, to get a different pitch of spiral, other change-wheels may be used. The next part to proceed with will be the first rim of the lid; this was held in a boxwood chuck, the fitting having been first made, and the curve turned with the spherical sliderest; then with a step-drill of smaller dimensions, the pattern cut, the 96 division, 2 for each cut; result 48 cuts. It will be here noticed that each cut is made of a corresponding length, so that stops must be used; being done with, the spherical being used, the stop on tangent-wheel must be the one brought into play to effect the purpose. The second curve is cut in a similar manner to it, being first fitted to the lower one, cut with the same drill and a division of 96, the same as the one previously, only being of less diameter, the cuts are brought closer together. The next piece will be that upon which a series of small beads are made. These are done with what is termed an astragal bead-tool—that is, flat at the ends, so that the superfluous material between the beads can be removed at the same time. There are 60 in all, and a division of that number was used for the purpose. It will be observed that between each bead a small round-nose tool has been inserted; this was done to simply throw up the bead, as it were, and make it more effective.

We now arrive at the deep concave curve at the top; this is done with the spherical sliderest, so arranged that the bare form is turned with it, and the fixed tool being then removed, is replaced by the drill-spindle and step-drill; the same one was used for this as for the two lower curves. There are 15 cuts altogether. The 60 division, taking 4 at each separate cut, having cut the long curve, it will be seen that the division has been so adjusted as to bring the next cut to the centre of the space left between the first series. There are also fifteen cuts around this part, and the distance is arranged, as before, by the segment stops on tangent wheel of spherical sliderest. I need scarcely point out that the whole of this box is carried out with the same kind of drill—viz., the step-drill, nearly from top to bottom. Nothing else has been used, except for the ball on the extreme top. To do this the under part was cut with a large step-tool; but, the diameter being so small, a certain amount of the pattern is obliterated. The curves on the ball itself were cut with the eccentric cutter, the same being set considerably below the centre of the work. To set the instrument below the centre, it is necessary to lower the body of the sliderest. This is effected by loosening the binding-bolt, and screwing the adjusting-ring down; this done, the rest will drop. It must be carefully done, and it can be reset to the centre at any time. The same division was used for this—60, 4 for each cut, there being 15, a single-angle tool, angle of 50° right-hand; the effect of this tool is very pretty for such work, and may be used in many different ways. The box, then, is now complete. Just a few hints as to the false bottom may be useful. Being made from a hollow piece of ivory, it must necessarily have the bottom put in. If for home use, boxwood will be quite good enough; if for a present, ivory should be used, and it should be screwed in to fit nicely, and turned off at the bottom flush all over, and if a small plain filling is left behind the screw, the joint ought not to be visible. Made as the

original from which this engraving is taken, it is a very pretty and useful ornament, and one that will not be likely to baffle any amateur turner of limited experience. Upon examination of proof I find the proportions not quite so accurate as might be: the top, for instance, is thicker than in the original, it being a difficult thing to engrave. The original, however, can be had by any amateur that cares to copy it. The illustration will, at the same time, show clearly what the design is, the mode of making, and the tools used.

THE PATENT LAWS.

IT will be in the recollection of our readers, as we mentioned it only a few weeks ago, that the Society of Arts have drafted a Patents Bill, which they have had printed and circulated with the view of calling a meeting for its discussion after the vacation. The British Association has also a Committee appointed to inquire into the working of the existing Patent Laws, and it so happens that many of the members of the latter Committee are also members of the Society of Arts' Committee: hence when Sir F. Bramwell rose to make his report on the subject at the recent meeting of the British Association he had little more to say on behalf of the Committee of the Association than to express the hope that the Bill put forward by the Society of Arts would lead to a free and open discussion, and enable the committee to make a satisfactory report next year. The Government have, however, intimated their intention of dealing with the question as soon as possible, and it is probable that in the coming session an attempt will be made to introduce an Act which will place the Patent Laws on a more satisfactory footing than they occupy at present. By a general consensus of opinion it is recognised that the Patent Laws require revision, and that in the direction of encouraging patentees. At the beginning of its last session the Society of Arts appointed a committee consisting of its chairman of council, Sir F. Bramwell, Prof. Abel, Mr. Alfred Carpmael, Sir H. Cole, Capt. Douglas Galton, Mr. W. H. Perkin, Dr. Siemens, and Mr. H. T. Wood, and the last named was requested to tabulate for the information of the committee a statement of the manner in which the various points are dealt with by the Patent Laws of other nations. The Committee, furnished with this information, considered the questions which have from time to time been discussed, and drew up instructions for the guidance of a Parliamentary draughtsman in the preparation of a Bill, which has since been printed, and which awaits criticism and discussion at the meeting to be called in the autumn. The Bill is believed by the Committee to be to the advantage of the community at large, and is such an Act as the Council of the Society of Arts would pass, if "happily for manufacturers and commerce," the Legislature would on this point delegate its powers to them. The phrase we have quoted was used by Sir F. Bramwell, and probably he alone is responsible for it; but it is certain that although some of the proposals of the Committee may meet with the cordial approval of the majority, there are others which will as certainly be strenuously opposed. However, the Council are willing to listen to the objections that may be urged against their Bill, and having duly considered them, will make such alterations as may appear expedient, and will then republish the draft as a Bill which the Council of the Society of Arts would desire to see passed in its entirety. It will be quite soon enough to deal with the details of the Bill when its provisions have undergone the promised criticism and discussion, and it is issued in its revised

form; but it contains one or two proposed changes which are of so radical a character, that they will necessarily attract the attention of all interested in the subject, and the Government will probably be influenced, if not guided, to some extent, by the discussion which will take place on the Society's Bill. The Council recognises the need of a patentee in the development of an invention, on the principle that what is every one's business is nobody's business, and that it is necessary for somebody to have a beneficial interest in an improvement, in order that its full value may be obtained by the public; but their most important proposal is the suggestion to take the patent business entirely out of the hands of the lawyers, so far as that is possible. Sir F. Bramwell tells us that, "fortunately," there is very little "patent" litigation nowadays; but the few actions that are tried are ruinously expensive. A considerable portion of the cost is swallowed up by the elaborate models which are needed to make the points plain to counsel, the court, and to the jury, and not unfrequently the litigants are chagrined to find that, notwithstanding all their efforts, they have not even succeeded in making themselves understood by their own counsel, who presumably "instruct" the Court, and the jury, where there is one. The first important proposition of the Society of Arts Bill—one which will commend itself to the majority of patentees—is that there should be appointed in lieu of the present commissioners, all legal officials, a body of commissioners, one of whom should be well acquainted with engineering, one with chemistry, and one with law. These commissioners are to have power to appoint the required staff, to grant patents, to hear causes, and to do all the legal business in connection with the Patent Office. The "required staff" will include examiners, whose duty it will be to see that the necessary forms are complied with, and that a sufficient description is given; but they will not be required to report as to novelty, utility, or sufficiency of the invention. So far there seems nothing objectionable in the proposals; but it may be doubted whether it is wise to call inspecting officers examiners, when their duties are limited simply to seeing that the documents are in proper legal form. How the law officers of the Crown will greet the proposal to put the transaction of patent business into the hands of those who really understand it remains to be seen, but undoubtedly Sir F. Bramwell was right when he selected that point as "probably the most thorough change made by the Bill." Another change proposed by the Bill, however, is one that requires careful consideration, for it affects the principle on which patents are granted. According to Sir F. Bramwell, the committee who framed the Society of Arts Bill are of opinion that it is contrary to the interests of the public that a patentee should be deprived of his invention by what, after all, are technicalities. It is a very common thing, he said, for a patentee (in this case a would-be patentee) to obtain provisional protection, and having done so, either through being too much occupied with other matters, or through being incompetent to develop his own ideas, to abandon further proceedings with his application, and to allow the provisional protection to lapse, and thereupon the provisional specification is made public. Something between 30 and 40 per cent. of the applications made for patents do not go beyond that stage, and the result is that there is made public a mass of crude and undigested matter, always useless to the manufacturer, but commonly destructive of the novelty of a patent which might come afterwards, and be fully worked out by an inventor. The committee propose that the provisional specification should be a merely

temporary document, and that it should never be made public, so that whether a patent be granted, or whether the provisional protection be suffered to lapse, the document should be destroyed. This objection to the publication of provisional specifications is held by many inventors and others interested in the subject, but there are many points to be considered before the present practice can be modified as suggested. The original idea of the provisional specification was to enable an inventor to describe his invention roughly, but still unmistakably, and to obtain protection for it, on the understanding that within six months he would file a complete specification. There is no compulsion about it, for a man may file his complete specification at once, and after the usual delay for notices of opposition, obtain the seal. If, then, the invention is of so much importance that the inventor desires to protect it at the earliest moment, and secure a few months of protection for working it out, it is scarcely pertinent to say that "he has been too much occupied with other matters" to carry it out, though it is possible that he may be "incompetent to develop his own idea," or, which is not unfrequently the case, may lack the necessary funds to procure the "seal." In the last case, injustice is done by the publication of the specification, but scarcely in the former instances; and it therefore becomes a question whether it is advisable to have a provisional specification at all; whether it is not better to reduce the cost of the stamps, so that a patent can be obtained at once and cheaply, and allow ample power for amendment and disclaimer. If the public has no right to provisional specifications, it might be urged also that it has no right to the completed specifications or patents which lapse by reason of the non-payment of the stamps due at the end of the three years. In the latter case, more real injustice is done than by publishing provisionals, for while the latter may give only a crude outline of the idea, anything that has once been a full-blown patent must, ex necessitate, have been fully described in a complete specification. So long as provisional specifications are allowed, it seems only just to other inventors that they should be published, and it does not follow that their publication vitiates a subsequent patent obtained by another applicant. As a matter of fact, many provisional specifications are deposited with the erroneous idea that the mere fact of having applied for a patent, and obtained "protection," entitles the applicant to put the word "patent" on the articles—a practice which might be prohibited with much advantage in any future Bill. These points will doubtless come up for argument in the autumn session of the Society of Arts, as will another proposal of a radical character, in which the committee suggest that a patent should not be rendered invalid by any dormant publication of the main ideas, such, for instance, as a book in the British Museum. They propose that, unless an invention can be shown to have been in use within thirty years, no mere publication, unaccompanied by use, should be considered to be an anticipation of a patent. With this proposal must be coupled another, which has long been a point of animated discussion: viz., the compulsory utilisation of a patent, either by the patentee or his licensees, under pain of abrogation of his rights; but on this latter point Sir F. Bramwell did not touch in his paper. With the details of the measure we have no concern at present, but we may mention that the proposed term is 17 years, with a possible prolongation of 11 years, to be obtained on satisfying the Commissioners that not sufficient reward has been received during the term of the letters patent. The stamp duties payable will amount to £12 10s. for the grant of a patent, £2 10s. being

payable on application; but at the expiration of the fourth year a sum of £30 will be payable, and at the end of the eighth year £60, no further payment being demanded during the whole term. These items will doubtless receive severe criticism, for it is obvious they are not calculated to encourage invention; the sum demanded at the initial stage being too heavy, while a really successful patent will have nine years to run without the patentee paying a penny, just at the time too when he is better able to pay a tax than when he is struggling to make his invention known. The better policy would seem to be to make the stamp duties as light as possible during the first five years, and recover the expenses of the office from duties levied on the successful patents, which could easily pay a duty of £10 per annum or more. Some little discussion followed the reading of Sir F. Bramwell's paper, but no attempt was made to criticise the proposals;—a good point was, however, made by one speaker, who said that in the United States a patent was really property, while here it was little more than a license to go to law. The features of the Bill quoted above are really its chief claims to attention, and probably the Government will be influenced to a considerable extent in framing their Bill by the criticisms to which the Society of Arts' Bill is treated—especially as that is practically the Bill recommended by the Committee appointed by the British Association.

A NEW LIGHT ON THE STOMACH.

By HENRY WILSON.

THE application of electricity in ways the most varied, and, perhaps, we might add, unexpected, has, within the last few years, developed with almost bewildering rapidity. As in so many other things, it has its applications also in medicine; perhaps one of the most novel and ingenious of these, as well as the least generally known, is the employment of the electric light to illuminate various parts of the body which are only obscurely visible, if they can be seen at all, under ordinary circumstances. There have been many instruments designed to facilitate in this way the diagnosis of the less accessible cavities of the human frame. The ordinary instruments are constructed to reflect the light either of day or of some artificial source upon the part to be examined. The bright table-spoon which a medical man will often use to help him to see a sore throat more clearly by reflecting additional light upon it, is of course a primitive form of such instrument. In some of the most recently perfected of these appliances a small piece of platinum joining the electrodes from a source of electricity, is placed in the focus of a small mirror. By allowing a carefully regulated electric current to circulate through the wires, the platinum is, of course, raised to a white heat and emits a brilliant light. This is reflected upon the part to be diagnosed, which is thus made clearly visible to the operator. Instruments for viewing the interior of the bladder, the œsophagus, or the stomach (for this unruly and mysterious source of trouble is no longer to escape the searching gaze of science,) are necessarily more complicated than those for diagnosing, for instance, the mouth or the ear.

We select the gastroscope for viewing the interior of the stomach, as the most ingenious and remarkable of all these instruments which have recently been brought to great perfection in Vienna, and also as showing to what a point of delicacy the execution of scientific instruments has been carried in our day. We should add that the gastroscope is not a mere model or plaything, but has been in actual use. A figure of the complete instrument is shown in the two blocks, Figs. 1 and 2, and reference to it and to the smaller cuts will enable us to explain the principal features, which will, we think, interest all lovers of ingenious mechanical appliances.

The Gastroscope consists mainly of a rigid horizontal tube, Fig. 1, *a*, terminating in one

explosion, and in the other partially flexible tube, which is the oesophagus until its end. This flexible metal tube, of 30 annular pieces, united and thus forming a continuous, whether it be displaced in a

the inside of the lower end taper inwards to an equal extent, so that one piece fits into another. As this tapering is only effected out of the thickness of the metal, this gullet-pipe consists of a tube of uniform diameter both within and without. Moreover, the edge of each of these annular joints is filed away on opposite

sponding slit in the tube *s*, Fig. 1, slides along the prism supports, which thus offer no obstacle to the motion of the gullet-tube, which in this manner is movable within the outer tube, while the latter and its inclosed prisms retain a constant position. This arrangement will be better understood by a reference to

FIG. 1.

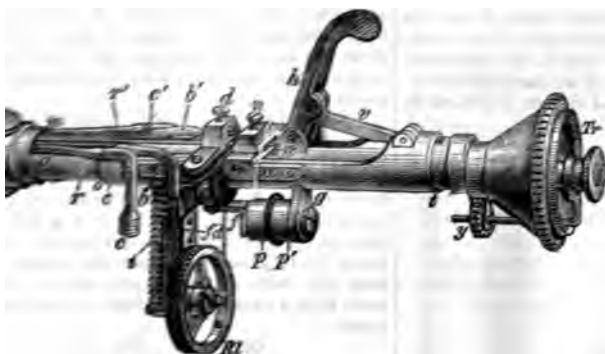


FIG. 5.

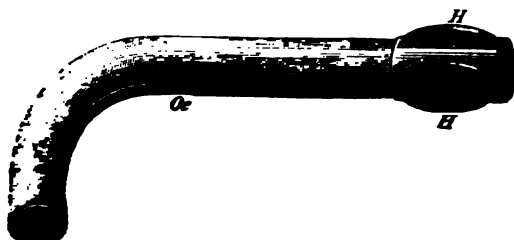


FIG. 3.



FIG. 6.

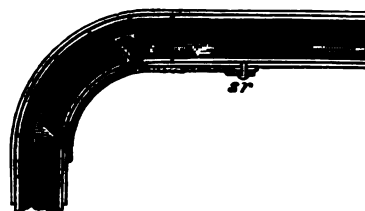


FIG. 4.



FIG. 7.



FIG. 8.



FIG. 9.



in a curve, without any chinks high, did they exist, the folds of frame might easily be caught. This close fitting arrangement asking the inside of the upper jar piece taper outwards, and

sides: on one side to a considerable extent, so as to enable it to be bent into a spiral, but on the opposite side only enough to allow it to be opened out till it forms a straight line. A glance at Fig. 2 will best supplement this explanation.

The jointed flexible tube terminates in a sort of tiny lantern *z*, which consists of an inner and an outer glass tube-head. Inside the inner glass is seen the little loop of platinum-wire *P*, the ends of which are of course joined to wires which run up the interior of the tube and can be connected at pleasure with the electrodes of a battery, by means of the screws *d* and *n*, Fig. 1, and thus cause the incandescence of the platinum, which furnishes the illumination. From this, light radiates freely on all sides and illuminates the interior of the stomach. A portion of the rays which fall upon the side opposite to the little window, *O* Fig. 2, situate immediately above the lantern *z*, are of course reflected back into it, where by means of the prism *Pr*, Fig. 3, they are reflected upwards in the vertical direction of the tube. Passing through the series of lenses *L*, they are parallelised, and arriving at the bend *Lt*, Fig. 1, are deflected by refraction to a horizontal direction by the coupled prisms about to be described, and seen in Figs. 4 and 6, whence, reaching the eyepiece at *L*, they convey to the observer's eye an image of a portion of that side of the stomach which may be opposite the window *O*.

In order to deflect the rays of light from the vertical direction of the tube *s* to the horizontal one of the tube shown in Fig. 1, which terminates in the eyepiece at *L*, prisms are employed in the bend at *Lt*. Fig. 4 shows the arrangement of these prisms, which are coupled immovably upon the curved piece of metal *bg*, and are attached at their apices on very narrow metal supports *st*, *st* to the curved plate, *pl*, the exterior of which is seen in the under side of the bend at *Lt* (Fig. 1). (Fig. 5 represents the guide-tube without this plate). The most ingenious feature of this arrangement is that it allows the gullet tube to move freely backwards and forwards through the curved outer-tube or guide (Fig. 5), and yet at the same time maintains the prism in a constant position. This is effected thus: The guide-tube, Fig. 6, has a small oblong aperture *ac*, on the under side, which is of just sufficient size to allow the insertion of the prisms one after another. The aperture itself is prolonged into a slit for some little distance in the direction of the lower end of the tube. A corre-

sponding slit in the tube *s*, Fig. 1, slides along the prism supports, which thus offer no obstacle to the motion of the gullet-tube, which in this manner is movable within the outer tube, while the latter and its inclosed prisms retain a constant position. This arrangement will be better understood by a reference to

To obviate the inconveniences which might arise from any elevation of temperature in the stomach, the space between the two glasses of the lantern is kept filled with water, and communicates with two diminutive caoutchouc pipes *rr* conveyed down the main tube, as seen in the sectional drawing Figure 7, and terminating in the bent nozzles *c c'*, Fig. 1. To these further indiarubber tubes are adapted, one to supply, and the other to lead off the water which is thus kept in perpetual circulation, and the temperature of which has of course to be regulated so as to obviate any inconvenient degree of heat produced in the stomach.

The crowning piece of contrivance and delicate workmanship in the instrument is an elegant appliance by which the extremity of the gullet-tube, with its little window, may be made to revolve. The operator has merely to turn the little milled wheel *R*, Fig. 1, round which is stretched the silk cord *sl*. The latter passes down the tube and round the tiny wheel *kr* shown in the section of the tube, Figs. 8 and 9. This tiny wheel, which, it will be observed, is toothed, plays into an indented ring round the interior of the lower rotatory portion of the tube, Fig. 9, which it can by this means cause to revolve whenever motion is imparted to itself by the agency of the silk cord which communicates with the milled wheel *R*, placed conveniently near the eyepiece. This ingenious and delicate contrivance obviates the necessity there would otherwise be of withdrawing, readjusting, and reinserting the instrument in order to observe different portions of the stomach, for the slightest turn of the wheel *R* causes a corresponding movement of the terminal of the gullet-tube with its window, and thus makes different parts of the interior circumference of the stomach successively visible to the eye of the diagnoser. Wherever a small supply of electricity is to be had, there the instrument may be used. A small portable apparatus for preserving a sufficient quantity of electricity has been designed by the maker, and now that the storage of electricity has become a recognised possibility, the ingenious instrument we have very briefly described may probably prove a welcome aid to the medical man in throwing a new light upon the stomach, that mysterious source of so many of "the thousand natural shocks that flesh is heir to."

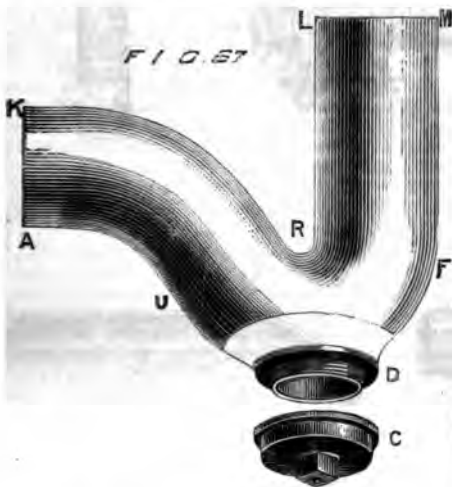
PRACTICAL NOTES ON PLUMBING.
XII.*

By P. J. DAVIES, H.M.A.S.P., &c.

Traps (continued).

Half ω -Traps or Siphon-Traps.

A SIMPLE curved pipe or tube bent in such a manner that it will retain sufficient liquid to bar the passage of lighter fluids, is, amongst plumbers, known as a trap, but how long such traps have been in existence no one can tell. Suffice it to say that siphons have been known hundreds of years before the Christian era. They answer for many sanitary purposes. Fig. 67 is the shape of the siphon trap now in



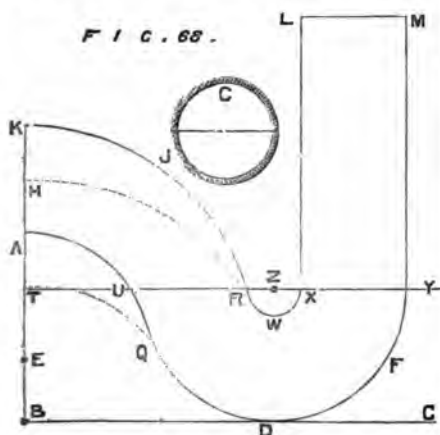
general use, with cap and screw, which may be cast, worked or bent up out of a straight length of pipe or in sections, but generally when hand-made in two halves from sheet-lead.

The cast ω -trap is much used in London and its vicinity, and the hand-made or sheet-lead trap is used, comparatively speaking, all over the world; within the last five years they have been made by hydraulic pressure—i.e., pressed into their shape by a method somewhat similar to that adopted in making lead-pipes. This method is undoubtedly the best, inasmuch as the lead is, as a rule, much more solid than when cast. In some instances, such as where there is a long outgo required, the hand-made ω -trap would be preferable, which, for closet-work, avoids a 4-in. joint, thus saving four or five shillings.

I shall now proceed to explain the method of striking the form of these traps geometrically.

Half ω -Traps. (Fig. 68.)

For a 4-in. trap open the compasses to about 1 in. so that you may strike the half-circle, R W X, Fig. 68, then draw the right line UY, cutting



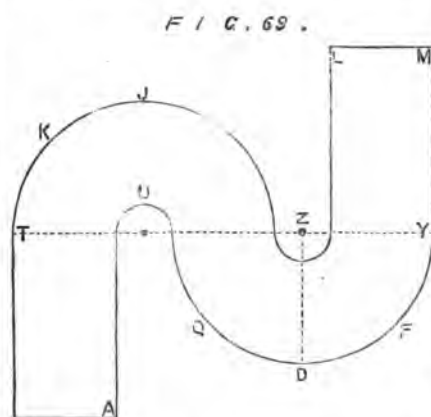
the point Z. Now open the compasses so as to strike the bottom arc D Y U, which must be 5 in. or 4 in. (the size of the trap) from the throat line W to D. Next draw the line B C parallel to U Y, and cutting the bottom or belly of the trap at D; then take the compasses with the

radius Z D, and from a point on the line B C, strike the outgo (shown on dotted line) T Q, cutting the neck of the trap as at Q; this forms an easy outgo. Open the compasses, and with a radius of B to R, strike the top H R, cutting the throat at R. This will give a lin. dip water-lock or seal. Next draw the line K B, cutting the point B, and perpendicular to B C, which will give you the square line for the outgo; but should you require more water-lock then, instead of striking the neck as per dotted line, go higher up for the centre, as at the point E, and with the same radius (Z to D) strike the neck line as at A U Q, and open the compasses to R for the top line K J R, which completes the pattern.

I have lately made some experiments with these traps, and find that 2 in. water-lock is better than 1 in., owing to this kind of trap waving its water-lock away, especially where well ventilated. I have given this diagram a water-lock of 3 in., which, to a great extent, gets over the difficulty of waving out; but this extra dip is greatly against the action of the trap for self-cleansing purposes, as the soil must take a great dive before it can reach the outgo.

 ω -Traps. (Fig. 69.)

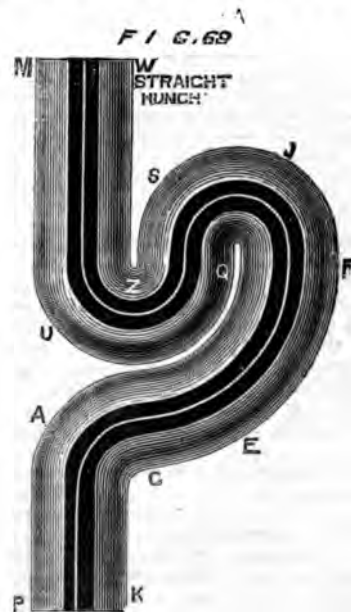
These traps are nothing more than the bottom of the half ω twice struck. If you require more or less water-lock, make a difference in



the height of where you place the point of the compasses, in striking the out-go. That is to say, if you require less dip, strike the throat U lower down, and if more, *vice versa*.

 ω -Hunch Trap.

This trap is nothing more than the ω -trap with the outlet continued to come in a straight line with the inlet, as at P K, Fig. 69 A. In making this trap, make M U Q A P first, and

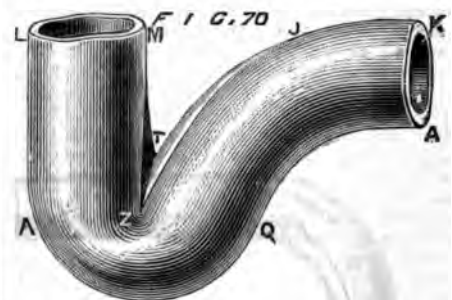


fit W S J F E G K to it. These traps are handy for rain and other water-pipe work requiring a

trap out of the way, especially for fixing in a brick chase. Also see Fig. 88 A.

Straight Dip ω -Traps. (Fig. 70.)

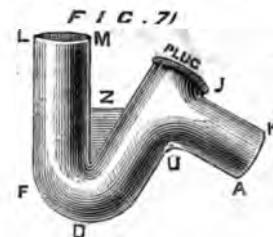
This is a trap I experimented with some 15 years ago, and went so far as to have a set of moulds made for casting them, but was better



engaged after that date. The object I had in view was to make the trap more thoroughly clear itself of soil, &c., so as to prevent it diving so low into the water. I found that by doing so a 3-in. water-way was equal in efficiency to a 4-in. round pipe throat or passage.

Sutlif's Cast ω -Trap. (Fig. 71.)

This trap has been cast with cleansing-cap, and screws J on top of the out-go. It has also a



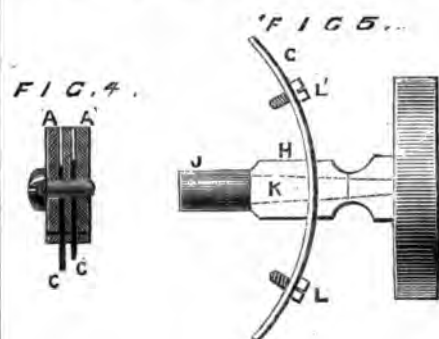
tie, Z, across the throat, to prevent its being pulled out of shape.

(To be continued.)

THE TELESCOPE: HOW TO MAKE
AND USE IT.—III.

By W. J. LANCASTER, F.R.A.S., F.C.S., &c.

IN making the rackwork to work as it should do, we shall take up more time than we may at first anticipate. However, as we have determined to do the work well, we will at once face all difficulties, and with a determination to succeed, we shall overcome all obstacles, and in the end be able to say "Well done!" Let us, then, refer to Fig. 2 (p. 586, Vol. XXXIII.), and having made A slide through B and C without any jerks, or one part tight and another part easy, then our next work is to cut the rack, or if from any cause the rack-tube does not



work smoothly, we will rectify this before going on with the racking. The tube A is out of 1 in. mandril tube, and should be 8 in. long. This must be well scrubbed with rough emery-paper, then finished off with (FF) emery-paper, and lastly, with (O) emery-paper and oil until a nice polish is obtained. If from any cause the

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tube does not move smoothly, then it should be put on to a chuck, and the chuck screwed tightly in the vice, and the whole of the tube carefully floated until all irregularities have been removed. This is a matter of time, and if it is possible to get another piece of tubing quite true we will get it; if not, of course then we must float and finish off as above. Having the tube all right, we will file a hollow in a square bar, or make a wooden pattern, and get a casting from it of the form we require it to be. It should be 4in. long, and in section must be like Fig. 3, in which *E* is the top of rack, *T* the bottom, showing the curve in the continuation of the black line, and one of the screws *S*, by which the rack is held to the tube. Having filed up the casting, the next thing (and a most important one too), is to cut the teeth in the rack. If possible, we will get some friend to cut this for us (if among our friends we have a good wheel-cutter), if not—well, I guess we'll be independent of the lot and cut it ourselves; and before attempting to cut the rack, we will purchase a piece of pinion wire having 12 leaves, the wire to be about a quarter of an inch in diameter. We may get just the length we require from a watchmaker; if not, we must purchase a stick, this will be about 13in. long, and will come in useful by-and-by. We have now to make the saw with which we shall cut the teeth in rack. Fig. 4 will at once show us the kind of saw we have to make: (*a a'*) are two brass plates about 8in. long by 3in. wide and 1-16in. thick; (*b*) is a centre-piece of exactly the same thickness as each of the leaves in the pinion wire, and *c c'* are two saws about 7in. long, screwed firmly in position, as per drawing. The one saw *c* comes down lower than *c'*; the difference ought not to be quite so much as in diagram, but just so much as when *c* is down to the bottom of tooth *c'*, will have started the next tooth. Now, the thickness of (*b*) regulates at once the pitch, and we have to be guided by the pinion we are going to use. Well, we will try to do this as it should be done, and we will first get to know the thickness we want it to be: to do this we either measure the space in pinion, or rub the pinion backwards and forwards on a piece of hard wood, taking care that the pinion rolls freely, and that the pressure we apply is neither too great nor too little. We shall now have an exact counterpart of the rack we wish to cut, and our work is to make *b* just sufficiently thick to enable us to cut two marks exactly in the wood with *c* and *c'*; well, now we will commence cutting the rack with our own saw: this, by the bye, must be put into a haft, or rather, the inch at one end which does not contain the saw must be tapered down so as to be driven into a haft. Now, then, we are ready to cut the rack, and having first made a mark with the edge of a three-square file, we will carefully cut it down with *c*, until it goes to the bottom, and *c'* has started the second cut. Then we cut this down to bottom, and so go along the whole of the rack, taking care to cut as true as possible. Now with a feather-edge we will take off the projections at the top of teeth, and give them a bevelled appearance; and, last of all, we will roll the pinion backwards and forwards on the rack until it works smoothly; then we will screw it perfectly true up to a true line marked on *A*, Fig. 2. The screws may go right through the rack-tube, and with a crossing-smooth we can neatly take off the little projections inside tube, and leave it ready to fit in the pinion, which is the next piece of work we have to do. Before leaving Fig. 2, though, we will file out of *B* a small piece to allow the rack to slide through, and the bottom of the rack should slide very smoothly on the part of *B* we filed out; this is the bearing for the rack, and it is equally necessary to have the bottom of the rack *T*, Fig. 3, quite smooth, and true from end to end, so that the rack will work nicely all along. Now find the pinion-wire and cut off with the three-square file, a piece 2in. long. We will chuck this in a hole in a brass chuck, and file the other end to a point, bring the back centre up to this, and cut off all the leaves beside about 3in., as in Fig. 5, the pinion-wire to be turned taper as *K*, Fig. 5, to be subsequently ground into *H*, Fig. 5. Having turned the pinion, and left it as smooth as possible on the taper part, we will next turn the pinion-nut, *I*, Fig. 5. This should be turned something like the shape in the drawing, and milled with a milling tool, either flat or two half-round mills, with a nick in the centre. Before we take the pinion-nut out of lathe, we

will drill a small hole through it, a little smaller than the end of pinion, then take it out and make *G* and *H*, Fig. 5. For *G* we will use up the widest of the two pieces we cut off the ends of the large tube, and having chucked the piece of tube and trued up both sides, we will then cut out a piece about same size as Fig. 5, *G*, and make a hole in the centre, through which *H*, Fig. 5, just moves very lightly; then we will solder *G* to *H*, and having done this, put the pinion into lathe again and grind it into *H*, as per dotted lines. This will take a little time; but by using first a broach, we can make *H* very nearly the shape we wish it to be, to take the pinion, then grind in with a little rottenstone and oil until the pinion works very smoothly when dry. Now we must go back to Fig. 2, and first drill a hole through the large tube, to come immediately above the rack in *B*; the hole should be in the centre of *B*, Fig. 2; *H*, Fig. 5, just sliding easily through it, so that the pinion *J*, Fig. 5, should just bed itself nicely into the rack. We can easily tell whether the pinion is too low or too high by turning it. If the tube *A*, Fig. 2, moves out smoothly, and will move back on turning the pinion the other way, without any loss of time, then the rack and pinion will do beautifully, and we will at once drill holes for the screws *L L'*, Fig. 5, to go through. These will hold all in place. If the rack does not follow pinion at once, we must make the hole larger, and move pinion till it does work smoothly, then put the screws *L L'* into their places. Having finished the rack, we must turn next a casting to screw into the front of rack-tube *A*, Fig. 2, into which a short piece of tubing should be soldered, to take the sliding tube *E*, Fig. 1, page 586; the sliding tube may be 1 1/2in. tube and 6in. long, with a casting on outside end, having the thread to carry eye-pieces. Now we can give Harry the tube to finish, and he must use much finer emery-paper, giving it a thorough good rubbing with *F F* emery-paper, and then with *O* emery-paper and oil, and—Now Harry, this is the dirtiest part of the work; but really it must be done, for from this dirt will come the beautiful polish that makes the outside of a telescope look so nice. Yes, it must be done. Take this piece of thick cloth, Harry; pour on it plenty of oil, and rub it along the tube until it looks quite dirty; then with oil and rottenstone rub it backwards and forwards in straight lines, for at least a couple of hours, until it has a nice polish; you can rub the oil off with a rag and lime. But don't get tired, Harry; it will repay us for all the trouble when finished. And now for the present we will leave Harry, and in our next we will make the stand, and probably the eye-pieces, so that very soon we shall be able to commence our observations. There is one thing we must do, and that is to carefully put by all the special tools we make ourselves. We shall want them again for other work.

THE PARIS ELECTRICAL EXHIBITION.—IV.

THE electric light has never been seen in such profusion as it is now in the evening at the Palais d'Industrie, where no end of different sorts of electric lights are at work. We have to distinguish between the electric arc and the incandescent system. The electric arc is the spark of a powerful source of dynamical electricity passing between two carbon-points; it is the oldest and most powerful form of the electric light; it requires a good regulator to keep the light stationary as fast as the carbon points burn away. In ordinary cases, all that is required is to keep the carbons always at about the same distance, and a simple regulator suffices. (For descriptions of lamps, regulators, dynamo-machines, consult back numbers.)

When we wish to keep our point of light in one fixed position it is a much more difficult matter, for we have to use a regulator which moves both carbons, and each at a separate rate, since the carbons burn unequally. Regulators are very good things, but if nothing else had been found, the electric light would still be in the experimental phase. It is the electric candle, which, dispensing with clockwork and complications, gave rise to the use of the electric light on a large scale for lighting streets and large buildings. The Jablochhoff candle simply consists of two parallel carbon pencils, separated by an insulating material, generally kaolin and

plaster of Paris. In order that both the carbons may burn down equally, we must have currents which are alternately reversed, so that in reality the Jablochhoff light is a rapid series of sparks, too rapid to be separated by the eye. These candles last about 1 1/2 hour. Several are put in the same globe, one carbon of each being connected to the positive wire, and the other carbons to the negative. Now, as the electric current always chooses the least resistant path, the candles will burn separately, one after the other, in the order of their respective resistances. M. Jamin has lately brought out a candle to burn for 160 hours; it is inclosed in a glass globe. In the Werdermann and Reynier lights, the two carbons are in contact. One of the carbons is very large, and the other, a small pencil of carbon, is kept in contact with it by the action of gravity. The pencil of carbon being thin it is raised to incandescence by the electric current, and there is also a voltaic arc at the contact of the two carbons. The latest system of electric light consists of a thread of carbon (carbonised paper, or fibre) which is raised to incandescence in *vacuo* in order not to burn away. The Edison, Swan, and Maxim lamps are on this system. Let us now consider the generators of the currents. We have batteries and machines. Batteries are out of fashion, except for the electric light on a small and expensive scale; 60 Bunsens being required for a single good light. Still, a new and constant form of the Bunsen battery has been devised by M. Tommasi, so that the electric light, by means of batteries, is to be seen at the exhibition. In the Tommasi battery the porous pot is double the height of the outer cell, and contains a semi-cylindrical glass bottle filled with fresh liquid to keep the battery in activity as fast as the old one is used away. All the outer cells communicate and can be filled or emptied simultaneously.

The sources of electricity mostly employed is a dynamo-electric machine with continuous or alternating currents as the case may be, worked by a steam or gas-engine.

The current may be utilised directly or stored up in "accumulators," or secondary batteries. At the Exhibition part of Swan's lamps are worked by Faure's accumulators. It is a very difficult thing to compare these lights and machines. The congress of electricians is to settle theoretical matters; there will also be a meeting of electricians for the practical part of the science. Having taken a general view of the electric light, we will consider some of the chief systems separately in future articles.

C. Detailla.

BRITISH ASSOCIATION.

ABSTRACTS OF REPORTS, PAPERS, &c.

Report on Underground Waters.

MR. C. E. DE RANCE read the "Report on the Circulation of Underground Waters," in which it was stated that the results of the committee's investigation showed that the Permian, Triassic, and Jurassic formations of England and Wales are capable of absorbing from five to ten inches of annual rainfall, giving a daily average yield of from 200,000 to 400,000 gallons per square inch per day. The area occupied by the formation was in round numbers—Permian and Trias, 8,600 square miles; oolite, 6,600 square miles; capable of yielding 1,720 millions. The lowest rate of absorption was 1,320, or united, affording a supply for 100,000,000 people, or 30 gallons per head. Mr. De Rance specially described the water-bearing conditions of the Yorkshire area. Professor Prestwich, of Oxford, remarked that the report was an excellent one. Dr. Wright said that this report redeemed geologists from the charge which had been made against them that their researches were not of any value to the public. There was no subject of greater importance than our water supply.

Report on Underground Temperature.

Prof. Everett presented the report of the committee on "Underground Temperature." During the year observations had been taken at the East Manchester Coal Field, the Talavgoch Lead Mine, Flintshire, and at the Radstock Collieries, Bath. With respect to the observations in the East Manchester Coal Field, these were taken respectively at Ashton Moss, Bredbury, and Nook Pit. At Ashton Moss, at a depth of 2,790ft., the temperature was 85°3'; at Bredbury Colliery, at a depth of 1,020ft.,

temperature was 62°; and at Nook Pit, at a depth of 1,050ft., 63½°. These observations agreed singularly well. The mean natural temperature was assumed to be 49°. The increments of nature at that depth would then stand as follows:—Ashton Moss, 36°3' in 2,790ft.; Bredbury, 13° in 1,020ft.; Nook Pit, 13½ in 1,050ft.; gave for each degree of increase—Ashton 76·9ft.; Bredbury, 78·5ft.; Nook Pit, 79ft. The observations showed great irregularity last year, and the new observations taken in 1880 increased the irregularity. The observations taken at a place in the lead mine 680ft. the temperature was 62° Fahr., while 48° assumed to be the surface temperature, gave an increase of 14° in 680ft. or of 1° for 47ft. At Ashton Colliery, observations were made at pits—the Wells May Pit, 560ft. deep; the W. Pit, 1,000ft.; and the third in the same a depth of 810ft. He assumed 50° in that as surface heat; and thus for 560ft. the temperature was 11·7°; for 810ft., 13°; and the same 680ft.

Lunar Disturbance of Gravity.

G. H. Darwin read the Report of the Committee appointed for the measurement of the Lunar Disturbance of Gravity. The experiments so far made had gone, confirmed the result of M. M. Adams and Plantamour, and it was thought could remain little doubt but that the surface of the earth is in incessant movement, with oscillations of periods extending from a fraction of a year to a year. Whether it be a purely superterrestrial phenomenon or not, this consideration should be of importance to astronomical observers, for instruments are necessarily placed at the surface of the earth. M. Plantamour spoke as though he generally recognised that one pier of a circle rose during one part of the year and another. But if this were so throughout the year they must suppose that there was a kind of the solid earth produced by climate changes; and all of the central parts of continents must amount to something considerable in vertical distance, and the changes of level on the easterly coasts of a continent must be exactly the reverse to one another. The idea seemed of course singularly improbable, but it was alleged that it was the eastern pier of transit instruments in which rose during the warmer parts of the year. Now if this be generally true for Europe, had no easterly coast, it was not easy to see how a change could be brought about except by the rising of the whole Continent. The committee believed that in the future it would be thought worthy to erect at each station a delicate instrument for the continuous observations of the changes of level. Dr. Haughton alluded to observations 40 years since by Sir William Hamilton, and if he remembered rightly, he found out the annual variations. Prof. Ball said he had been in the habit of attributing these minute changes in the level to a sort of microscopic earth-tremors; if he might use the expression, though they be due to atmospheric or climatic influences. Thomson said the whole of the earth was going down every day, and he advised the experimenters to dig down a mine, where the whole class of disturbances would be annulled. A continual oblation of this kind would be of great use in connection with earthquakes, and by this means a amount of knowledge might be obtained. Quakes made great disturbances, and one place, say, in the neighbourhood of the Red Sea, would send its vibrations through the earth. A regular systematic gravitational laboratory was one of the appliances of science that they must look in the future.

Report on Meteoric Dust.

F. Schuster read the report of the Committee on Meteoric Dust. The committee had not been his year to do much more than to find out had been done. Professor Schuster quoted extracts from Mr. Ranyard's paper as to results of observations made by Professor W. Phipson, and others. Professor W. Phipson had found iron in the Giant's Causeway, and Phipson had observed iron deposited on the surface of the wind, but he found iron only in parts of the year, and only when the wind was from a certain direction. The Committee knew that iron did fall, and they would like to know the year, for it was most important; but the difficulty was to find a suitable spot to make observations sufficiently free from dust to allow such observations being made. He had suggested a place in the Alps, and he thought Sir Wm. Thomson had been to Canada. With regard to the instrument to be used, two had recently been described in a publication, in which iron would be on glass plates covered with glycerine. H. Scott said, from observations which had been made, the iron in the Giant's Causeway was of terrestrial origin. They had recently made a large collection of iron dust from a Dundee mine from the far north of Spitzbergen, and they found it coming down as a substance of

grey dust on the floor. He put a large quantity into a bottle, and this substance, which was mixed with ice, was sent to London. It, of course, remained frozen whilst in the Arctic regions, but when placed in a room it rapidly melted. When the bottle was opened they were driven from the room by the smell of phosphoretted hydrogen coming from it. Dr. Gladstone remarked that it was easy to find iron, but the difficulty was to prove it to be meteoric iron, for, as they knew, the wind picked up fine dust from the earth, and carried it to almost any distance. Sir W. Thomson said it was impossible to take meteoric dust separately from whatever other dust may be in the air. His reason for suggesting Canada was, that during the winter months so large an expanse was covered with snow from which no terrestrial dust would proceed. Places could be found sufficiently far from human habitation to admit of their observation being undisturbed by smoke. The glaciers of Greenland were also very suitable. The committee did not feel that the subject was yet ripe for continued observations, but he could not doubt that there was a large field for the dust committee.

High Molecular Weights.

Prof. W. Odling, M.B., F.R.S., gave an address "On the Inferences Deducible from High Molecular Weights, as Exhibited by the Oxides of Manganese." He contended that estimations of vapour-density had not had, and could not have, an absolutely determining influence, but thought these estimations always required to be checked by purely chemical considerations. In particular, he referred to the cases of bodies which had two or more distinct vapour-densities—cases which were becoming added to daily. He expressed his entire concurrence with the views as to the non-existence of two distinct forms of combination, atomic and molecular, and strongly opposed the notion that various metallic elements possessed a definite capacity of saturation. He contended that the doctrine of atomicity furnished a very inadequate idea of the most important facts of chemical combination, and that the representation of atomicity notions by graphic formulae was highly misleading. Prof. Williamson said he entirely agreed with the reader of the paper that chemical tests had always been final, and he did not think that they could be otherwise. Referring to vapour-densities, Prof. Williamson said that in all cases valuable suggestions had been derived from a study of this particular subject. He pointed out that chemists ought to be a little more cautious in interpreting their ordinary reasoning results arrived at. They were too apt to lose sight for a time of the fact that what was one thing at one temperature was not the same at another. At a low temperature they had no right to say it was the same as at a high temperature. He did not know a single body which could be proved to be the same in its chemical functions and constitution at different temperatures. It would be useful to them as chemists to keep in the habit more and more of describing bodies and their functions in relation to the particular temperature at which these particular functions were found to be exercised by them. So long as they did not do this, they would be constantly falling into statements which might be liable to misrepresentation.

Rotational Co-efficient in Metals.

Dr. E. H. Hall, of Baltimore, U.S., made a communication on "The rotational co-efficient in metals." This paper had reference to a discovery made about two years ago at the John Hopkins University, by which it was shown that when a conductor bearing a current of electricity is subjected to a magnetic force at right angles to the direction of the current, a transverse electromotive force is set up in this conductor, the direction of the transverse force being perpendicular to the plane of the primary current and the magnetic force. The term "rotation co-efficient," as here used, means the transverse electromotive force which would be set up in a conductor of square section of unit area, bearing the unit electric current, when acted upon by the unit magnetic force. Several articles upon this subject have already been published; but the present communication gives some newly-discovered facts connected with the matter. Sir Wm. Thomson said the paper was the most important that had been made to the section, whilst the discovery was the most important with regard to the properties of matter that had been made the days of Faraday.

Chemical or Magnetic Action?

A paper was read by Mr. W. Thomson "On certain Phenomena which appeared to be of the nature of Chemical Magnetic Action," from which it appeared that about two years ago he accidentally observed a peculiar phenomenon. A piece of iron had lain for some time on a piece of cloth which had been dyed with Prussian blue, and at certain points on either side of the iron the blue-colour of the cloth was discharged, and the fabric rendered white. Anxious to know whether the prussiate had simply been decomposed, or whether

the colour had actually been removed, he burned a small bit of the bleached fabric, and found that it left a perfectly white ash; when a similar piece of the blue cloth was burned an ash having a deep red colour was obtained. On further testing he found that the merest trace of iron remained in the part which was bleached. He then instituted a series of experiments, amongst these being one which consisted of placing a piece of flat iron, 2in. by ½in., on a piece of wet Prussian blue-dyed cloth, laid on a plate of glass. In a few hours the colour from the vicinity of this small bar, on either side, became fainter and fainter, and that action continued until, after a few weeks, the colour was entirely discharged in a semicircle at each side of the piece of iron for about ¾in. from the iron, whilst deep blue lines of colour seemed to flow away from the two sides of the piece of iron to distances from 1½in. to 1½in. from the iron.

Chemical Action between Solids.

Professor Thorpe, Ph.D., F.R.S., read a paper on "The Chemical Action between Solids," in the course of which he drew attention to the extremely rare instances of such action hitherto observed, showing how many of these might be explained on the supposition that combination actually occurred between the bodies either in solution or in a state of gas. He illustrated his subject with experiments in the formation of several compounds by bringing together the components in their solid form, choosing as examples such as would manifest their form by characteristic colours. After a short reference to a memoir of Professor Springe, he said one of the most remarkable results obtained by that Belgian professor was the formation of coal from peat, by subjecting the latter to high pressures. Peat from Holland and Belgium when exposed to the pressure of six thousand atmospheres was, according to Springe, changed into a mass which in all physical characteristics resembled ordinary coal. Experiments of the same kind as those of Professor Springe were made by Professor Thorpe, but they gave entirely different results.

Report on Electrical Standards.

Prof. Carey Foster read the report of the Committee on Electrical Standards. He said this was an interim report of the committee for issuing practical standards for use in electrical measurement. It appeared to the committee that in order to perform the task intrusted to them they had two principal questions to consider; first, to select or prepare a well-defined standard of accurately known absolute value for each kind of magnitude; and secondly, to take measures for making certified copies of each of the adopted standards accessible to the public. The standard magnitudes which the committee have had under consideration as yet are (1) the standard of resistance (2) the standard of capacity, and (3) the standard of electromotive force. As to the first of these, the standard of resistance, Prof. Foster gave an account of preliminary experiments on the determination of electrical resistance in absolute measure.

Report on Luminous Meteors.

Professor A. S. Herschel read the report of the committee on luminous meteors, in the course of which he referred to the aerolite which fell near Middlesbrough this year (see p. 107, Vol. XXXIII.) and imbedded itself to a considerable depth in the earth. It was estimated that it struck the earth with a velocity of 402ft. per second. There was no doubt it fell at least 40 miles. The committee recommended that, as the information they had received was of such a miscellaneous character, they should not make any further reports for a few years.—Sir William Thomson said the great majority of meteoric stones, instead of falling to the earth in a solid mass like the one produced, generally got shivered to pieces in the air through becoming so intensely hot.—Prof. Herschel observed that the stone in question had not been exposed to any great heat.—Sir William Thomson observed that in all probability some of the vegetation existing was of meteoric ancestry. The stone in question was not on the earth a quarter of an hour before it was picked up, and it was certain that it came from outside the earth. He also said there was a general consensus of sentimental belief that in many other bodies in the universe there was something like the life on this earth, but that was not a scientific belief; however science was in what might be called a sceptical condition. Life elsewhere was a possibility, and science only went the length of saying that life elsewhere was not impossible. At the same time he did not say that the sentimental belief might not be as well founded as any scientific belief, but all he could say at present was that such a belief was not founded on scientific grounds.

Dissociation of Elements.

Prof. Dewar read a paper on the alleged decomposition of elements, in which he argued that Mr. Lockyer's views regarding the existence of carbon vapour in the corona of the sun would not

bear scientific investigation, and that his views regarding the modification of the spectrum of magnesia were equally illusory, and gave no proof of the decomposition of elementary substances. Finally, he discussed Mr. Lockyer's theory of "basic" lines, and addressed himself to a refutation of them. The results recorded, he said, strongly confirmed Young's observations, and left little doubt that the few as yet unresolved coincidences either would yield to a higher dispersion, or were merely accidental. It would, indeed, be strange if among all the variety of chemical elements—and the still greater variety of vibrations which some of them were capable of taking up, there were no two which could take up vibrations of the same period. They certainly should have supposed that substances like iron and titanium, with such a large number of lines, must each consist of more than one kind of molecule, and that not single lines, but several lines of each, would be found repeated with the spectra of some other chemical elements. The fact that hardly a single coincidence could be established was a strong argument that the materials of iron and titanium, even if they be not homogeneous, were still different from those of other chemical elements. The supposition that the different elements might be resolved into simple constituents, and into a single one, had long been a favourite speculation with chemists; but however probable that hypothesis might appear *a priori*, it must be acknowledged that the facts derived from the most powerful method of analytical investigation yet devised gave it but scant support.

Pressure of Wind.

A paper prepared by Mr. F. Hawksley on "The Pressure of Wind upon a Fixed Plane Surface" was read, in which the author said:

Of the phenomenon called a "gust of wind," nothing is known, either as to its cause or as to its exceptional but almost momentary velocity, or as to the extent of the area over which it temporarily operates; but it is, notwithstanding, certain that a wind-pressure of even 40lb. on the square foot is unknown in these islands, because, as may be readily shown, that intensity of pressure would suffice to have overthrown most of the long-existing factory chimneys, to have overset most windmills, and to have scattered the greater number of the slighter-built domestic and other structures, which have, nevertheless, "weathered many a storm" and still remain intact. The conclusion of the author of the paper was that for structural calculations a *maximum* wind-pressure of 40lb. per square foot might be very safely adopted, notwithstanding some common anemometrical observations to the contrary. With regard to these observations, the author remarked that the instruments in use were little better than philosophical toys, and that in general they afforded no direct comparable or reliable indications of either velocities or pressures, and that they were often judiciously placed in many instances to record the effects of combined and therefore locally accelerated currents, while, in other instances, they recorded only the effects of obstructed and therefore locally extended currents. As the acquisition of accurate data was of great and increasing importance, the author suggested that the British Association and other learned societies interested in physical investigations should unite in providing the necessary funds and observers for the purpose. —Dr. Siemens pointed out that Mr. Hawksley had not allowed or provided for hurricanes and gales. —Sir F. Bramwell, speaking from the commercial point of view, said it would be impossible to erect bridges and other structures specially susceptible to wind-pressure which would be able to withstand any sort of hurricane or gale.

Grants made by Council.

The following grants, amounting to £1,280, were made for scientific purposes:—

THE COUNCIL.—Exploration of mountain district of Eastern Equatorial Africa, £100.

MATHEMATICS AND PHYSICS.—Mr. G. H. Darwin, lunar disturbance of gravity, £15; Dr. A. Schuster, meteoric dust, £20; Professor Sylvester, fundamental invariants (partly renewed), £80; Mr. R. H. Scott, synoptic charts of the Indian Ocean, £50; Professor G. C. Foster, standards for use in electrical measurements (partly renewed), £100.

CHEMISTRY.—Professor Dewar, present state of knowledge of spectrum analysis, £5; Professor Balfour Stewart, calibration of mercurial thermometers, £20; Professor Roscoe, wave-lengths tables of spectra of elements, £50; Dr. Hugo Müller, chemical nomenclature, £10; Professor Odling, photographing the ultra-violet spark spectra, £25.

GEOLOGY.—Dr. J. Evans, record of the progress of geology, £100; Professor Ramsay, earthquake phenomena of Japan, £25; Dr. H. C. Sorby, conditions of conversion of sedimentary materials into metamorphic rocks, £10; Professor W. C. Williamson, fossil plants of Halifax, £15; Professor A. C. Ramsay, geological map of Europe, £25; Professor E. Hull, circulation of underground water, £15.

Professor W. C. Williamson, tertiary flora associated with the basalts of the North of Ireland, £20; Dr. Sorby, British fossil polyzoa, £10; Prof. Leith-Adams, carboniferous limestone caves in south Ireland, £10; Professor Green, exploration of Raygill fissure, £20.

BIOLOGY.—Mr. F. M. Balfour, table at the Zoological station at Naples, £80; Dr. Burdon Sanderson, albuminoid substances of serum, £10; Dr. Pye-Smith, influence of bodily exercise on the elimination of nitrogen, £50; Dr. M. Foster, Zoological station in Scotland, £40; Mr. J. Cordeaux, migration of birds, £15; Lieutenant-Colonel Godwin Austen, natural history of Socotra, £100; Mr. Thiselton-Dyer, natural history of Timor Laut, £100; Mr. Stainton, record of zoological literature, £100; Professor Flower, photographs of typical races, £10.

STATISTICS.—Mr. F. Galton, anthropometry, £50.

MECHANICAL DRAWING.—V.*

By PROF. JOHN E. SWEET.

(Continued from p. 566, Vol. XXXIII.)

Instructions for Practice.

IN the first lesson it was the aim to impress the student with the importance of working with as much accuracy as possible; for upon the accuracy of the work depends the accuracy of the results. In the kind of work suggested for this lesson an entirely different principle must govern every move. Rightness is altogether a different thing from accuracy. To illustrate: A shaft, 1in. in diameter, is required or may be already in a machine. The draughtsman makes his drawing 1-32in. too large or too small, but figures it one inch. The drawing is all right, because it represents the thing as it is, or, if made to the figures, will be what is required; still it is not accurate. On the other hand, a bolt, 8in. long, may be required. The draughtsman draws it 7in. to a decimal. It will be very accurate, but an inch too short. The important thought I wish to enforce by this is, the necessity of thinking what you are about:

1st. Do not expect to arrive at anything like correct results in solving problems by the graphic method, except by careful work.

2nd. Do not fool away a lot of time in measuring the sizes of waste-oil cups, and drawing them to the 1-64 of an inch, when the size to the eighth or quarter is near enough.

The man who works with accuracy, where accuracy is required, and with indifference when

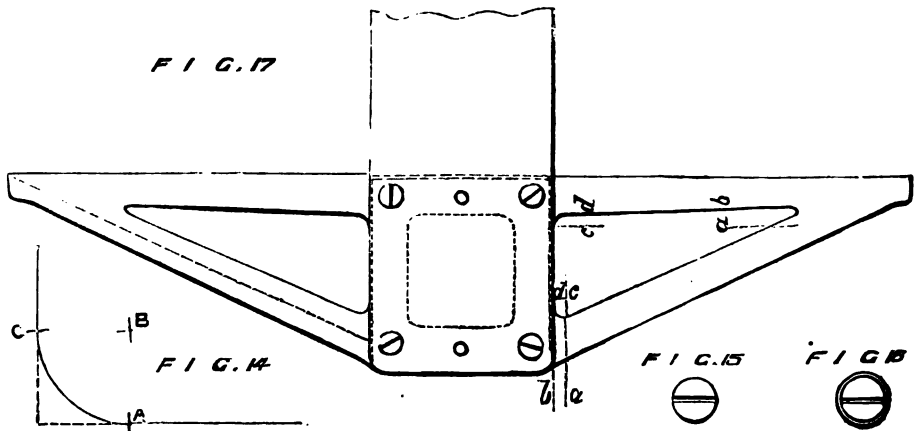
of the scale to the vertical line, run along with the pencil, counting 8, 16, 24 as you come to the full inches; 25, 26½ as you reach the $3\frac{5}{16}$ in. In this way

you soon get to feeling the $\frac{1}{16}$ th of an inch is the expression of an inch, and for the time cease to consider it as an eighth. After drawing the four lines representing the boundary of the board, determine the radius to which the corners are rounded, if rounded at all; and if you have the small bow pencil, strike them to the proper curve with it; if not, round them by free-hand. It is not an easy matter to set the compass so that a circle will blend properly with two straight lines. The following method will be found an assistance: Set the pencil-point of the bow pencil at the corner, and the needle-point on one of the lines, as at A, Fig. 14; then strike an arc, as shown at B; then place the pencil-point at C and the needle-point on the arc.

A circle struck from the centre will blend with both lines. When the drawing is to be inked, and the draughtsman is not specially expert, two lines drawn, as shown at A and C, showing where the circle should end, is a help. The circles should be inked in first, and the straight lines drawn to join them. If the original lines are drawn fine, and the ends extending too far be erased, the drawing can be gone over the second time with the pencil, and a fair-looking drawing produced by the pencil alone.

If the board has been slit in strips as heretofore recommended, the lines representing the joints can be drawn, and the spacing done by experimenting with the dividers, or without experimenting with the scale. Let us assume there are twelve strips in the board, and the drawing is 2½in. wide. If the drawing were 3in. wide, every $\frac{1}{4}$ of an inch would represent a strip; but being less, the strips are proportionally less. Now if the drawing scale is turned at an angle across the drawing until the 0 and 3in. mark of the scale coincide with the two edges of the drawing, the points can be laid off from the ½in. marks, the same as if the drawing were three inches wide. To make the drawing complete, a view of the end or side, or both, of the board must be given.

After the two lines representing the thickness of the board either above or below, or at either end, the proper length or width can be laid off by simply squaring over from the original drawing. Such a view is called by the mathematician and instructor a projection, or projecting the drawing. But if the drawings were of a machine, it would be by mechanical draughtsmen called a side, front or back view, as the case might be; if of a building,



the requirements are indifferent, is sure to be thinking of what he is about. He is not likely to make such outrageous blunders as the man who knows nothing but fine measurement, nor is he half as long about it.

In the advice given for the selection of some object to represent "something that the student has at hand" may not have been quite sufficiently explicit, for he might have a locomotive in sight and a cold chisel in his hand. Try the cold chisel first; or, better still, make a drawing at a scale of $\frac{1}{4}$, $\frac{1}{2}$ or $\frac{3}{4}$ the size of the drawing-board you are working upon. Measure the board carefully, and as there are but these general dimensions it is well to make them all and carry their dimensions in your mind, simply as discipline in that kind of memory. Do not go through the mental operation of dividing, but if you are working at, say, $\frac{1}{4}$ full size, lay your scale upon the paper and run off as many eighths as there are inches in the measurement. That is, supposing the board to be 26½in. long, with a back and vertical line to represent the bottom and left-hand end of the board, then with the zero

it would be called a front or side elevation. This is the basis of all drawings used to represent objects, and if the drawing as now finished be given to a workman, and the scale to which it is drawn designated, the workman can make another board like the original without further explanation. It is desirable, however, to put upon each drawing the dimensions in figures. It would seem that a simple sketch with the figures would be just as valuable as a complete drawing; and in this case it would be; but as the work becomes more complicated, the advantage of complete drawings becomes more apparent.

The T-square may next be taken as a good object to represent, referring to the Figs. 2 and 6 (pp. 467, 495, Vol. XXXIII.) for the methods of representation, rather than things to copy. This class of drawing, that is, the making of drawings of things already made, requires absolute fidelity in the representation. In this class of work it is better to illustrate a dozen unimportant features than omit one important one. The omission of a single line sometimes leaves an important part unintelligible. If the square is a wooden one, the kind of screws, even with which the blade is

* From the American Machinist.

fastened, should be indicated. The ordinary method of representing the common wood-screw is shown in Fig. 15, and a complete representation by Fig. 16. In making such drawings as this of the T-square, it is not unusual to break out a piece of the work in appearance, so as to get the important parts on a large scale or full size, and yet not take up the necessary paper to show the whole or unimportant parts.

If the T-square is of the steel kind, Fig. 6, refer to Fig. 17 for an enlarged view of the head. This form of head will no doubt look very plain to many. Especially those who have had free-hand, as ordinarily taught, will want to branch off into an elaborate display of scroll work, believing such ornamentation appropriate. But the moment the draughtsman begins to conceive forms of his own then he begins to be a designer; and if he will school himself in the proper principles of designing, as he advances, he will find less to unlearn in after years, and less to look back upon with regret than if he permits fancy to take the place of reason. Tools and machines should not be made ornaments. Neither should they be made ornamental, when making them so interferes in the least with their utility, their use, or with the facility with which they can be cared for, or kept clean. A strict adherence to these principles does not in the least prevent tools from possessing elegant forms, and the construction of machines possessing grace and beauty in the extreme.

If the designer cannot give graceful forms to simple things, he will not be likely to design very graceful ornaments. If he keeps within these prescribed limits, though he may not produce any very brilliant results, he is sure not to produce any ridiculous ones. Strains go in straight lines, and are best resisted, when possible, by straight bodies, with the line of strain passing through the centre, or axis of the body. These principles are embodied in this simple T-square head, and the same is applicable to the most pretentious machinery. The natural strain on the T-square head is at the ends, and must be resisted by the screws. Lines running from the end to the screws, pass as near through the centre of the arms as they well can. The accidental strains, which, in this case, are likely to be much greater than the natural ones, are likely to come from dropping the square on the floor. The worst place for it to strike would be on one end, and here the strain would be resisted in the best possible way. The arms are made widest at the centre, to resist side strain.

To determine the size of curve, to use at the junction of the brace and body of the head, I have found that the method here shown looks well. Let the altitude of all the curves be equal. That is, the distance from *a* to *b* and from *c* to *d* are the same. Any projecting arm should be the strongest, and finished with a root or curved joining, when it joins the body of the work, as a limb of a tree is tapering and joins the body of a tree with curves at the junction. In the designing of this T-square head no thought was taken of this principle, but the pattern was whittled out until it appeared to satisfy the designer, and it was afterwards found that the axis of the brace was on a line from the corner to the screw, and so it will be found with a great majority of our best-designed machinery, and all architectural styles. They have been made to look right at first, and the laws of right have been discovered afterwards.

Do not attempt to find out the right and wrong ways to represent an object, for there is no such thing as right and wrong about. Do not have any set ways or rules (conventional ways) to make your drawings. You will be a great deal happier without them. If your view of the drawing-board looks better to you with the lower and left hand end lines made twice as large as the others, make them so, unless there is some greater reason for doing otherwise. Do not try to save two cents' worth of paper by spending two dimes' worth of time and thought and bother getting three or four views, one over the other, on the same paper, in broken parts, dotted lines and the like.

THE SCIENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING.—V.*

By Professor W. GRYLLS, ADAMS, F.R.S.

(Continued from p. 9.)

Magnetic Machines.

THE same reasoning will apply to the case where a permanent magnet is used in place of the original battery current, a closed circuit being moved in the magnetic field, or a magnet moved in the neighbourhood of a fixed coil. In fact, the theory of Ampère requires that a small closed current should be equivalent to a magnetic molecule, and so a collection of equal small closed

currents, all going the same way, and occupying a given area, is equivalent to a collection of equal magnetic molecules with their poles in the same direction—i.e., to a magnet. But a collection of equal small closed currents all going the same way, and occupying a given area, is equivalent to a current around that area.

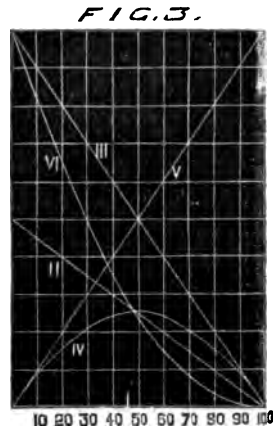
We may readily express the efficiency of magneto-electric machines by a formula. Taking *k* to be the effective work done by a unit current in one turn of the armature, and *n* the number of turns in a minute, and *C* the strength of the current, the total effective work is *Cnk*; and the work done in overcoming the resistance, *R*, of the circuit is *C²R*; hence, by Joule's and Ohm's laws, if *E* be the electromotive force,

$$EC = C^2nk + C^2R.$$

$$\text{Hence the efficiency} = \frac{C^2nk}{C^2nk + C^2R} = \frac{1}{1 + \frac{R}{nk}}$$

Thus, for a given resistance, the greater the number of turns of the machine, the greater is the efficiency, and the higher the resistance, the less the efficiency. This formula shows that machines and lamps of high resistance can only be efficient when the machines are revolving at high speed.

We may represent the efficiency of batteries or magnetic machines which are employed to drive an electromotor, such as a dynamo-electric machine, by a diagram from *La Lumière Electrique*, in which the electromotive force of the battery or exciting machine is measured on a horizontal line, and either the current or the energy expended is represented by vertical lines. The total electrical energy, represented by a straight line (III.), is the sum of the effective work (IV.), and the loss of energy by heating, &c. (VI.).



- I. Electromotive force.
- II. Strength of current.
- III. Energy converted into electricity.
- IV. Effective work in the external circuit.
- V. The efficiency.
- VI. Energy not converted into useful work.

It will be seen that when the efficiency is $\frac{1}{2}$, the greatest amount of effective work is produced, and this amount of work is $\frac{1}{2}$ the total electrical energy. Since the electromotive force is proportional to the number of revolutions a minute, this diagram gives the effective work and efficiency at different speeds.

In the case where the fixed and the movable parts of the machine are electro-magnets, and the same current passes round both, then we have—

- (1.) The action of the currents on one another.
- (2.) The action of the fixed magnetic core on the movable coil, and of the movable magnetic core on the fixed coil.
- (3.) The action of the two magnetic cores on one another.

Hence the value of *k* is of the form $a + bm + cm^2$, where *a*, *b*, *c* are constants, and *m* depends on the magnetic properties of the cores.

Each of these actions arises from the influence of two equal currents on one another, and, therefore, will be proportional to the square of the current, and to the number of turns of the coil in a minute, so that—

$$K \text{ is proportional to } nC^2(a + bm + cm^2) \text{ and the efficiency—}$$

$$\rho = \frac{1}{1 + \frac{C^2R}{K}} = \frac{1}{1 + \frac{R}{n(a + bm + cm^2)}}.$$

The most important part of the action in such machines depends on the action of the two magnetic cores one upon another. The reactions between the fixed and the movable cores produce great disturbance, in consequence of the cores not

taking up their full magnetism instantly, but requiring time for their full magnetisation. In consequence of this, in all dynamo-electric machines, it is necessary to allow the rotation to go on, through an angle determined by the retardation of the magnetism of the cores, before taking away the current from the machine to do external work; hence, in order to get the greatest current, the springs for making contact must in such cases be shifted round in the direction in which the rotation is taking place. Faraday attributed this retardation to the time required to develop the molecular currents in the molecules of the magnet.

Alternate Current Magneto-Machines.

In alternate-current machines, there is no commutator for making the current continuous; but the currents from the coil are collected and sent through the external resistance in opposite directions for every half-turn of the armature. The earliest of these was the "Alliance" magneto-electric machine, which has been adopted by the French Government for lighthouse illumination. Holmes converted this into a continuous current machine, and was the first to produce, in 1858, the electric light on a grand scale for lighthouse illumination. He afterwards removed the commutator, and again converted it into an alternate-current machine.

The four methods of placing the coils on the revolving wheel, in machines for electric lighting, which have been employed in lighthouses, have been summed up Mr. Douglass:—

1. In Holmes's magneto-electric machine, the bobbins are arranged transversely, with their axes parallel to the axis of rotation around the circumference of the wheel.
2. In Siemens' machines, the wires are lengthwise, and revolve about the long axis of the piece on which they are wound.
3. In Gramme's machines, the wires form a helix around a ring.
4. In the De Meritens machines, the wires are wound as in the Gramme, but are divided into separate parts, which are insulated from one another, and passing in succession in front of opposite poles of magnets, give off alternate currents.

The Siemens' Alternate-Current Machine.

A central disc carrying bobbins is set at right angles to a shaft, and revolves between two sets of electro-magnets ranged in circles on each side of the disc, having their axes parallel to the shaft. The bobbins have no iron cores, and so the heating caused by magnetisation and demagnetisation of the iron is avoided. The electro-magnets are excited by a small Siemens continuous-current machine.

This is similar to Wilde's dynamo-electric machine, which he produced in 1866, except that in the coils on his cast-iron disc Wilde placed soft iron cores, and arranged them so as to form eight groups of four each. The current from one of these groups excites the electro-magnets, whilst the other seven groups give out the current for external use. Among the more recent alternate-current machines, arranged so as to be excited by a separate continuous current machine, there is one which has lately been invented by M. Gramme, in which the bobbin of the continuous-current machine, which excites the magnets, is placed on the same axis with the rotating armature which gave the alternate currents, so that the two turn with the same velocity, and the combined machines run at the same rate. This is much simpler than having two machines, and it is called a self-acting machine.

From principles which I have already explained, the greatest amount of effective work or yield obtained from an alternate-current machine, driven by a separate exciter, is not more than 50 per cent. of the electrical work given out by the first machine.

Result of M. Mascart and M. Jamin's Experiments.

M. Jamin has found that, in the Alliance machine for electric light and giving alternate currents, the strength of current can be calculated by Ohm's law, considering the electromotive force as proportional to the velocity, but replacing the resistance of the bobbins by a resistance about eight times as great. The resistance to be added is proportional to the velocity of the machine.

All theoretical determinations of the efficiency of machines are complicated by the retardation of magnetisation of the magnets, which necessitates a change of position of the commutator in the direction of the rotation of the armature. If this change were not made, then it would be possible, with a bobbin in which the wire resistance was high, to get currents in opposite directions when the coil is rotated at different rates. For slow rotation, the galvanometer needle is deviated to one side; on increasing the velocity of rotation, the current is increased, at last reaches a maximum, and beyond that diminishes rapidly to

* A series of "Cantor Lectures" delivered this year before the Society of Arts.

nothing, and becomes negative; as the velocity is still increased the current reaches its greatest negative value, and then increases again, and may have several such fluctuations.

The efficiency of the Siemens dynamo-electric machine has been examined experimentally by Dr. C. W. Siemens, who has communicated the results of his investigations to the Royal Society, and by Dr. Hopkinson, whose results are published in the "Transactions of the Institution of Mechanical Engineers;" also M. Hospitalier and Messrs. Auerbach and Meyer have experimented on Gramme machines, and M. Mascart and Angot have considered the subject, both theoretically and practically, in some excellent papers which have been given in the *Journal de Physique*.

Taking the experiments of M. Hospitalier as given in *La Lumière Electrique*, we get the results, as shown in the diagram.

	Ohms.
The total resistance of the machine before the experiment, was	1.185
" " of the heated bobbin	.75
" " " electro-magnet	.72

Total 1.47

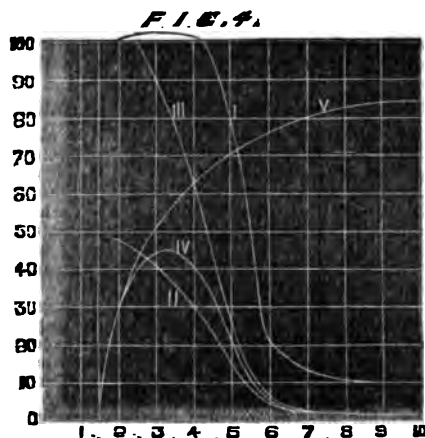
The resistances are laid down on the horizontal line to the scale of 1 c.m. per ohm.

The scale of electromotive force (I.) is 1 c.m. for 10 volts.

The scale for currents (II.) is 1 c.m. for 10 webers. The scale for work (III. and IV.) is 1 c.m. for 20 kilogrammetres.

Curve (V.) represents the efficiency—i.e., the ratio of the effective work in the outer circuit to the total work converted into electricity.

This curve expresses the ratio of the external work to the total work produced, and approaches the value unity as the resistance is increased; but for high resistances very little work is produced.



- I. Electromotive force.
- II. Strength of current.
- III. Energy converted into electricity.
- IV. Useful work in the external circuit.
- V. Efficiency.

From the curves it would appear that this Gramme machine does most effective work in the outer circuit, without greatly heating the internal circuit, when the total resistance is about 4 ohms—i.e., when the external resistance is about twice as great as the internal resistance. For less resistance the machine is greatly heated from the amount of internal work consumed, and for higher resistances the work converted into electricity becomes very small. The following numbers give the results of one experiment with the dynamo-machine:—

No. of turns a minute	1,000
External resistance	2.7 ohms
Current	25.5 webers
Electromotive power	107 volts
Total work converted into electricity	3.64 h.p.
Effective work in external circuit	2.38 h.p.

The efficiency in this case is 65 per cent. The effective work in the outer circuit is not more than 50 per cent. of the total work done to produce it.

With Gramme Machine.

In Auerbach and Meyer's experiments for 800 revolutions a minute, the maximum electromotive force is 76 volts, and for 61 volts, or two-thirds of the maximum value, there is a current of 6.5 webers through a resistance of 7.8 ohms. Below this value the current is unsteady. With Siemens's machine, a speed of 700 revolutions a minute gave a maximum electromotive force of 76 volts, and for 61 volts there is a current of 15 webers

through a resistance of .6654 ohms. With a small Siemens machine, a speed of 1,000 revolutions per minute gave a maximum electromotive force of 42 volts, and for two-thirds of this, or 28 volts, the current was 11.2 webers through about 2.2 ohms resistance.

Dr. Hopkinson has investigated the way in which the electromotive force in a Siemens machine depends on the current. He has shown that:—

- (1) The electromotive force is, for a given current, proportional to the speed of revolution of the armature.
- (2) That the electromotive force does not increase indefinitely with increasing current, but,
- (3) Only increases in the direct ratio as the current increases up to about two-thirds of its maximum value.

The current is very unstable for small changes of resistance, or of speed of engine, as long as the value of electromotive force is less than two-thirds of its maximum value. There is a remarkable difference in the ratio $\frac{E}{C}$ depending on change of speed from 600 to 700 revolutions a minute, shown in Fig. 1, where the current changes from 5 to 15 webers, for this increase of one-tenth of the speed.

As regards the relation of work converted into electrical energy to the work expended to produce it, it appears from the experiments of Mr. Schwendler and Dr. Hopkinson that, with the Siemens machines employed by them, the loss of power was from 12 to 14 per cent., so that if the external resistance of the circuit—i.e., the electric lamp, &c., be so adjusted that half the total work produced appears in the arc, then 43 or 44 per cent. of the total work expended is produced in the arc.

The results arrived at by Dr. Siemens with his latest machine on Wheatstone's principle are:—(1) That the electromotive force, instead of diminishing with increased resistance, increases at first rapidly, and then more slowly towards an asymptote. (2) That the current in the outer circuit is actually greater for a resistance of 1½ ohms than for one ohm.

With a current of 20 or 40 webers the horsepower expended was 2.44 h.p., and the effective work 1.29 h.p., giving an efficiency of 53 per cent., as compared with 45 per cent. in the ordinary Siemens machine. The maximum energy which can be converted into heat in the machine is 1.3 h.p. The new machine will give a steadier light with greater economy, and may be driven by a smaller engine.

(To be continued.)

CHEMICAL NOMENCLATURE.

THE president of the Chemical Section of the British Association, Prof. A. W. Williamson, made some observations on the present state of chemical nomenclature, which led to a discussion of the subject by many of our leading chemists. The practice of stating in a name as briefly as possible certain facts, and, as a rule, important facts, had been, as every chemist knew, the chief object of their nomenclature. But he thought that he might be permitted to say that if one looked to the composition of any result like the present nomenclature of chemistry, it was of immense importance to consider its purely intellectual principles—viz., the principles of convenience, and perhaps even of popular tastes. They found names given which, when carefully considered by chemists, told a story, but a very long story, and in a manner which was really free from ambiguity, but only by aid of a great number of syllables had produced a compound word of inconvenient length. On the other hand, amongst very common substances, that systematic process had been, he thought, to a considerably less degree adopted. The older names of commoner substances, such as salts, were to a great extent based upon facts which were true law, but which were by no means the only facts to be recalled into question. Of course, every chemist knew the great number of names that were in common use, and how far they served to recall a particular process, but only one among many processes by which the substance could be formed. On the other hand, many names had grown up from bodies which were purely empirical—names which did not recall any particular properties, but served with great convenience and without ambiguity to indicate the body. If they looked to the circumstances which affected that one condition which he had submitted as essential to names being perfectly free from ambiguity, there was perhaps hardly one condition more practically important than this. That there should be in the names as little change as possible, and more especially when a name that had once been given had come to be used in relation to particular substances. It was in the memory of chemists that changes of name had taken place not only when a

particular substance was recalled, but that there was also a considerable number of cases showing that the name given at one time to one body was afterwards given to another. After expressing the hope that the subject would be dealt with by his colleagues, the president concluded an interesting address.—Prof. Roscoe said there were probably few chemists who would agree on every point raised by Prof. Williamson, as the subject was one on which there was great diversity of opinion. But he felt that the president had put the matter before them in a very clear way, and had shown them what principles their nomenclature should be based upon. He would not think of entering into any particular point, but he thought the section might as well be informed that a committee had been formed for the purpose of considering the historical development of the question, and he hoped some general mode and some general arrangement might be come to in the matter. He felt bound to say that, looking at the present state of the science, he could not see how it was possible to come to any other nomenclature than that which they now adopted, for unless they adopted a merely mechanical method of naming their compounds, he could not see what advantage would be derived by the change.—Prof. Odling held that the certain names were infinitely preferable to the names applied at the present time to different compounds.—Prof. Thorpe remarked that the main point of Prof. Williamson's address, as explained in his examples, appeared to bear on the abandonment of the word "acid." The conclusion that the term ought to be abandoned had been forced upon him during his experience as a sub-examiner at the London University. No one could form an idea of the confusion that was brought into the teaching of chemistry by the use of the term "acid," and he thought they would be doing a real service if they could get rid of it, inasmuch as perplexity and confusion would only remain so long as it remained.—Dr. Gladstone expressed his satisfaction that the matter had been brought forward, and that it was to be looked into. The subject was really of greater importance than appeared on the surface. It appeared to him desirable that they should, as far as possible, put their house in order in respect to their nomenclature.

THE CAUSES OF VOLCANIC ACTION.

THE causes of volcanic action formed the subject of a paper read by Prof. Prestwich at the meeting of the British Association, which was followed by an animated discussion:—The author said that the hypothesis generally accepted in this country is that of the late Mr. Poulett Scrope, who considered that "the rise of lava in a volcanic vent is occasioned by the expansion of volumes of high-pressure steam, generated in a mass of liquefied and heated matter within or beneath the eruptive orifice." According to his view, the expulsion of the lava is effected solely by high-pressure steam, generated at great depths, but at what depths is not mentioned, nor is it explained how the water is introduced, whether from the surface or whether from water in original combination with the basic magma. The objections to this hypothesis are—1st, that during the most powerful explosions—i.e., when the discharge of steam is at its maximum, the escape of lava is frequently at its minimum. 2ndly, that streams of lava often flow with little disengagement of steam, and are generally greatest after the force of the first violent explosion is expended. 3rdly, that it is not a mere boiling over, in which case, after the escape of the active agent—the water—and the expulsion of such portion of the obstructing medium, the lava, as became entangled with it, the remaining lava would subside. Of the important part played by water in volcanic eruptions there can be no doubt; but instead of considering it as the primary, Prof. Prestwich viewed it as a secondary cause in volcanic eruptions. All observers agree in describing ordinary volcanic eruptions as generally accompanied or preceded by shocks or earthquakes of a minor or local character, to which succeed paroxysmal explosions, during which vast quantities of stones, scoria, and ashes, together with volumes of steam, are projected from the crater. The first paroxysms are the most violent, and they gradually decrease and then cease altogether. The flow of lava, on the other hand, which commences sooner or later after the first explosions, is continued and prolonged independently. Ultimately the volcano returns to a state of repose, which may last a few months or many years. Unfortunately, very little is known of the substrata of volcanoes. Etna and Hecla apparently stand on permeable Tertiary strata, Vesuvius on Tertiary and Cretaceous strata, while in South America some of the volcanoes are seemingly situated amongst paleozoic and crystalline rocks. Under ordinary circumstances all the permeable strata and all fissured rocks become charged with water up to the level of the lowest

point of escape on the surface, or if there should be an escape in the sea-bed, then to that level, plus a difference caused by friction. When undisturbed, the underground fissures and cavities of the volcanic materials forming a volcano must soon become filled by the infiltration of rain-water from the surface, while the strata on which they rest are charged, or not, with water, according as they are permeable or impermeable—following the usual laws affecting underground waters. No eruption of lava can then take place without coming in contact with these underground waters. The first to be affected will be the water in the cavities of the mountain in and around the crater. As the pressure of the ascending column of lava splits the crust formed subsequently to the preceding eruption, the water finds its way to the heated surface, and leads to explosions more or less violent. When the fluid lava breaks more completely through the old crust, and the mountain is fissured by the force and pressure of the ascending column, the whole body of water stored in the mountain successively flows in upon the heated lava, and is at once flashed off into steam. As the more superficial waters of the superincumbent lavas and ashes are exhausted, the springs in the deeper underlying strata, cut through by the fissures in which the main ducts are situated, come into play, and varying with the pressure consequent on the rise and fall of the column of lava, discharge their contents more or less rapidly in those ducts, where, when they reach the point, when pressure permits, they flash into steam and rise in vast bubbles of vapour to the surface of the land. As the underground springs fed by the rainfall are exhausted by the expulsion of the large volumes of water converted into steam, another agent comes into operation. The surplus water, one portion of which usually goes to feed the surface springs, while another portion passes through the permeable strata into the sea-bed, is not only removed, but the level of the underground waters in the sedimentary strata is so lowered that the hydrostatic pressure is no longer equal to that exercised by the column of sea-water, so that, instead of an outflow from the land, an inflow from the sea necessarily takes place through the same channels or strata, and thus, taking the place of the displaced fresh water, finds its way to the volcanic ducts. In conclusion, Prof. Prestwich said he conceived that the first cause of volcanic action is the walling up of the lava, in consequence of pressure due to slight contraction of a portion of the earth's crust. Secondly, the fluid lava coming into contact with water stored in the crevices of the masses of lava and ashes forming the volcano, the water is at once flashed into steam, giving rise to powerful detonations and explosions. Thirdly, follows an influx of water from the underlying sedimentary or other strata lying at greater depths into the ducts of the volcano; and, lastly, as these subterranean bodies of water are thus converted into steam and expelled, the exhausted strata then serve as a channel to an influx of sea-water into the volcano.—Prof. Seeley thought it was better to take the point of view that the earth was already cooled rather than to get rid of the difficulty raised by Mr. Mallett by assuming other difficulties in the supposed pasty mass below.—Dr. Evans said that although Professor Prestwich had not dwelt so much as some would have wished on the connection of chemical heat and volcanoes, they were much indebted to him for showing the connection of water with volcanoes.

THE COLOUR-SENSE IN LOWER ANIMALS.

DURING the meeting of the British Association, Sir John Lubbock, the President, read an interesting paper before the department of zoology and botany, describing experiments he has made on the colour-sense of some of the lower animals. In the course of his remarks he said:—Most botanists are now agreed that insects, especially bees, have played a very important part in the development of flowers. While in many plants, almost invariably with inconspicuous blossoms, the pollen is carried from flower to flower by the wind, in the case of almost all large and brightly-coloured flowers this is effected by the agency of insects. In such flowers the colour, scent, and honey serve to attract insects, while the size and form are arranged in such a manner that the insects fertilise them with pollen brought from another plant. Nevertheless, these views have not escaped criticism. M. Bonnier, for instance, has attempted to show that they are in many respects untenable. I do not propose on the present occasion to follow his general argument, but merely that portion of it relating to colour. In order to test whether and how bees are affected by different colours, I tried the following experiment. I took slips of glass of the size generally used for slides for the microscope—viz., 3in. by 1in.—and pasted on them slips of paper, coloured res-

spectively blue, green, orange, red, white, and yellow. I then put them on a lawn in a row about a foot apart, and on each put a second slip of glass, with a drop of honey. I also put with them a slip of plain glass with a similar drop of honey. I had previously trained a bee to come to the spot for honey. My plan then was, when the bee returned and had sipped for about a quarter of a minute, to remove the honey, when she flew to another slip. This, then, I took away, when she went to a third, and so on. In this way I induced her to visit all the drops of honey successively. When she had returned to the nest, I transposed all the upper glasses with the honey, and also moved the coloured glasses. Thus, as the drop of honey was changed each time, and also the position of the glasses, neither of these could influence the selection by the bee. In recording the results, I marked down successively the order in which the bee went to the different coloured glasses. For instance, in the first journey from the nest the bee lit first on the blue, which, accordingly, I marked one; when disturbed from the blue, she flew about a little, and then lit on the white; when the white was removed, she settled on the green; and so successively on the orange, yellow, plain, and red. I repeated the experiment 100 times, using two different hives, and spreading the observations over some time, so as to experiment with different bees and under varied circumstances. The precautions taken seem to me to have placed the different colours on an equal footing; while the number of experiments appears sufficient to give a fair average. It will be observed also that the different series agree well among themselves. The difference between the numbers is certainly striking. Adding together 1, 2, 3, 4, 5, 6, and 7, we get 28 as the total number given by each journey; 100 journeys therefore give, as the table shows, a total of 2,800, which, divided by seven, would, of course, if no preference were shown, give 400 for each colour. The numbers, however, are—for the blue, only 275; for the white, 349; yellow, 405; red, 413; green, 427; orange, 440; and plain glass, as many as 491. A second mode of testing the result is to take the percentage in which the bees went respectively to each colour—first, second, third, and so on. It is found that out of a hundred rounds the bees took blue as one of the first three in 74 cases, and one of the last four only in 26 cases; while, on the contrary, they selected the plain as one of the first three only in 26 cases, and one of the last four in 75 cases. On the whole, then, it seems clear that bees are affected by colour, and that their favourite colour is blue. M. Paul Bert has made some very interesting experiments on the small fresh-water crustacean belonging to the genus daphnia, from which he concludes that they perceive all the colours known to us, being, however, specially sensitive to the yellow and green, and that their limits of vision are the same as ours. Sir John Lubbock then described his own experiments with daphnia under different parts of the spectrum, and concluded by saying, "It seems to me, therefore, though I differ with great reluctance from so eminent an authority as M. Paul Bert, that the limits of vision of daphnias do not, at the violet end of the spectrum, coincide with ours, but that the daphnia, like the ant, is affected by the ultra-violet rays."

SMITH'S PATENT CAMERA.

THIS camera has been specially designed for the use of those who, while desiring to obtain results of the highest class, prefer the weight of the apparatus reduced to a minimum. The inventor claims to have produced a camera which, although combining every possible movement of back and front, is not only very much lighter than any equally efficient apparatus, and by the simplicity of its mechanical construction, is economical in cost. At first sight the camera differs little in appearance from an ordinary folding camera, being merely two polished mahogany frameworks, each about an inch in depth, with the leather bellows packed away inside. The base-board, however, is quite detached, and in use the front and back frames are each attached to it by a separate thumbscrew. Fittings to suit these are let into the side and end of the frames, so that the camera can be set up either vertically or horizontally. The fitting to the back frame is a modification of a ball and socket, or universal joint, which allows of the back being fixed at any angle to the axis of the lens, and so forms a compound swing-back. The front would appear to be somewhat heavier than needful, but is so made for the sake of the firmness, so essential for instantaneous pictures, which now form an important feature of outdoor photography. The fronts slide in grooves in the ordinary way, but the usual screws and plates for fixing them are dispensed with, as by a simple and ingenious arrangement of springs they stop securely in position wherever placed. The range of focus will be governed by the length of the base-board, which is normally about 2in. longer

than the plate; thus a 3-plate camera will have a range of focus from about 2½in. to 8½in., or more if required, by increasing the length of the base-board. The latter is fitted with a series of holes through which the thumbcrews fixing the camera pass, the focus being first approximately obtained by the distance between the screws. A focussing-screw completes the adjustment of focus. This screw, contrary to usual practice, is made of fine pitch, as after a preliminary trial the exact focus of any lens for landscape work can be marked on the base-board, and will rarely require even the slightest adjustment. The fine screw will give this adjustment with the greatest ease and accuracy. The base-board is also made to do duty as the stand-head, the legs of the stand being fitted directly to pins fitted in it. This is necessary because the whole of the central axis of the base-board may be required for the various positions of the thumbcrews, when lenses of different foci are employed. The stand is of novel construction, and although very light, weighing only 1½lb., is sufficiently firm. Mr. Woodbury says of it, "I have tried a good many stands in my time, but your new one pleases me most, combining as it does, the two essential qualities, firmness and lightness." Each leg consists of three rods riveted together near one end. The centre one swings round and is arrested by a stop when in a line with the two outer ones, which are then opened out and stretched on to the stand head (base-board). The leverage thus obtained grips the centre leg, and with the stop renders it quite firm. Thus it is simplicity itself, requiring no fastening of any kind. The dark slides are also a special feature, and have been made with the greatest care so as to be absolutely light-proof. They are made on the principle now generally adopted in America, the shutters drawing completely out, an automatic cut-off or inner spring shutter closing the aperture through which they pass. The shutters are made of ferrotype plate, and are, therefore, very light, very inexpensive, and occupy but little space. Against the one drawback, that of being easily bent, must be set also the ease with which accidental injury can be smoothed out, and the facility with which, in case of greater damage, new ones can be procured, the material being a current article of commerce, and easily cut to shape. The total weight of a half-plate camera, with 3 double backs and 4ft. 6in. folding stand, is 4½lb.

The inventor is Mr. George Smith, manager of the Sciopticon Company, London, by whom it is manufactured under the name of the Perfect Pocket Camera.

DESTRUCTIVE DISTILLATION.

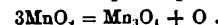
By ALFRED H. ALLEN, F.I.C., F.C.S.

WHEN non-volatile organic substances are subjected to heat in a close vessel they undergo "destructive distillation."

Many substances which can be distilled without decomposition when cautiously heated undergo destructive distillation when heated rapidly, or in admixture with inorganic matters, such as sand or clay.

The presence of oxygen, sulphur, nitrogen, &c., in the substance heated gives rise to products containing these elements. When the heat is applied gradually, the products first obtained usually contain the largest proportion of oxygen, the distillates becoming more highly hydrogenated and carbonated as the temperature rises.

The nature of the decomposition which takes place on heating is indicated by the term "cumulative resolution." A familiar instance of this action occurs in inorganic chemistry, when manganese dioxide is heated to full redness. Three units of the substance then decompose in partnership, thus—

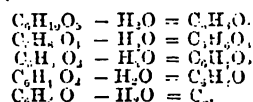


Another example is furnished by the action of heat on ordinary phosphate of sodium (hydrogen-disodium phosphate).



In a similar manner when glycerin is heated, polyglycerins are formed by the loss of the elements of water.

A similar mode of decomposition is common to all poly-alcohols. Thus, in the case of woody fibre (cellulose) we may have the following series of changes:—



In practice, the bodies formed are not those indicated by the above formulae, but polymers of these.

The above processes, complicated by other

* From advance sheets of "Commercial Organic Analysis," Volume II.

reactions, occur in the natural formation of coal from cellulose, as also in the artificial distillation of wood.

By analogous reactions occurring simultaneously with the above, oxides and hydrides of carbon are formed, and are condensed in the receiver or pass away as permanent gases. The nature and proportions of these bodies obtained will be largely dependent on the character of the substance distilled, the temperature of the retort, and other conditions. When the heat is very moderate the hydrocarbons produced are chiefly of the series known as the "paraffins," having the general formula, $C_n H_{2n+2}$, of which marsh-gas is the first member; but as the higher members of the series readily split up into lower members and hydrocarbons of the formula $C_n H_{2n}$, the latter bodies are always simultaneously obtained. By further degradation, hydrocarbons allied to acetylene are formed, whilst benzene and its homologues contain a still smaller proportion of hydrogen.

When the temperature is very high, hydrogen, acetylene, benzene, and naphthalene are the chief unoxxygenated products. Thus, coal being distilled at a high temperature for the manufacture of coal-gas, the liquid hydrocarbons consist chiefly of benzene and its homologues, and naphthalene.

At a dull red-heat, such as is employed for the distillation of bituminous shale, the liquid products are wholly free from benzene and naphthalene, whilst little or no hydrogen or acetylene is present in the gases. On the other hand, the liquid products are rich in paraffins and olefins, with some anthracene and chrysene; and it is a remarkable fact that the oxygenised and nitrogenised products consist chiefly of phenols of the formula $C_n H_{2n-1} OH$ and bases of the formula $C_n H_{2n-1} H$ (pyridine bases), although the corresponding hydrides, $C_n H_{2n-2}$, H —i.e., benzene and its homologues, are wholly absent.

As a rule, when the temperature of the distillation is low, a large yield of liquid products is obtained, together with a low yield of gas of high illuminating power. At a high temperature, a maximum production of gas of low illuminating-power results, while the proportion of liquid products is small. The higher the temperature of the retort, the larger the percentage of solid carbonaceous residue (coke or charcoal) left in it.

The following table indicates the general nature of the more prominent organic products of the dry distillation of coal, bituminous shale, peat, and wood, as the processes are carried on in practice. To facilitate comparison the leading organic constituents of natural petroleum are shown in juxtaposition with the products of the various artificial destructive distillations:—

Organic Products.	Coal.	Bituminous Shale.	Peat.	Wood.	Petroleum.
<i>Hydrogen</i>	large	traces	large	large	present
<i>Gaseous Hydrocarbons—</i>					
Marsh Gas and Homologues	large	large	large	considerable	present
Olefins	large	large	..	..	present
Acetylene	present	none	..	..	..
<i>Liquid and Solid Hydrocarbons—</i>					
Liquid Paraffins	small	large	considerable	absent	very large
Solid Paraffins	traces	considerable	present	present	moderate
Liquid Olefins	small	very large	moderate	..	considerable
Liquid Acetylenes	present	present	..	..	..
Benzene Hydrides or Paraffenes	?	?	?	?	considerable
Benzene and Homologues	large	none	..	moderate	present
Naphthalene	large	none	..	moderate	none
Anthracene	moderate	trace	..	..	present
Chrysene	moderate	considerable	..	present	present
<i>Oxygenated Bodies—</i>					
Acetic Acid	present	present	large	large	..
Methyl Alcohol	none	..	considerable	considerable	..
Phenols	large	present	..	moderate	..
Oxyphenols (Creosote) ..	none	none	..	considerable	..
<i>Nitrogenised Bodies—</i>					
Aniline bases	present	none	..	..	..
Pyridine bases	considerable	considerable	..	..	..
Acridine	present	..	..	..	..
Carbazol	present	..	..	..	..

It will be seen from this table that the products of the distillation of each of the raw materials contain certain characteristic bodies. Thus, oxygenated products are found most largely in the products of the distillation of wood; paraffins are especially characteristic of petroleum; olefins, and, to a lesser extent, paraffins of the distillation of shale; whilst coal-tar is remarkable for the large proportions of benzene and naphthalene contained in it.

JAPANNING AND JAPANS.

WHEN finished wood, papier-mâché, composition, or metals are varnished in the usual manner and left to dry in the air, the drying is in most cases imperfect, and the coating more or less uneven. If the surface thus varnished is heated for some time to a temperature of from 250° to 300° Fah. or higher, it is found that the whole of the solvent or vehicle of the gums or resins in the varnish is soon driven off, and the gummy residue becomes liquefied or semi-liquefied, in which state it adapts itself to all inequalities, and if the coating is thick enough, presents a uniform glossy surface, which it retains on cooling. This process of drying out and fusion secures a firm contact and adhesion of the gums or resins to the surface of the substance varnished, and greatly increases the density of the coating, which enables it to resist wear and retain its gloss longer. This process of hardening and finishing varnished or lacquered work by the aid of heat constitutes the chief feature of the japanner's art. In practice the work to be japanned is first thoroughly cleansed and dried. If of wood, composition, or other porous material, it is given while warm several coats of wood-filler, or whiting mixed up with a rather thin glue size, and is, when this is hardened, rubbed down smooth with pumice stone. It is then ready for the japan grounds. Metals as a rule require no special preparation, receiving the grounds directly on the clean dry surface. In japanning, wood and similar substances require a much lower degree of heat, and usually a longer exposure in the oven than metals, and again a higher temperature may be advantageously employed where the japan is dark than when light-coloured grounds are used; so that a definite knowledge of just how much heat can be safely applied and how long an exposure is required with different substances and different grounds can only be acquired by practical experience.

The japanner's oven is usually a room or large box constructed of sheet-metal, and heated by stove-drums or flues, so that the temperature—which is indicated by a thermometer or pyrometer hung up inside, or with its stem passing through the side wall midway between the top and bottom of the chamber—can be readily regulated by dampers. The ovens are also provided with a chimney to carry off the vapours derived from the drying varnish, a small door through which the work can be entered and removed, and wire shelves and hooks for its support in the chamber. The ovens must be kept perfectly free from dust, smoke, and moisture.

A good cheap priming varnish for work to be

red, vermilion or Indian red; green, chrome green or Prussian blue and chrome yellow; blue, Prussian blue, ultramarine, or indigo; yellow, chrome yellow, &c. But black is the hue commonly required. The following are good common black grounds:—

1. Asphaltum, 1lb.; balsam of capivi, 1lb.; oil of turpentine, q. s.

The asphaltum is melted over a fire, and the balsam, previously heated, is mixed in with it. The mixture is then removed from fire and mixed with the turpentine.

2. Moistened good lampblack with oil of turpentine, and grind it very fine with a muller on a stone plate. Then add a sufficient quantity of ordinary copal varnish and rub well together.

3. Asphaltum, 3oz.; boiled oil, 4qts.; burnt umber, 8oz.; oil of turpentine, q. s. Melt the asphaltum, stir in the oil, previously heated, then the umber, and, when cooling, thin down with the oil of turpentine. An extra fine black is prepared from: Amber, 12oz.; asphaltum (purified) 2oz.; boiled oil, half a pint; resin, 2oz.; oil of turpentine, 16oz. Fuse the gum and resin and asphaltum, add the hot oil, stir well together, and when cooling, add the turpentine. A white ground is prepared from copal varnish and zinc-white or starch. Large japanners seldom make their own varnishes, as they can procure them more cheaply from the varnish-maker. From one to six or more coats of varnish are applied to the work in japanning, each coat being hardened in the oven before the next is put on. The last coat in coloured work is usually of clear varnish, without colouring matters, and is, in fine work, sometimes finished with rottenstone and chamois. For ordinary work, the gloss developed in the oven under favourable conditions is sufficient.—*Scientific American*.

SCIENTIFIC NEWS.

THE death is announced of Mr. Frederick Currey, F.R.S., F.L.S., a well-known botanist and fungologist. For 20 years he was secretary of the Linnean Society, and at his death, which took place last week, he was treasurer and vice-president. Mr. Currey was born in August, 1819. His valuable collections of fungi are by his direction to be sent to Kew.

Mr. Richard Clewin Griffiths, who died last week, was the Father of the Apothecaries' Company, and was master 27 years ago. He was a member of many of the learned societies and one of the founders of the Zoological and the Botanical Gardens. He was one of the first to commence general medical practice, from which, however, he retired in 1850. He had reached the ripe age of 90 years.

The attendance at the meeting of the British Association, though falling short of the numbers at such meetings as those of Glasgow, Newcastle, and Liverpool, amounted to a total of 2,556, the number of Associates' tickets issued being 1,232; of ladies, 514; and foreign members, 24.

On the motion of Sir John Lubbock, the council were requested to take steps to ascertain the feeling of foreign scientific societies as to the advisability of holding an international congress.

One of the most interesting reports presented to the meeting was that of the committee on the migration of birds. Observations have been received from 103 lighthouses and lightships, which show that migration of one species of birds or another is almost continually going on; but the great migrations are in the autumn and spring. From the facts gathered at lighthouses and lightships, it appears certain that many thousands of birds must perish at sea. The white fixed lights attract the greater number of birds, the mortality at Skerryvore for October, 1877, amounting to no fewer than 600, chiefly the common thrush and the ring-ousel. Revolving lights are also fatally attractive, for at the Casquets, during the four hours from 11 p.m. to 3 a.m., October 7, with the wind S.S.E. and rain, landrails, water-rails, woodcocks, ring-ousels, song thrushes, and swallows were seen around the light, and of these there struck the glass and killed themselves, one landrail, one water-rail, four ring-ousels, and no fewer than 100 swallows. The larger birds do not often strike the glass in the revolving lights, but follow the rays. So far the observations show that all birds, with few exceptions, are migratory—even sparrows, which invariably leave Heligoland before the end of September.

At the meeting of the Balloon Society held

last week, the president, Mr. Le Fevre, gave an account of the electrical stationary balloon, invented by M. Jules Godard and M. de Fonvielle. In the centre of the car, poised on a vertical axis, is a disc, which is in an electric circuit, and by some means, not clearly explained, keeps the car in equilibrium. The current, derived from a Faure battery, is also employed to work a small screw, so that the balloon can neither ascend nor descend. Mr. Le Fevre said the result would be that "the law of gravitation would be overcome, and that we should be able to suspend a body in the air at any altitude, and in any position."

Mr. Edison has, it is said, offered to light some shops at the West-end, with incandescent lamps for six months free of all charge.

The difficulty in connecting light-ships with the shore, by means of telegraph cables, appears to lie in the fact that a suitable connection at the ship-end is wanting. In storms these vessels pay out cable by an automatic arrangement—sometimes many fathoms—and an apparatus is wanted which will also pay out the electric cable.

A statue is to be erected in Franche Comté to Claude de Joffroy, who is said to have invented steam-vessels about 1751. At Boulogne, a statue was inaugurated on Monday to Frederic Sauvage, the inventor of the screw propeller, which he exhibited in 1832. In 1835 our Government offered Sauvage a sum of money on the condition that the invention should become the exclusive property of England; but although Sauvage was poor, he declined the offer. He died in the Picpus asylum at the age of 71, a pensioner of the State.

Prof. Cantoni has been appointed director of the meteorological observatory, to be erected at Pavia. Observations are to be made on the influences of light, heat, and electricity upon vegetable growth, in addition to the ordinary meteorological and magnetical work.

The idea of propulsion by means of the screw seems to have occurred to the fertile mind of Leonardo da Vinci towards the end of the fifteenth century. It is well known that he was all his life more or less occupied with the problem of flight, and in one of his works is a drawing (reproduced by M. Govi in a note in *Comptes Rendus*), which represents a large helix made, as the descriptive notes indicate, of iron wire with linen cloth having its pores stopped with starch, and connected by cords to a disc supporting the axis. This instrument (he says), if well made and whirled rapidly, would rise, screw-like, in the air. He seems to have made small paper models, the axis of which consisted of a thin slip of iron, which was twisted, and then left to itself, giving the necessary motor-force. M. Govi also furnishes proof that this remarkable genius conceived the idea of the parachute. If a man had a tent of starched cloth (he says) 12 "braccia" square and 12 high, he might throw himself from any height without fear of danger. (A drawing is added.)

In the Norwegian division of the Paris Exhibition there is shown a woodpecker caught by its beak on the top of a telegraph-post. The naïve account given informs you that this poor bird became a victim of the sound produced by the telegraph wires, which it mistook for that of certain insects on which it feeds. According to *L'Electricité* the sound of this vast Æolian harp, formed by telegraph lines, has produced other effects not less singular. Thus wolves have completely disappeared, because of it, from districts where they were previously numerous.

The regular administration of salicylic acid to cattle as a preservative against spleen disease (called *sang de rate*), is known to have been practised some time by Herr Ludloff, a cattle-breeder, near Gotha, with the best results. It has been alleged that such treatment is prejudicial to reproduction. Herr Ludloff shows by statistics, however, in a letter to Dr. Quesneville (*Mon. Sci.*) that, given in the small quantities he specifies, one gramme a-day per head of large cattle, it has no such effect. The experience ranges over four years and a half.

Feeding cows with green maize has been lately under consideration in France. In a note to the *Journal d'Agriculture Pratique* M. Genay gives his experience in this matter. With proper manuring he got as much as 155,000 kilogrammes of maize per hectare. He says the cows don't take to this fodder very well. They have to be

gradually habituated to it, by mixing the maize at first with bran and oilcake. But in a few days they will eat enormous quantities of maize alone so long as it is green and tender. (They are previously fed about three months with clover alone.) Now, whenever the maize régime is fairly started one notices three things: (1) The quantity of milk diminishes; likewise (2) the proportion of the cream to the milk; and (3) less butter is obtained from the milk. The butter, too, becomes white like that of winter. These effects are more pronounced as time goes on. They may be counteracted with a little bran and oilcake. M. Genay finds it still advantageous to sow a certain quantity of maize, because in years with a very dry summer, this fodder may prove a valuable aid in the maintenance of the cows.

M. Decharme has begun the study of a new kind of figures produced thus: Red-lead, in fine powder, is diluted with water, and a horizontal glass-plate is covered with a thin layer of the mixture, on which drops of the same mixture are then let fall. One thus gets pretty regular figures formed of red-lead arranged in extremely fine radii, and in concentric rings, the whole forming very varied designs, according to the thickness of the layer or that of the drop received, and especially according to the length of fall. The figures have apparently some analogy to those of circular plates, studied by M. Decharme. One may obtain, according to experimental conditions, the three systems of acoustic figures observed by Ohlrad, *diametral*, *circular*, and *compound* figures. In M. Decharme's experiments these systems generally coexist; but one or other may be made to predominate at will.

A correspondent of *Les Mondes*, M. Voitelier, describes a contrivance of his to prevent birds flying, without recourse being had to any mutilation or cruel operation on the bird. It consists of a small (partly skin-covered) chain, one end of which passes round the first feathers of the wing, while the other passes round the body of the wing, and is attached to a sort of swivel in the middle. The bird can move the wing freely, but cannot extend it sufficiently for flight. In position, the fetter is quite invisible, and the bird retains its elegance and ease of movement. M. Voitelier applies his system to peacocks, ducks and fowls; often, also, to birds of high value, but somewhat wild. He keeps numbers of pheasants and partridges in his garden, till he has occasion to let them loose, when they escape as readily as if they had been reared in the woods. Several gamekeepers have adopted his fetter. In the close season the pheasant breeders have been accustomed to collect all the birds required for reproduction, and to inclose them within netting till hatching was over; (inclosed in wire-work these wild birds sometimes kill themselves). But their wings must not be cut, for they have to be set at liberty in a few months. Accordingly the fetter has proved very acceptable, as extensive inclosures may be dispensed with.

The absorption of ultra-violet rays by certain media is being investigated by M. De Chardonnet. One method adopted is to direct a beam through a liquid in a trough with parallel glass or quartz sides, to Poitevin's photochromic paper (which indicates, by change of tint, the presence of actinic rays). In a second method, a solar beam from a heliostat is sent through a slit, an objective of quartz and Iceland spar, and a prism of the spar, to a photographic plate or fluorescent screen; then a trough half filled with liquid is put before the slit. The author finds that the liquid circulating in plants, or impregnating roots and fruits have all an avidity for chemical rays. Fluorescence does not seem to be directly related to intensity of actinic absorption; thus decoction of radish absorbs less than decoction of potatoes, yet the former is without the property, while the latter is not. White wine is weakly fluorescent; red wine does not fluoresce. Of the few animal liquids examined, blood is found a powerful absorbent; but the aqueous humour of a calf's eye, and the albumen of eggs, have no action on chemical rays. Distilled water, alcohol, sulphuric ether, collodion, and solution of cane sugar are also inactive. Gelatine intercepts all the chemical rays, and it is sensibly fluorescent. Comparing two simple photographic objectives, of equal focus, one made by Darlot, of Paris, the other by Dallmeyer, of London, the author found the latter considerably more transparent.

It gave an invisible spectrum 25 to 40 per cent. longer than the other.

A simple lecture method of producing the Lissajous figures with sand, is described by Dr. Weinberg in *Carl's Repertorium*. From the upper corners of a rectangular frame, two cords converge to a point, where they pass through a small piece of thin lead pipe, then down vertically to a little ball of lead hung to them. A piece of cork is adapted to the ball, so as to hold a test-tube filled with fine sand, and drawn out to a fine point with aperture below. A large sheet of paper is placed underneath. The ball being drawn obliquely out of the position of rest, and let go, and the finger that has been applied to the hole of the test-tube withdrawn, the formation of the Lissajous curves on the paper commences. The pendulum can be shortened or lengthened by an arrangement on one side, which admits of the cord being pulled in or let out.

USEFUL AND SCIENTIFIC NOTES.

Machinery for Aerial Navigation.—Monsieur Capel and the Rev. A. de la Panze obtained provisional protection for an invention which is thus described:—The object of our invention is to provide an aerial locomotive which will be at once economical in its working, speedy, buoyant, and dirigible. Hitherto in most of the machinery or apparatus employed for navigating the air too much attention has been paid to buoyancy at the expense of dirigibility, thus allowing the car and balloon to be more or less, if not entirely, at the mercy of currents of air. Our invention consists in a suitable car or boat built as lightly as is consistent with strength. We may construct it of bamboo, or of the light weldless steel tubing now manufactured, the whole being trussed or stayed together in the strongest yet lightest manner. The framing may be covered with oiled silk or any suitable light air and waterproof covering. In the centre of the car we place a light strong mast or pillar, on the top of which a large light extended plane surface is balanced or suspended, proportioned to the weight and force of the car or boat, and preferably consisting of a light framing over which a covering of oiled silk, light varnished or coated canvas, or other suitable air-proof material is rigidly stretched. This plane may be inclined either upwards or downwards. Supports or stays extend from the mast or pillar to the ends of the boat or car carrying bearings, and in each bearing is mounted a Hooke's, ball-and-socket, or other form of universal joint, to which a fan or propeller is attached, so that the fans or propellers driven by motive power propel the car or vessel, and, receiving lateral motion from the gearing, steer the vessel. The propellers may be actuated by light steam, gas, or other explosive, or by electric or other engines, or by air or gases compressed into tanks at stations, and these tanks carried by the car and their expansive contents used to actuate the engines. We mount the car on light wheels, which may be fixed on elliptical or other springs to ease the bumping of the car on touching the ground. In using the apparatus the plane surface above the car is fixed in a horizontal position, and the latter being placed on a level road, the engines are started and the car runs forward. The plane surface is then inclined upwards, which lifts the car. When the desired elevation is reached, the plane surface is gently lowered to a horizontal or nearly horizontal position, and the propellers still continuing to revolve, the car travels horizontally forward. To descend, the plane-surface is inclined in the downward direction. The descent is facilitated by steering the apparatus in a circular direction.

AMONG the latest uses to which it is proposed to put the electric light is the illumination of rivers to permit the rafting of logs at night. The Muskegon Boom Company will be the pioneers in this direction. In Baltimore experiments have been made with a view of illuminating water at night to a depth of 200ft. Such a means of illumination, it is believed, would be of great service in searching for lost treasure and drowned persons, in raising wrecks, removing torpedoes, and other subaqueous labours.

At the Royal Manchester and Liverpool Agricultural Society's Show, held at Blackburn on the 1st, 2nd, and 3rd inst., Messrs. W. H. Bailey and Co., of the Albion Works, Salford, Manchester, exhibited their slow-combustion hot-air engine, for which they obtained the first-class silver medal for its excellence and superiority.

ALTHOUGH theory would appear to indicate that in heating large rooms by steam-pipes, the pipes should be placed near the floor, it is now quite generally conceded by those who have tried both plans, that better results are obtained by locating them overhead.

LETTERS TO THE EDITOR

We do not ask reviewers responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.

All communications should be addressed to the Editor of the *English Mechanic and World of Science*, 21, Finsbury-square, London, E.C.

All orders and remittances to be made payable to J. F. BARNARD.

*In order to facilitate reference, Correspondents, when sending of any letter previously inserted, will oblige by mentioning the number of the letter, as well as the page on which it appears.

*I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects. For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet to keep a duffer with this little pitance of his, will undertake to write the whole body of physics: a view from whence great inconveniences derive their origin.

—M. J. J. J. J.

SKELENOGRAPHICAL.

1881.—THE *Skeleto-graphical Journal*, Aug. 24, 1881, contains a letter from Mr. Neison, in which are some important passages, which, for the benefit of those readers who may not have access to the *Journal*, and who take an interest in lunar matters, I take the liberty to quote:—

In regard to the *Diagram and Continued Observations*.—My own experience is in accord with Mr. Neison's view. Vol. IV., p. 32, that as a formation is gradually modified, and additional experience is gained of its variable appearance, not only do the principal features become much easier to recognise, but many additional features are gradually recognised, which at an earlier period have quite escaped notice. The drawings which are constructed and frequently illustrate this in a most remarkable manner, the earlier drawings showing only the larger features, and these often incorrectly figured: but as additional experience is gained, not only do the drawings become more accurate, but many additional details are observed and delineated. This is the reason why so many distinguished astronomers have found it difficult to recognise that our observations of lunar objects with those of more practised observers of the Moon, is however great may be their experience in observing with the telescope—experience gained perhaps in terrestrial observations or in examining these planetary details—it will not compensate for that experience in observing lunar details. Those who attempt to examine any portion of the lunar surface, they find the greatest difficulty in recognising the smaller formations, and compare to details that are readily overlooked—so, with more practised eyes would recognise the same, and they describe as conspicuous features. The observations of Linné, made some fifteen years ago, afford more than one illustration of this fact. In the case of Hyginus N., which was then described as being a faint, inconspicuous spot, and was not detected, by both Otto Struve and Neison, and thus on occasions when more experienced observers have seen this curious formation with the greatest ease and distinctness. On one occasion a very distinguished astronomer sent me a drawing of a portion of the Moon, which he assured me did not agree in the least with my description of it. There being five craters, not four, as I had stated, and I had given the relative sizes as wrong. The real truth being he had mistaken the crater-like walls of valleys, each twenty to thirty miles in diameter, for the four small craters, and was as large, to which my description applied, and he had not even detected the four small craters lying in their midst. Another such observation was the drawing of Hipparchus, in which he drew the three craters, Halley, Hind, and Harrison, as small craterlets; and G, L, G, and S, as extremely minute craterlets; not one of the four craters was seen.

I have given the last paragraph of Mr. Neison's letter in full, because it appears of great importance to attempt to reduce the observation of lunar objects to a system, for it is only by careful and continuous observation that the details of any particular spot or region can become well known, so that similar and minute details, probably of an essential character, may be recognised, and as these are properly noted and placed together in the construction of a diagram of the particular region under examination, those features that are not and may be regarded from those that are not. The constant opportunity to, and are constantly tested, and the formation, the occasional change of detail in the appearance of a temporary feature, or a change. Hence, observations of the lunar surface can only be conducted in a great measure, and only by a description, indeed, in a very detailed manner, and the remarks of Mr. Neison, which are of so high a quality even experienced and distinguished astronomers may appreciate the importance of what they say,

unless they are well acquainted with the formation which they have under examination. This is particularly the case with the formation Hipparchus adduced by Mr. Neison; a map of this formation has been before the astronomical public during the last eleven years, and may still be had of Mr. W. Wesley, 28, Essex-street, Strand; it contains 115 distinct objects, 31 of which are craters and craterlets laid down in their proper positions, accompanied by a list in the order of their magnitudes, and their measurements given in seconds of arc. The letterpress also contains notes of the most conspicuous objects, as well as a comparative description of two excellent photographs by Rutherford and Gill.

Strong Probability of the Existence of an Obscuring Medium in the Low-lying Districts of the Moon.—Mr. Neison, in the last paragraph of his letter, has this remark:—"I think . . . that it is not improbable that there may be a real local haze or obscuring medium at times over the interior of Plato and other deep walled plains. There seems to me some weighty evidence in favour of these, and I am aware of no sound objection, either astronomical or chemical, against the possibility of this occurring." In connection with this view, we find on p. 36 of Mr. Neison's book on the Moon the following passage: "It appears probable that a very small residuum of aqueous vapour may, if not must, exist upon the surface at times and in places: for owing to the tenacity with which such material as composes the surface retains moisture, it does not seem likely that by the influence of the surface already containing a certain amount of moisture the extreme outer layer that is most favourably placed for absorbing the aqueous vapour could be entirely denuded of it." If this be so, then a certain amount of moisture must be liberated when the temperature of the surface increases beyond a certain degree. As has been already observed, it is in the interior of the deep formations that the last traces of the lunar seas must have lingered, and here accordingly would the most favourable condition exist for the liberation by the solar heat of a temporary vaporous covering." In conclusion, I beg to recommend to the consideration of every student of the Moon's surface letter 19164 in the issue dated Sept. 9, 1881.

Leytonstone, Sept. 12.

W. R. Birt.

GRINDING AND POLISHING A 9in. SPECULUM—NEW METHOD OF TESTING AND SILVERING SPECULA.

[19187].—I WAS pleased to notice, in your issue of July 8th, an article by E. P. Aintree on the time necessary in grinding and polishing a speculum with a machine. Now, with your permission, I will relate what I have done "by hand." I have a Newtonian reflector—my own construction—9in. aperture, and 61in. focal length, which I ground by hand, following the "two discs" method described on page 593 of Vol. XXVII. Although the short focal length, compared with aperture, makes the curve of speculum necessarily quite deep in the centre; yet, notwithstanding the greater quantity of material to be ground away, I finished the rough-grinding in much less time than would have been necessary had I used a machine. Thinking my speculum was not as perfect as I was capable of producing, I recently "cracked" another disc from a large piece of thick glass I had, and began operations. I will first describe the "cracking" process, as I have never seen anything of the kind described in your columns. I took the large piece of glass—1in. thick—and cut a deep circle with a "diamond" on each side, and of the same size as the intended disc. Then I heated an arc of this circle several inches in length, quite hot, over an alcohol lamp, and then applied a piece of ice to the heated portion. The result was several cracks, running in the direction of the heating portion. Selecting the one nearest the edge of the disc, I applied a heated iron—white-hot—along the direction I wished the crack to follow, the result, of course, being a slight extension of the crack. Then applying ice or cold water, the crack extends a little farther. In this manner I produced a very fair disc, which I rounded in the usual manner, using very coarse-grain emery.

The time occupied in the different stages was as follows:—"Cracking" disc, 1h. 30m.; edging disc, 4h. 30m.; excavating concavity, 6h.; covering grinder with small squares of plate-glass, 2h.; flour-emery and lengthening focus a few inches, 3h. and 5m.; one-minute emery, 1h. 35m.; three-minute emery, 2h. 5m.; ten-minute emery, 2h. 5m.; constructing four polishers of different sizes, 6h. 30m.; polishing with large polisher, 90m.; figuring, 10h.; time consumed in testing, about 5h. Total, 40h., which is less than half the time it took Mr. Aintree with a machine. I won't say I have as perfect a figure to my mirror as he has; but it is perfect enough to more than pay me for my trouble. The highest power I have is a 9in. periscopic eyepiece, giving a power of 122, and there is no falling off in definition. I think I can double the power without

spoiling definition, and intend to order a 9in. periscopic right away.

About an inch of the edge is somewhat imperfect; but for "clusters" and nebulae, the whole aperture can be used.

My first speculum had a focal length of 61in., and I wished my new one to have about the same; but, on a cloudy day, I worked too long at the rough-grinding, and got a focal length of 57in. I then removed several of the central squares, and finished grinding with flour and washed emery. I now had a focal length of 60in. At the end of "figuring," the focal length was just 61in., or 1in. less than my first speculum, which, I think, is as near as an optician could come with grinding-tools.

My polishers are constructed of two pieces of pine wood, the grain crossing, and glued and screwed together. The smaller ones are made of thin discs of plate-glass, and are 1, 2, 3, and 4in. in diameter respectively. The pitch covering them was of such consistency that a piece of the temperature of the room would receive three clear impressions of the "milling" on the edge of a 5-dollar gold piece, when the latter is allowed to rest on the edge for sixty seconds. A light frame is made to hold the piece upright, without influencing its weight. This is the rule given by Mr. Lassell, and I can certify it has given good results.

In using the "Foucault test," I have considerable trouble in getting enough light to test by. I have a strong light, and a series of holes, 1-32nd to 1-200th of an inch; but cannot get sufficient light to test by when using a hole less than 1-60th of an inch. But I have found a new method of testing, which, I think, gives accurate results. Take a pinhole about 1-60th of an inch in diameter, and notice its appearance with a high-power eyepiece (240 I have generally used), then draw out the eyepiece just a little, and the image, of course, enlarges.

Now, if any portion of the mirror is too high or too low, it will give a bright or dark spot respectively on the enlarging disc of light, and will be diametrically opposite the defect in the mirror. I have been enabled by this to detect defects that I could not see in using Foucault's; and, when in doubt with the latter as to the species of a defect, have resorted to the eyepiece test, and can judge of the nature of the irregularity in five seconds. I was more troubled with rings and zones than irregularities, and now have a surface that Foucault's test does not show to have any irregularities, but this test reveals a few. Will "A. J. S." Mr. Bell, Mr. Blacklock, and other amateurs please give their ideas in regard to this mode of testing, whether it fails under any circumstances, and why?

My lamp is about ten-candle power, and has a tin chimney, 14in. high; the pinholes are punched in a piece of tinfoil, and fastened in front of light. I use a razor-blade for cutting off the rays at focus. During three years past I have used a dozen or more receipts for silvering, and have always been—until lately—quite unsuccessful; but, since using the formula described by Mr. Brashear in volume XXXI., page 327, I have had success every time. Have just silvered two 9in. specula, and a "flat," with perfect success. My method of silvering, however, is different from any I have seen described. I clean my mirror well, and place it face upwards, and pour on the solutions as deep as possible without overflow. The mirror is, previously, slightly warmed, and the solutions made of about twice the usual strength. In my case, the silvering is usually completed in from five to seven minutes. The mirror is then thoroughly washed and dried, and has a surface of no reflecting power whatever. I then go over it with a camel's hair brush, and clean off the brownish powder which adheres, and then polish for five minutes with a soft piece of chamois skin, the result being an excellent reflecting surface.

I was guided to this method of silvering by noticing that the glass silvering-vessel used always received as heavy a deposit as the mirror, and the process is much more economical of distilled water, and that is quite an item with me, for it only takes about 4oz. of solution to silver a 9in. surface, instead of a pint or more in usual process.

I was for a long time deterred from making a speculum, on account of not wishing to make a machine; but was glad to learn a machine was unnecessary, and I would advise the amateur every time to grind and polish by hand, unless he can have the use of a machine without taking the trouble to make one. If the Editor wishes, I will describe in my next an admirable substitute for an observatory, which I constructed in about a day and a half, at a cost in money of only 4dols. 30cents (about 18s.; probably, in England, the cost would not exceed 8s. or 10s.), and which answers perfectly the purpose for which it was intended.

Harry L. Baldwin, jun.

251, Kansas-avenue, Denver, Colorado.

August 22.

[Please send.—Ed.]

GRINDING EDGES OF GLASS SPECULA.

[19188.]-I beg to tender my experience with regard to the edges of glass specula. I once attempted to grind and polish a speculum with the edge rough, and can assure our readers the job was one of great difficulty. It required most careful washings between the different grades of emery used, and even then a grain or two would sometimes remain concealed in some crevice (in spite of careful brushings in water), find its way to the front, and cause scratches; small bits of glass would chip off from the edge, causing great annoyance, although this evil may be avoided by grinding a bevel first. I do not say it is impossible to finish a speculum with the edge rough, but I do say it is most unadvisable, slovenly, and unworkmanlike. Having decided that the edge should be ground, I proceeded somewhat like others have who since then have described their methods in these pages—viz., in a lathe, using a piece of zinc and coarse emery. This succeeded very well, and I was quite satisfied with the result; but it took several hours (I do not recollect how many), and was a most tedious and monotonous job. I next ordered a disc with the edge ground, determined to have nothing more to do with grinding edges; but by some mistake it arrived in the rough. Of course I was a little disappointed, but set to work on the edge with a diamond tool I procured for the purpose, and in about two or three hours got it into shape. I then finished the edge with fine emery and a strip of thin brass. In conclusion, allow me to say: firstly, be sure to have a nice ground edge; secondly, if possible, get it done for you; thirdly, if you do it yourself, the diamond tool is the quickest. A. N. H.

ECLIPSES.

[19189.]-If "F.R.A.S." will be kind enough to re-read my question, he will perhaps find that it deserves a somewhat more courteous answer than he has given.

The solar eclipse limits are about $13\frac{1}{2}^\circ$ and $18\frac{1}{2}^\circ$, which means that if at conjunction the Sun is less than $13\frac{1}{2}^\circ$ from the nearest lunar node a solar eclipse is certain at that conjunction; if more than $18\frac{1}{2}^\circ$ there is certainly none; if between $13\frac{1}{2}^\circ$ and $18\frac{1}{2}^\circ$ an eclipse is doubtful, and more precise calculation of the actual facts required to remove the doubt. From these data, and the further data of Sun's average daily motion ($59' 8.33''$), and average daily regression of lunar node ($3' 10.6''$), it is easily seen that there may be two solar eclipses every time the sun crosses a lunar node, one at the conjunction preceding the node, one at the following conjunction. My difficulty is to prove that there must be one solar eclipse at every passage through a node (before or after); or again, that there must be two in a year. L.

LIGHT-DRAUGHT STEAMERS.

[19190.]-I FEAR that what Mr. S. E. Peal (letter 19168, p. 623) asks for is an impossibility. The displacement of a craft 80ft. long, 20ft. wide, and 1ft. draught of water may be taken at 36 tons. Now, the weight of this boat we may call 16 tons, leaving only 20 tons carrying capacity if fitted as a barge, without engines. The engine and boiler being $8\frac{1}{2}$ tons, and coal estimated at 1 ton for every 60 miles it would be necessary to travel without coaling, leaves only about 8 tons, I suppose, carrying-capacity at that draught. If there is water enough, however, she might be loaded to 2ft., and she would then carry 46 tons; lin. of immersion may be roughly reckoned at 3 tons displacement. At the first glance, I was inclined to propose a boat 15ft. wide, with four narrow side-wheels, as I thought the great weight of machinery at one end to drive stern-wheels would depress the stern too much, but I find, on making some calculations, that when unloaded the stern draught would be only 12in., the mean draught being 8ft. To obtain sufficient strength to withstand the strains of weight at the extremities, recourse must be had to some unusual means, and I think bow-string girders best. They should be three in number, one amidships and one at each side, rising to about 6ft., and stayed at intervals of 10ft. Two paddle-wheels, 8ft. diameter, floats 4ft. 9in. by 20in.

The engine had better have a single cylinder; it will scarcely be necessary to work the paddles independently. Diameter of cylinder, 15in., stroke 30in. It would be well to have a small condenser to supply clean feed-water if the rivers in Assam are as muddy as the Hooghly. Such a boat would have a speed of about 8 miles per hour, and would consume about 1 ton of coal in 7 hours. It would be well if the length could be greater; with the restrictions in size and draught, all I can lead Mr. Peal to expect is: Carrying capacity 10 tons, with coal for 100 miles steaming.

Sept. 8th.

Paugul.

SMALL ELECTRIC MOTOR.

[19191.]-On reading the description given in the last number of "Ours" (19182, p. 16), it occurs to

me that I recently saw at the Paris Electrical Exhibition, a motor which, whilst efficiently answering the purpose, was very much smaller and less clumsy than the one above alluded to. It was shown there as applied to the working of a lock-stitch sewing-machine. I am unable accurately to describe it from memory, but it struck me at the time as being the simplest and best as well as the smallest thing of the kind I had seen. Externally it was elliptical in shape, apparently measuring about 7in. by 4in., and was fitted upon the axle, which usually carries the driving-wheel of the machine; the axle was extended through the standard, and terminated just outside it by a small grooved wheel, over which a round band was passed and connected to the machine on the table above in the usual way. When put in action the motor was caused to revolve with great rapidity, carrying the axle with it, the speed being reduced to the required rate by the proportionate sizes of the grooved wheels. The motive power was derived from a form of bichromate trough battery of five or six cells placed on the floor within easy reach of the worker, and the machine was started or stopped by a simple contrivance for immersing or withdrawing the plates from the fluid. The motor weighed considerably less than the fly-wheel and treadles which it superseded, and its efficiency was demonstrated by the young lady in charge who worked with the machine at frequent intervals. The motor is exhibited by "The Electro Dynamic Company," 2009, Pine-street, Philadelphia, and may be seen in the nave on the ground-floor, American Section, class 9, No. 1141; the battery employed being No. 1097, class 2, by the same exhibitors, from whom (or from their representative, Mr. Griscom) it would no doubt be easy to obtain further particulars. E. T. Lewis.

HEATING-SURFACE OF MODEL BOILERS.

[19192.]-On page 504, Vol. XXXII., "Sun-light" gives as his rule "15 square inches of heating surface for every circular inch of diameter and stroke." As an example he gives 12in. by 4in. = 48 square inches, as ample surface for a pair of cylinders 1½in. by 1½in. If I understand the wording of his rule, it may be formulated thus $S = 15 (D^2 + L)$ where S = heating surface in square inches; D = diameter of piston in inches, and L = length of stroke in inches. If that is so, surely the two cylinders (cutting off at half-stroke) would require $15 (1\frac{1}{2} \times 1\frac{1}{2} + .75) \times 2 = 90$ square inches of heating surface, whereas he gives only 48 to 54 square inches. If I misunderstand his rule, will he kindly set me right? In applying this rule to tubular boilers, does he reckon the efficiency of heating surface in tubes according to Molesworth, or is it near enough in model-work to reckon tubes as equal in efficiency to flat horizontal surfaces? Glatton.

THE POSITION MICROMETER OF THE WASHBURN OBSERVATORY.

[19193.]-THE micrometer attached to the 15in. equatorial of the Washburn Observatory was furnished by the makers of the telescope, Alvan Clark and Sons.

A good many changes have been made in the micrometer, and a new method of illuminating the wires devised, which in practice has been found very satisfactory. It has been fully tested by making several hundred double-star measures, and such changes and further improvements made as were deemed desirable.

The double stars regularly measured are of the class requiring the most perfect illumination of the wires possible, being for the most part very close pairs or very faint companions and unequal pairs. In many cases it would be simply impossible to use a bright field and get satisfactory results. My experience is that the bright wire illumination is practically much the best for all purposes, and beyond all doubt the best for the most important double-star work. All my attempts to use a bright field have been wholly disappointing. The great trouble heretofore in using bright wires has been to avoid stray light in the field from the micrometer lamp and get sharp and uniformly bright wires in the varying positions they must take. In the Fraunhofer diagonal-arm plan generally used, it is necessary to rotate the lamp with every change of the wires in position angle, so as to bring the lamp into the plane which passes through the micrometer-screw and the axis of the telescope—otherwise the light is feeble, and the wires, when brought within two or three diameters of the webs, are indistinct and hazy. Again, a shadow is cast on the wire or the light more or less reduced when the lamp is placed in the proper position with reference to the wires, by the partitions through which the light passes from the hollow arms. Many other devices have been suggested and used; but it is questionable if any plan has been thoroughly tested in actual practice better than the one last referred to, notwithstanding its many defects. Indeed, nothing is easier than the

attaching of a lamp to a micrometer in such a way as to readily show the wires. In the course of attempts to improve the illumination of one micrometer in particular, on the 6in. equatorial, which had all the defects of all micrometers and none of their excellences, various results were obtained, which, so far as one could see, promised to be successful; but when the micrometer was attached to the telescope, and moderately close and unequal double stars sought to be measured, the light was found to be an utter failure for any such work. It is hardly necessary to say that almost any plan will answer fairly for measuring wide and bright stars; but the time has gone by when it is worth while giving a fine telescope to such work any considerable part of the time.

The accompanying engravings, from photographs of the micrometer and the lamp attachment, will make plain the end-illuminating plan used at this observatory. The square micrometer box in front of the position-circle is exactly 6in. in length, and from this the dimensions of the various parts will be easily seen. A is the lamp, moving freely around the horizontal end of the tube C, and kept in a vertical position by the weight E. The light from the lamp passes into C, and after a reflection from a mirror in the angle of C, passes through H into the micrometer-box, and directly on the wires. The rod F is screwed firmly into C, and forms an axis about which the latter turns freely. The counterpoise D attached to C by a bent arm, keeps the shorter arm of C, to which the lamp is attached, always horizontal. The long arm I is sufficiently bent or curved to allow the lamp to swing through it in any position. I is attached by a set screw, N, to the plate in which the micrometer-box slides when the bisecting screw K is turned, so that the additional weight of the illuminating apparatus has no connection with the bisecting and micrometer screws. The tube C fits loosely over H, forming a support or bearing when the longer arm of C is in a horizontal or inclined position. H passes inside C perhaps half an inch in the normal position of the box. This distance is increased or diminished as the bisecting screw K is turned. The outside of the lamp A is made of tin, open at the bottom and top. The lamp itself, somewhat smaller than the inside diameter of A, so as to give a free draught, is inserted from the bottom, and held in place by thin brass springs attached to the lamp and pressing against the inside of A. For some weeks past, gas has been used in place of the lamp, a small flexible rubber tube being attached to B, and running up the telescope tube over the intersection of the axes, and thence down the pier to the floor. This rubber tube is always in place, not being disturbed by reversing or moving the telescope in any position, and is more convenient than an oil-lamp, which requires more or less attention. It will be readily seen that the micrometer lamp will always maintain a vertical position, no matter what the position angle of the wires may be, or the place of the eye-end of the telescope. The light from the lamp is coloured or diminished at pleasure by means of the slot in A, as shown. The edge of the lower part of the arm I, for convenience in counterpoising, fits into a slot in one of the diagonal hollow arms, and turns the latter with it. To the opposite hollow arm a weight is attached (not shown in the engraving) sufficient to balance the micrometer lamp and its attachments. The lamp, tubes, arm, &c., should be made as light as possible; but I should be rigid enough to have no appreciable flexure in the different positions. In the micrometer described, the entire weight of the device is 26oz; this could be probably reduced 6oz., and perhaps more. The effect of the light on the wires is greatly improved by putting within the box and on the side of the wires opposite H a slip of glass or other reflecting material, in such a position that the wires can be seen reflected in it looking into the tube C. The light is thereby reflected back on the wires, illuminating them on both sides, and making them as near as may be symmetrical.

Other changes have been made in some of the working parts of the micrometer, which have been shown by experience to be of very great importance. The bisecting-screw K has been extended on the side opposite the nut and fitted with an additional head, L. The pinion for rotating the micrometer-box has been changed to a point opposite K, and is moved by the milled head M. It is hardly necessary to say that, in measuring angles, either K and M or L and M must be used simultaneously, one with each hand. If the micrometer-screw is anywhere near a horizontal position, K will naturally be used with the left hand, and M with the right. If the micrometer-screw is more nearly vertical, L and M will be used. In the same way, in measuring distances, K and P or L and P will be used at the same time—the former when the box is horizontal, and the latter when it is more nearly vertical with respect to the observer. There is no position where it is not entirely convenient to use one or the other in all measurements—an important advantage, not found, so far as I know, in any other micrometer.

if the eyetube were out of adjustment, and the flat and mirror set at night on a star concentrically, though without knowing it, say, at a focus of 200, and then examined by day, with the tube farther out, say, focus of Kellner, when it would be eccentric.

Neither of these are, however, satisfactory explanations, particularly to Mr. Calver.

In investigating the relations of the mirror, flat, eyetube, &c., and their connection with the cone of rays, I came upon a curious fact, which is no doubt well-known to opticians—that the axis of the cone of rays from the mirror does not fall upon the centre of the flat—that is, on its minor axis; and I shall be glad to place this before your optician readers and correspondents, and invite their opinions as to whether any allowance has to be made for this, and what effect it has, or if any, on the adjustment of the flat and mirror.

This is readily seen in the following figure. A B represents the flat, full size, showing section of cone 2 in. diameter at the point where it meets the flat at C, 9 in. distant from the focus. E E is the axis of the cone, and F F F F the sides of the cone. The flat makes the angle 45° with the axis, which I find is also the correct re-entrant of the sides of the cone. This is easily ascertained as follows:—Set the flat A B at 45° with the axis, and draw a line from the focus, 9 in. from C, through the point D, 1 in. from the flat at C, and continue it till it reaches the flat at A. From A draw the line A F, one of the sides of the cone towards the mirror making the angles a and a' equal to one another. Draw the line A G from the point A parallel to the axis, and mark off A E equal to E F. Make the two angles b and b' equal to one another, and draw the line F B at that angle till it meets the flat at B. Make the angles c and c' equal to one another, and draw the line B F at that angle, which being extended will meet the starting-point at the focus of the cone.

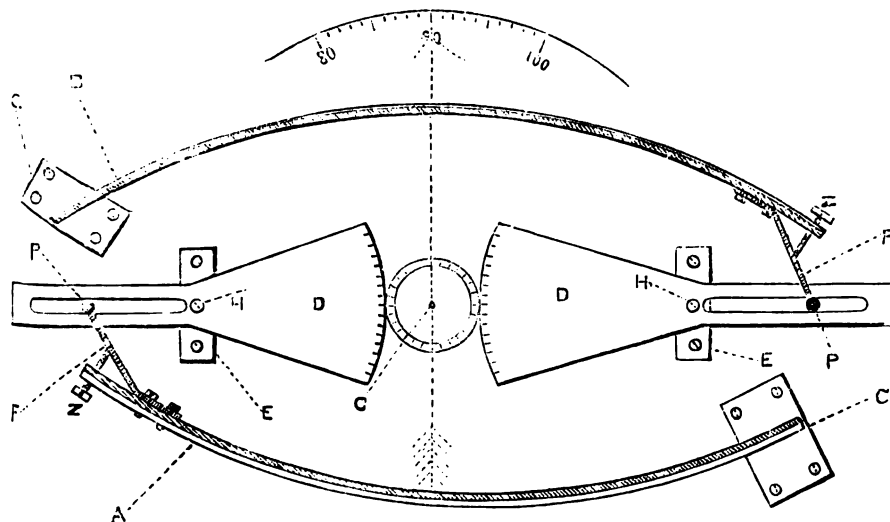
It will now be seen that the part of the flat B C is shorter than C A, and the difference appears to increase with the increased size of the flat, in proportion to its distance from the focus. Without any further comment, I leave this with your correspondents. Does this in any way affect the adjustment of the flat and mirror?

Fordingbridge.

T. Westlake.

THE AUBURNDALE METALLIC THERMOMETER.

[19196.]—HAVING lately examined the works of this new machine, I take pleasure in forwarding a sketch. A, B, the compound laminae, fixed at G,



but free to move the other end. F, F, "adjusting-pieces" of spring-steel, screwed to A, B, and "set" by set-screw Z, Z.

P, a pin fastened to end of F, and working in slot of sector-piece D, so that as the laminae change their shape, the sector-pieces rotate around the axis H, which is placed at the centre of curvature of the sector; E, E, support the axis H, H.

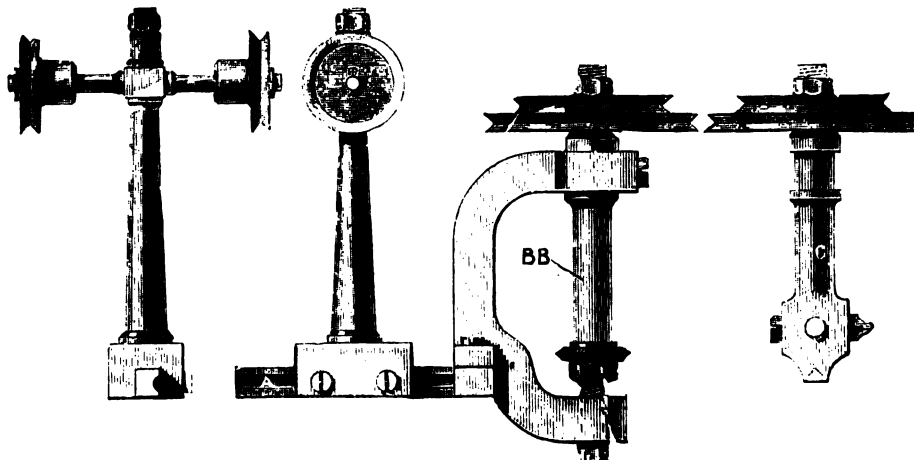
C is centre pinion, gearing into sectors; on axis of C is indicating-needle, shown in dotted line. Pinion C slips endwise out of gear to adjust the instrument by aid of F, F. The machines are made with dials from 1 in. to 12 in. or more across.

"Ro ne puis, Souza je suis."

MILLING MACHINE.

[19197.]—I HAVE at last sent you drawing of my milling machine, which I find an invaluable tool, and which, I hope, may benefit your readers. It will be seen by the drawing at once, without any

particular explanation, only that the pulley on spindle is taken off A A, and placed on C the other way up, or small speed downwards, and the guide-pulley E is reversed with bosses outwards. For fly-cutting the pillar which carries guide-pulleys,



slides on shank A, which puts the required tension on the driving-gut, and secured with two screws on the pillar B into slot in shank A. The shank A passes through the tool-dome, and is quite secure, is made of iron, and case-hardened; the pillar is of iron, the spindle of cast-steel, and the pulleys and remainder of gunmetal.

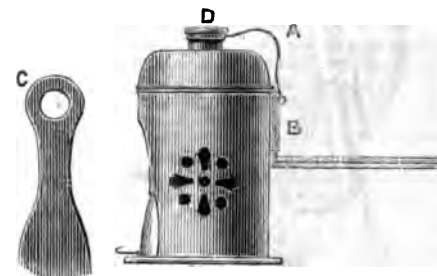
D. Young.

A SAFETY BLOWPIPE SPIRIT-LAMP.

[19198.]—EVER since I purchased a French blow-pipe spirit-lamp some few years ago, the thought has occurred to me as often as I had occasion to use it, that the article, useful as it is, could never be reckoned perfect without some means of knowing when the boiler required replenishing, as if left to get nearly empty, an explosion might occur. Having often considered this desideratum in vain, the thought recently occurred to me that the boiler might be made to record its diminished contents by its own diminution of weight. Being fully satisfied

attachment makes no difference, and no more trouble in filling the boiler. The stopper is taken out, the spring turned back on its joint, and the contents of measure poured in through a funnel; then the spring and stopper are replaced. Now, I

have graduated the strength of this spring, so that when about half-empty it will overcome the reduced weight of the boiler, and cause it to rise off its seat, and so give notice that it is so far emptied. Of course, it could be made to register when one-third or a quarter full, but think the above safest. Any mechanic of ordinary skill could make and apply this contrivance to his own lamp. Figure (C) shows the top part of the spring with hole for



feed-pipe to pass through. In making this contrivance it is essential that the boiler should rest on its seat without in any way hitching—that is, it must be perfectly free to rise by the sole action of the new safety-spring.

Of course, this idea could be modified in many ways. For instance, a bridge might be placed over the boiler, and this have a short helical spring graduated to the required strength fixed midway under it, to which the boiler might be attached.

F. M. Crichton.

A FAULT IN DESIGN OF TRICYCLES—EQUILIBRIUM OF BICYCLIST.

[19199.]—I HAVE noticed a fault in the design of some tricycles I have seen about, and, I believe, in some of the newest patterns it is more noticeable

FIG. 1.

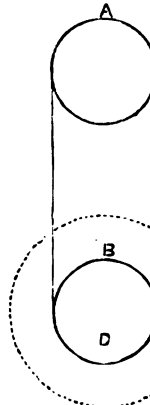
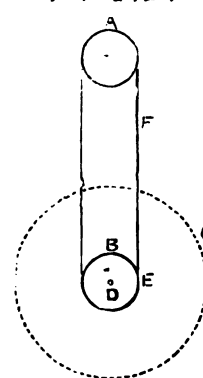


FIG. 2.



of the feasibility of this plan, I have succeeded in carrying it out as follows:—

In these French lamps the boiler rests upon the top of the stove, and is pressed upon by a short bit of spring just behind the handle, to keep it tight and prevent its falling off. The handle is made removable by having a short steel blade at its upper end, which runs into a flat hollow socket fastened to the upper part of stove. Removing this socket and the bit of binding-spring, which last must be entirely discarded, I made a new socket of brass (B), and jointed to the back of it a piece of French timepiece mainspring (A), shaped as in sketch, the end of it having a circular hole to just admit the feeding-pipe of the boiler passing through it; and the stopper, with its safety-valve (D) being screwed down over it, keeps it from rising up. This spring is so graduated in strength as to be kept down by the weight of the boiler when filled with the fluid contents of the brass measure supplied with these lamps, which is just two fluid ounces. This new

than in older ones: I refer to the excessive smallness of the toothed wheels over which the chain passes. What the object can be in decreasing the

been altered to the usual C.R. style. In the rough sketch which I gave (p. 18) of one of the C.R. engine engines, the engraver omitted the number. I had intended it for 129, as that engine is fitted with the Westinghouse brake. On the Caledonian engines the air-pump is placed on the left-hand side of the boiler, not on the right, as is done on most railways. Please understand that in speaking about the S.C. Ry. fireboxes I use the terms "front" and "rear" in relation to the engine itself, not to the foot-plate—thus, the "front" compartment is that furthest from the footplate.
Sept. 9th. Carstairs.

THE CONTINUOUS BRAKES RETURN.

[19204.]—THE Seventh Continuous Brakes Return (No. C. 3038) for the past half-year has been published, and the following table gives the amount of rolling stock fitted with brakes which appear to fulfil the necessary "conditions."

I have in former letters expressed the opinion that vehicles which are "fitted with connecting-pipes only" should not be placed in the same column as those which are actually fitted with brakes, therefore in the table I have given them separately. The Midland and Great Western Companies include 423 engines as fitted with the Sanders brake, but of this total no fewer than 405 have "steam brakes" which do not comply with the conditions.

During the half-year 14 more Midland express engines (which used to have the brake upon their axles only) have been fitted with the Westinghouse automatic driving-wheel brake upon the coupled wheels.

The North-Eastern Company have 28 "goods" engines fitted with the Westinghouse brake to work excursion trains, in addition to 178 passenger engines.

The progress made by some lines has been very satisfactory, but still much remains to be done.

In the "General Report" upon the accidents in 1880, it is shown that out of the 118 cases inquired into there were no fewer than 47 instances of "inadequate or unsuitable brake-power."

Clement E. Stretton.

Saxe-Coburg-street, Leicester, Sept. 9th.

THE AVERTED ACCIDENTS AT STRATFORD AND BURN-HILL.

[19206.]—UPON the 1st of August an accident, which would no doubt have proved very serious, was averted at Stratford Station upon the Great Eastern Railway. A passenger-train was standing at the platform and was well filled with passengers. Everyone naturally supposed that it was properly protected by the signals and block-system. Great consternation ensued when another passenger-train was seen approaching at a rapid pace. Some of the persons on the platform gave a danger "hand-signal" to the driver; he at once put the Westinghouse Automatic Brake "on," and brought his train safely at rest within five or six feet of the other train.

On Monday, August 22, a very serious accident was averted near Burn-hill, upon the Bedfordshire and Saltburn branch of the North Eastern Railway. When the 1.50 passenger-train was approaching a bridge which crosses over the line, the driver, Charles Baxter, saw it fall down upon the rails. He at once applied the Westinghouse Automatic Brake, and stopped the train only a few yards from the debris.

No official report has yet been issued by the Board of Trade, but the railway officials concur in the opinion that no other continuous brake in use

STATEMENT showing the Amount of Rolling-stock fitted with Continuous Brakes which appear to comply with the Conditions of the Board of Trade, June 30th, 1881.

Name of Continuous Brake.	Name of Railway Company.	Amount of Stock fitted.		Fitted with Connecting-pipes only.	Miles run by fitted trains in half-year.
		Engines.	Carriages, &c.		
Barker's Automatic	Great Eastern	2	12	..	40,629
Eames' Vacuum	Lancashire and Yorkshire	5	8	..	Not given.
Fay, Newall, and Eames'	Lancashire and Yorkshire	..	10	..	Not given.
Fay, Newall, and Sanders'	Lancashire and Yorkshire	..	6	..	Not given.
Sanders and Bolitho Vacuum	Great Western	221*	650	76	618,812
"	Lancashire and Yorkshire	2	2	..	Not given.
"	Midland	202*	1,575	499	1,581,852
Smith's Automatic Vacuum	Great Northern	2	33	..	25,919
"	Lancashire and Yorkshire	2	9	..	Not given.
"	London and South Western	5	11	..	11,844
"	Taff Vale	3	15	..	11,509
Steel M ^r Innes	Caledonian	4	33	..	32,542
Westinghouse Automatic	Great Eastern	41	602	..	498,310
"	Great Northern	2	14	..	27,023
"	Lancashire and Yorkshire	11	37	..	Not given.
"	London and South Western	2	7	..	21,249
"	London, Brighton, & South Coast	198	1,488	298	1,789,158
"	London, Chatham, and Dover	11	56	..	91,123
"	Midland	57*	98	71	377,944
"	Midland, Scotch Joint Stock	..	40	..	..
"	North Eastern	206*	977	..	1,213,890
"	Rhymney	7	12	12	37,440
"	West Lancashire	3	16	..	21,022
"	Caledonian	9	226	..	49,979
"	Glasgow and South Western	46	278	..	189,073
"	North British	91	814	..	1,022,896
"	East Coast, Joint Stock, and Cars	..	..	120	Not given:
Total as above		1,132	7,029	1,076	
Total December 31, 1880		824	4,450	744	
Showing an increase of		308	2,579	332	

The total passenger rolling-stock consists of 1,169 engines and 44,545 carriages and vehicles, and the above table shows that only 1,132 of the engines and 7,029 of the carriages are fitted with efficient brakes.

Upon the Midland Railway, Barker's hydraulic brake has been removed from nine carriages, and they have been refitted with the Sanders and Bolitho.

Sixteen carriages upon the Great Eastern have had Smith's vacuum brake removed, and replaced by the Westinghouse automatic.

Smith's (plain) vacuum brake has been removed from the carriages upon the Lancashire and Yorkshire Railway: the "return" states that it "was taken off May 26, 1881."

The "Fay and Smith" combined brake, therefore, has become extinct, and does not appear in the return.

could have stopped the train without, in either case, touching the obstruction. All other brakes being "slower in action" than the Westinghouse, it will be seen that the trains must run a greater distance, and, in cases like the above, "a second of time" and "a few feet of distance," become questions of life or death to passengers and railway servants.

In the recent accident at Bow, there can be no doubt that if the second train had been fitted with an efficient continuous brake, the collision might have been avoided, or very greatly mitigated, in spite of the error of the signalman in allowing it to enter a block section which was not "clear." Of course, this error could not have been made if the interlocking and block systems had been combined by either the Hodgeon, Sykes, or Spagnoletti systems.

Clement E. Stretton.

Leicester, Sept. 8th.

MEDICAL REPLIES.

[19206.]—THE three queries, 44673, 44680, and 44684, ask me about "a child with a perpetual cold," "a swelling of the cheek," and "the best medicine for aneurism." None of these queries can be usefully answered in the "E.M.": each case needs the personal examination of a skilled physician to arrive at an accurate diagnosis of the nature of the case and the character of the patient. I can only promise to see these patients at the Temperance Hospital, on Monday or Thursday, at two o'clock. James Edmunds, M.D., &c.
Grafton-street, Bond-street.

BEVELLING AN OXFORD FRAME.

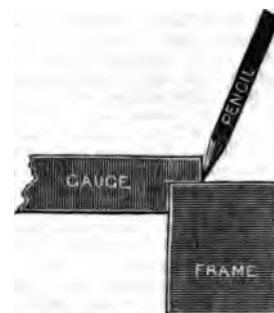
[19207.]—THE difficulty of "F.R.A.S." (let. 19109, p. 594) is not common to amateurs only. A careful, experienced workman will run his chisel into the grain occasionally when doing similar work in soft wood. For working bevels of 6in. and upwards in length, a small "bull-nose" plane is a very useful tool. The sketch shows one about



3in. long; the cutter, 1in. wide, being fixed close to the end of the plane. Oakland.

STOP-CHAMFERING OXFORD FRAMES.

[19208.]—I see one or two replies to this query, but all rather amateurish. I think the querist will find this a better plan. In the first place, do not use a toothed gauge for lines; it leaves a nasty, ragged edge, but a bit of wood notched, as shown in sketch (known as a pencil-gauge), and a pencil



With dovetail-saw run a cut down at inner extremity of stops to pencilled lines, also other out-nearly to lines every 1/4in. to cut off the grain, and prevent ripping; then with a sharp, thin chisel out the chamfer down to within a trifle of the lines, except at the two ends, which must be finished right down. Next use one of the small iron block-planes, with mouth close to end (to be got at by ironmonger's at about 1s. each), finishing with fine glasspaper on a bit of smooth wood or cork. Last of all, cut down the stops with chisel.

Joiner.

[19209.]—I HAVE witnessed the manufacture of hundreds of Oxford frames by different workmen whose methods were not exactly the same, but all turned out good work; from which I conclude that success is not entirely dependent on the method adopted or the tools used; but if the following hints are of any service to "F.R.A.S." or any other reader, I shall be glad.

I will describe the proceedings of one workman. Having determined the "sight"-size of the frames to be made and the length of the horns, the stuff is first squared up and "halfened" together. Observe which side the joints look best, and mark that for the front; then on the other side make a gauge-line that will determine the length and width of the rabbet, and another gauge-line on the inside to mark the depth of ditto. Now gently take to pieces, and proceed to work out the rabbet with a chisel and mallet, or, better and quicker, with a small circular saw. After the rabbet is finished the bevels may be attached; to work at them comfortably we require a means of keeping the corner uppermost; this is done by having a piece of lin. stuff 4in. or 5in. wide, and a little longer than the longest frames you intend to make, with a V gutter worked in it. There are two ways of finishing off the ends of a stopped chamfer, either with a curve or angle. The curved ends are the quickest done and the easiest to accomplish if we go the right

unchanged. Already the chain of animated nature would seem full of gaps; but the gaps are widened still more by races well adapted to their surroundings exterminating those less well-adapted, and by the changes of surroundings exterminating those races unable to adapt themselves readily to them. Meanwhile, other variations from the original protoplasm have been developing; but as each could scarcely fail to meet with different modifying circumstances to the others, they would not develop in the same direction nor evolve the same forms. Under these circumstances, I do not see how we could expect to find anything different to what we do find, even if evolution acts now as it always did act.—W. J. RENDELL.

[44525].—**Battery for Electro-Motors.**—I hope Mr. Sutcliffe will excuse me, but I can refer the querist ("A. H.") to a motor somewhat similar to that on page 16 of this week's issue, which will give a great increase of power at a little extra cost. For an engraving of it, see page 233, Ferguson's "Electricity." If he cannot see that work, he will find the principle of its action in any elementary textbook, under the title of Ritchie's rotating magnet, but that has a permanent magnet and mercury commutator; whereas Ferguson's has a spring commutator, thoroughly adapted for practical working. If a still more powerful arrangement is wanted, that suggested by Mr. Lancaster, on page 20, will answer admirably, but it would be much more expensive.—M.M.I.Sc.S. and A.S.T.E.

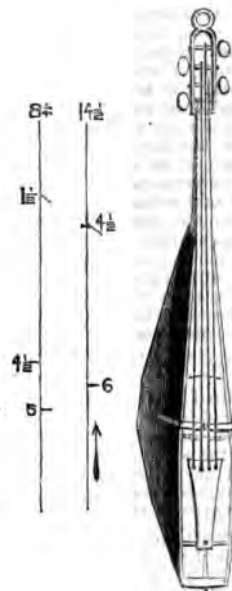
[44531].—**Electrical Contact.**—I have referred back to notes I took at the time I examined a very fine electric clock, and find that the contacts were of gold of 22 carat for the main contact. But that one or two in which wear might occur were of gold alloyed with some other metal to harden it. The precise alloy was not disclosed, and was apparently kept a secret. I would add also that the soft-gold contacts were of extra size to what I should have considered needful, and were flat surfaces almost, instead of mere platinum points as usually found. On the Continent, I know that platinum is largely used for contacts. I have also seen gold used in German clocks on one or two occasions.—SUNLIGHT.

[44559].—**Staining Ivory.**—By "lye," I understand a solution of caustic soda or potash, either of which would precipitate oxide of silver from a solution of the nitrate. The subcarbonate of soda will do equally as well as the carbonate. A carbonate of silver is formed, which, under the action of the light is decomposed into oxide. These preparations of soda are, I think, generally termed *carbonate* and *bicarbonate*.—Os.

[44573].—**Pumping.**—You may raise water with your power 120ft. if you shorten the stroke still higher in proportion. P. J. Davies has only told you one-half your power is calculated to do. To the second part of your question, you may do so, but I would advise you to have your column of the same diameter as the piston.—AN OLD PITMAN.

[44594].—**The New Violin.**—The "F. D." can make one at a cost of 3s., if he makes his own fingerboard out of maple. Now, if some of "ours" can show us the way to make a neck, with or without the scroll, that would reduce the cost to 2s. 3d. Is the scroll done in a lathe? If so, how? I should like to know. I have been about a little—as my pain will let me—and have seen thousands of fiddles. One wholesale place had a 65s. v. £5 violin, very good, but, like all French fiddles, very brassy; a cheap fiddle, 16s., fit to burn; another, 14s., quite equal to the £5. They would not believe their eyes, but I appealed to their ears, and they were convinced. Moral: We pay for work and style, not for tone. Well, I would not have any of their violins, because they are all rough on the fourth or covered string. How is this? Because, for 300 years, the soundboard has been moved the wrong way. My tone is firm and strong. Tuned in fifths, you'll hear the third. I have made a magnificent alto or tenor, the tone of which is exquisite with the voice; and I have made a violoncello with medium results, very good indeed; but I like to have the best. But this is travelling wide of your mark. There were two mistakes in letter 19107: the measure 2-8 should read 3-16in., and the soundpost should be 1½in. long. The two soundboards are the same shape, and are parallel to each other. They are 14½in. long. The ½in. is to fit into the neck. The bridge comes in the middle, and allows the string to be 12½in. long. The treble soundboard is ½in. thick. Glasspaper it smooth. The bass is 3-16in. thin, not thinner, or the tone becomes feeble. The bottom pieces must fit exact to measurement given in letter 19107, and good cabinetwork is necessary. Use sycamore or plane-tree, ½in. thick, true the edges with a plane, holding the wood in a vice. The piece that carries the tail is ½in.; that insures a good reaction. You see a half-inch hole is bored 3in. from the top; well, you pass some thirdstring gut through the tail, make a loop and knot; let the

knot come under the tail, pass the loop through the hole in end-piece, and instead of a button, simply put a thick wire through, to prevent a pull back, and there you are. I have sent a side view



as plain as I can, and I have prepared two rods, one 8½in. long, which you will mark off as directed, in inches, which represents the width of soundboard. The other rod is 14½in. long, which signifies the length of soundboard. Get a piece of cardboard and place width rod perpendicular from a base line. Mark off and draw straight lines across the board. Place the length-rod at right angles, or horizontally to the first, or along the base line. Mark off and draw lines from the top to base line. The 1½ is the rise behind bridge, 4½ is under the neck, 5 depth of the rise behind bridge. The other rod has 4½, which is the length of rise, as is point on bass line, to cut off corner from 5 to it. Six is the next point on bass line to be cut off to 4½. Number your points, and you won't make a mistake. When you place the pasteboard pattern, cut the wood so as to have the grain straight. There is a slip to cut out of pattern, to make the rise, so as to leave 3in. under the neck, and I think that is all. The rods as drawn are only imaginary, space not permitting otherwise; but the numbers of inches are correct. With respect to the holder there is no difficulty; but I should like our friends to suggest their ideas on the subject. The great requirement is to bring the violin well over the left arm and elbow.—FIDDLER.

[44596].—**Sewer-Gas from Drains.**—If I were the "Anxious Father," I would not attempt the cleansing of pipes, &c. Condry's fluid is often used as a disinfectant; yet the use of this or any other fluid is, at the best, only a very temporary remedy. As to the use of disinfectants in the powdered state, I have an opinion that it were better to put all or any of these in the dusthole, for the powder adheres to the sides of basins and traps and conducting-pipes, and in the course of time makes matters worse instead of mending them. If an attempt be made to cleanse the pipes with spirits of salts or strong chemical compounds, the trapping parts and the more exposed parts would be in danger of corrosion, for that which would erode the adherent matter would eat away the metal of which the more exposed parts are generally made. What is the complaint? Sewer-gas. Now there is no mistaking sewer-gas, and if sewer-gas comes into the house, there is not proper interception between the house and the sewer. From the manner of the wording of the query—i.e., "The end of the drain is siphoned properly," I conclude that the drain is not siphoned at all, but that at the end of the drain is what is called a flap-valve trap, which for trapping purposes is no good at all, or a siphon may be set into the drain, but not properly, for a siphon may be set to lose a great part of its trapping-power, and when so set is a delusion. But what is to be done in this case, of course, if it is no question of pounds, shillings, and pence—have all the fittings replaced with new; but if economy is to be the order of the day, and I would suggest a remedy I would say—Cut off the w.c. arrangement by one or more siphons, just as close to the house as possible, and insert the rain-water pipe outside of the siphon—that is, so make your arrangements that the rain-water pipes ventilate the sewer, if you please; but do not trust to these for ventilating your drain. Now,

suppose your drain trapped at the end of the drain, as you state, and ventilation provided by the rain-water pipes, if there be defects in any parts of the drains inside of the house, when the air inside has become warm, if the cold air can find way down the rain-water pipes and up the drain arrangement and into the house more readily than in any other way, the cold air will come that way, and if air comes that way, it will not be very healthful air. My advice is, to find out the outlets of all the arrangements inside of the house and trap them off with ventilating siphons, inserting a pipe in the upper arrangement under the w.c. seat out through the outer wall and into the open air.—JO BOOMER.

[44596].—**Sewer-gas from Drains.**—There are many cheap chemicals that "An Anxious Father" may, with impunity, throw down his closets and drains that will clean them and make the smell of sewer-gas ten thousand times worse. It is not so much, I think, the cleaning of the traps and iron pipes that is meant, as the deodorising and disinfecting of them, and for this purpose I know of nothing cheaper and more effective than two parts of what is called chloride of lime, and one part of carbolic acid mixed; but although I can recommend this as an effective disinfectant it will not remedy the evil. The only effectual way to get rid of such stenches as "An Anxious Father" describes is to have a thorough system of ventilation to every sewer-pipe opening into the house: pipes such as rainwater-pipes, or pipes which are, at any time, used for any other purpose—throwing matter or liquid into the sewer-pipe, and thus forcing bad air out of closets, sinks, &c., by causing a backing of any matter that may be lodged in them—are quite insufficient. The O-siphons, too, as fixed to closets, are quite useless where there is any fall from them; the passage of matter past the siphon causing, through suction, the lower bend to become emptied and, therefore, useless. A piece of piping should be carried from the top of the upper bend of the O-siphon through the wall to the outside; this would prevent the lower bend from being emptied, because there would be air provided from the outside for the suction, leaving the opening into the drain from the house hermetically sealed by the water lodging in the lower bend. Sinks should have no direct connection with the drain, but should openly empty themselves down a grid exposed to the atmosphere. If "An Anxious Father" has a grid in his cellar, my advice is have it filled up at any expense, never mind about there being a water-tap over it, or its draining the cellar, or the servants complaining of the trouble of drying it; better by far have all the trouble and all the floods than have such abominable typhoid exhalers exist. I don't think the expense of new pipes will be at all necessary if every siphon is separately ventilated. Our worthy friend, Mr. P. J. Davies, who is giving us such able, practical lessons in plumbing, might, I think, with benefit to a great number of "ours," give a series of papers upon the different kinds of plumbing as it exists in different kinds of houses, dealing with the defaults that exist, and suitable suggestions for the healthy remedying of such defaults, so that we may have a chance of utilising his "Practical Notes on Plumbing," as I am sure many of us will find necessary.—G. H. WILKINSON.

[44613].—**Hydraulic Organ-Blower.**—You have, I fear, started on a bad principle. You must try again, and this time you will no doubt be successful. What you want is a piston-valve, carrying with it the main slide-valve of the motor, and at the side or back of this an auxiliary valve (which may be very small comparatively) worked by a rod and tappet connected to the main piston-rod. The tappets strike the lever at the end of the auxiliary valve, which, as the main piston is still moving, owing to the main slide being full open, the valve is opened wide at once. This, then, admits water from the main to the one end of the main piston-valve, forcing it over at once to the other end, and reversing the water inlets and outlets. Not only so, but it firmly holds the main valve in position, if the motor be vertical, as it is sometimes handy to fix them. Any water that may leak past the main valve pistons is at the same time exhausted, so that it may not be moved until the end of the stroke is reached. Air-vessels on both ends of the cylinder are also most useful, as they take off all shock, and, in my opinion, are better than one main air-vessel on the supply-pipe. The cylinder you have would be none too large for the stroke. If needed, I would further explain.—SUNLIGHT.

[44615].—**Sash-Weights.**—I can from experience fully endorse "J. N. O.'s" opinion that interchangeable boxes with half-sash weights fastened to planed plates is the best and quickest method of making sash-weights in quantities. "Cast Iron" must understand that to get up such a plant will run into a great expense.—WORKING TOM.

[44641].—**Testing Gas-Meters.**—The certificate was certainly wrong if it was as stated in the query: the decimal point is in the wrong place.

For as 2:20 : 2 : 100 : 90.9. The meter should, therefore, be 9.1 per cent. slow.—W. W.

[44611].—Testing Gas-Meters.—To ascertain the percentage of error in his meters, "Gas-Meter" must subtract the amount registered by the meter from that shown by the scale of the test-holder, or vice versa, according as to which is the greater quantity; if the holder shows the larger measurement, the meter is slow, if the smaller, then the meter is fast. The difference then multiplied by 100, and the product divided by the reading of the test-holder, the quotient will be the required percentage, as in the case given:—

Reading of holder 2:20
Meter 2:00
Difference 0:20
100
2:20 : 20:0000 (90.9 per-cent. of
19:80 meter, slow.
20:00
19:80
20

If the reading of the holder had been 1:80, and that of the meter 2:0, the meter would be 2:10ths fast, or

Meter 2:00
Holder 1:80
Difference 0:20
100
1:80 : 20:000 (11.11 per cent. fast.
18
20
18
20
18
20
18
20

The first example would read: meter, nine and nine-hundredths per cent. slow. The second, eleven and eleven-hundredths per cent. fast. I hope the above will make all clear to "Gas-Meter." I expect the omission of the decimal point in the second term of the example given puzzled him, as the example as it stands will not work out to the result given. Newbigging's "Handbook for Gas-Engineers and Managers," contains a complete set of tables showing the percentages of error in meters.—GAS MANAGER.

[44612].—Faulty Common Well-Pump.—"M.I.C.E." gives the true cause of failure of "Working Tom's" pump. As the bucket is 20ft. or so above the water, the little remaining atmospheric pressure is not sufficient to overcome rapidly the inertia of such a column of water. An air-vessel can, however, most certainly be applied, and would be a certain cure if valves, pipes, &c., are all in proper order. A piece of 3in. pipe 6ft. long, standing vertically on the horizontal pipe as near the pump as convenient, would answer perfectly, but do not remove the bottom valve.—W. WYATT.

[44613].—Faulty Common Well-Pump.—Thanks for the reply and suggestions to my query. Taking "E. F. C.'s" suggestion, I beg to say we always place a stop just above the under-valve to keep it from being thrown out of its seat and tapping over; the bucket-valve I had thought did the mischief as "E. F. C." suggests, but on examination nothing could be discovered amiss with it. Even that did not satisfy me, and I had a similar bucket taken from a pump that was working well and placed in the faulty pump, with no better result. I note for the first time in reading "E. F. C.'s" reply that in my query I omitted the size of pipes. Pump is 3in.; suction-pipe 2 1/2in. W.I. tube; the valves are of the usual water-way that we allow, and I think, bearing in mind the suction-pipe of this size, and the same size valves, have given us no trouble in other pumps. To "Working Bill" I would say that the pump has been used without the retaining-valve, and it was no better. Looking at the reply of "M.I.C.E." he has introduced a new feature to my mind, for in calculating the length of suction-pipe to be fixed to a pump it has always been our custom to ignore the bottom and length of pipe, and to only pay heed to the vertical height. Does "M.I.C.E." mean to say that the horizontal length has the injurious effect, for if so would be kindly explain how it is that our rotary pump daily throws water under the following arrangement: One-inch galvanized suction and delivery-pipe, well 14ft. deep, horizontal 48ft. long, rotary-pump, then 14ft. vertical height to the top of the tank. "M.I.C.E." will also note that we need not trouble ourselves as to friction in pump-pipes, as it

is thoroughly understood and granted that a suction-pump in good working order should lift water the vertical height of 27ft.; and the total vertical height for the suction-pipe in the pump in question is only 19ft., and deducting 3ft. of water leaves 16ft. above water-level. I am well and painfully aware of the truth of the remark of "Sunlight," that mechanics ordinarily overlook small things, and in this case every small thing that I can think of my men have tried; every inch of pipe, especially joints, have been examined over and over again, but no leakages of any sort could be discovered. The horizontal pipe was originally laid with a slope towards the pump, but that was discovered by the spirit-level, and made to slope the other way—towards the well. It worked no better by the alteration. We always sent two men, so that one could work the pump while the other was examining the pipe. As the pump was fixed according to the instructions of the estate architect, he has now ordered its removal altogether, having decided to dig a new well. I rather regret this, for I do think the pump, so fixed, ought to have worked satisfactorily, and now I am afraid, unless some correspondent can solve the problem by any theoretical suggestion, it will always remain a puzzle to—WORKING TOM.

[44650].—Faulty Castings.—If "Working Tom" will see that the following instructions are carried out, he will be able to get good sound pipes, allowing a reasonable amount of waste. 1st. See that the pit is cut so that it will neither wash away nor scab the mould (which would cause sand-holes in pipe). 2nd. That the core is made of good ground loam, with plenty of horse-dung, sawdust, and hair in it; core-bar well lapped with hay or haybands, and well dried out and blacked (or it is sure to scab and cause the sand-holes in the pipe). 3rd. Ladies clay-washed, and then coated with loam (same as used for the cores will do), and brushed over with blacking-wash, properly dried and new-coated every day used. If ladies or cupola-spouts are coated with loam sand when dry, if the skin gets broke, then the sand crumbles away, and is liable to get into the pipe through the pit, and will cause a bad one if not properly skinned. We make our spouts up with fireclay and wash it with blacking. 3rd. Bad coke and iron will cause sulphur-holes, the same as wet sand and cores will cause blow-holes in pipes. To get good sound pipes to stand the test well, the proportioning of charge for cupola requires judgment. It should always consist of two kinds of pig-iron and scrap, good coke, and a quantity of limestone (about 1 in 20 to 30; it is used as a flux, and no cupola can be said to work properly without it). The pig-iron used should contain a good percentage of carbon, it being more fusible and flows easy. At some places the cores are rammed up with sand in half-core box, and jointed for common pipes; but it is a way that does not suit—A SAND SCRATCHER.

[44655].—Condenser.—To "SUNLIGHT."—The joints have all been examined and found tight. I should have said 18ft. lift. Instead of a pump, as you suggest, how would it do to connect to water-main, say, 1in. pipe, to use it along with the 13ft. lift? I don't require to use the 18ft. lift often—not more than, say, 24 hours in 12 months. A 3in. water-main is on the premises.—W.

[44666].—Electric Clocks.—I have not finally decided as to the battery, and intend to try several kinds. Hitherto I have used the perchloride of iron battery, which consists of zinc in salt and water in a porous cell, and a carbon plate in a solution of perchloride of iron in the outer cell: this gives a strong current and is fairly constant. My clock is finished in the rough—it works well, and strikes the hours and half-hours; the whole working automatically by electricity.—H. B. T. S.

[44668].—Cupola.—A cupola about 22in. in diam. would melt the iron you require. Fan should not be less than 20in. in diam. or the castings you mention. No. 1 pig would stand; scrap; No. 2 1/2; No. 3 would have to be used without any mixture if castings are thin. In charging furnace fill up to 13in. above tuyeres, then use a riddell of coke to 2 1/2 or 3 in. of iron. I should not use "Cleveland"—it is very bad-running iron; use about a couple of handfuls of limestone every time you cast.—J. N. O.

[44671].—Astronomical.—Without inspection it is almost impossible to tell what the defect in your reflector actually is. If, as you state, you are able to divide—Anatom with a refractor of this aperture, difference overnight can certainly have nothing to do with the fault. You say that "the silver film is deteriorated considerably." If the film has become tarnished, rubbed off, or injured in any way, this may of itself explain half the difficulty. The mirror alone may be in fault, or the small diaphragm close to the eye is out of centre; but it is, I repeat, utterly impossible to judge without examination. My advice is, send it, or take it to one of our first-rate opticians, and await his verdict. By the way, you mention a Sun refractor "of first-rate quality," as not showing

companion to the Pole-star. Surely this is an error.—ACONITE.

[44670].—Tricycle.—If you will refer to page 14, No. 859, you will see some remarks on the subject which indirectly bear on the question. I must, therefore, tell you, I think for easy riding that 50in. wheels are too large for comfort. Without seeing your general plan, I should not like to say definitely, but it certainly appears to me, from the information already given, that you are introducing needless complication, parts, and weight. I think you would do better to have the riders sitting side by side as the double Devon motion and several others. In your plan the power of the one rider would be first transmitted to the second pedal shaft, and thence the collective strength of both to the drivers. I have recently seen a machine in which two riders sat back to back, which enabled the power of both to be transmitted direct to the main crank, and that without the additional pitch chain, &c. This plan retained the advantage of a narrow machine to pass through ordinary doorways. For the reasons I give in the letter I name, I should not recommend wheels over 44in. at outside; but if you like speeded up to 50 or so, you will find that quite enough. Your frame should be steel tube, say, 1 1/2 outside diam. The size of the spokes would be in proportion to the number of them. On hearing further, I shall be at all times pleased to help you.—SUNLIGHT.

[44674].—Small Boiler.—The class of boiler you are thinking of, as I read your query, is that of a plain cylinder with two cross tubes or flues. Such a boiler would not be one I should advise by any means, but if our friend was to set such a boiler without the cross tubes and as an ordinary externally-fired boiler, then well and good. Please, however, to fully understand that I do not recommend such a class even, as they are open to gross defects in careless hands. Possibly the vertical way of setting the boiler is to economise space; but such economy would not be much in the long run. If you have a boiler built to your order, I should most strongly advise a Cornish. There you have a main furnace tube running from end to end of the shell, and to which it acts as a stay; and such would be far better on many scores than plain vertical. As to the seam, if you can get a welded one, well and good; but see that the firm who make it really can make a good job of it. Otherwise, I should prefer a riveted one, and, therefore, if you go to any ordinary boiler-making firm I should say have a riveted one. Both dimension and thickness of plate would depend on the class of boiler, and it would not matter whether it was an ordinary externally-fired, a Cornish, or vertical with internal firebox. If you will, after perusing what I have just said, let me know what class of boiler you decide on, I will give you all dimensions, thickness of plate, and other particulars necessary with pleasure.—SUNLIGHT.

[44682].—Enlargement of Photo to be Finished in Oil.—There are but two ways, based on the same theory. In the one case you might use the apophengoscope with a lantern, or other a megascope could be used. But let that neither of these instruments will produce a clean and sharp image in the enlargement; it will be a loss of sharpness, but at the same time affords the artist a chance of getting the outline, and gives some little idea of the enlargement. But a strong light is needed, and either instrument a card photo can be used for purpose. Both Mr. Lancaster and myself have several times described the apophengoscope in pages of this journal; but if the question is the back numbers by him, should our value be tributor Mr. Lancaster be unable to spare, I will give any additional information necessary.—SUNLIGHT.

[44683].—M. R. Engines.—Thanks to "tear" for his very full reply to my query. The engine was built by the M. R. Company, and is at Bedford. 200 is a six-coupled tank, built Derby, 1875, and stationed at Birmingham. 212, and 213a are of same class, and all rolled but I do not know date. 299 is a six-coupled goods engine, built at Derby, 1899, and stationed at Birmingham.—J. L. F.

[44685].—Turner.—We occasionally turn the balls between the centres of the lathe, by having pieces cast to the balls for holding in the chuck, and taking carrier; we use a steel gauge to insure roundness; then, when turned, we count of each and file up to the same steel gauge.—WAGNER TOM.

[44672].—Pannikins.—If "Engineer" will advertise his address in the "Scripsey Ad Column," I will inform him where he can get them made by machinery and by hand.—R. R. DUNN.

[44687].—Waste of Soap and Soda.—The soap and soda will probably be dissolved and an enormous quantity of water as to make it possible to recover them economically. By salt to a pretty strong soap liquor would last

It is said that a 10-light Brush Gy
machine has worked 400 Swan lamps
the amount of 100,000 hours.

oxygen and hydrogen, those two gases when separated can be recombined with the production of intense heat and water, and it is also obvious that the energy given out in the shape of heat will be rather less than the energy expended in dissociating the gases when in the shape of water, as there will be some loss in the most perfect arrangements. Hence it would appear to follow that no practical advantage can be obtained by making gas from water. Advantage does not always follow directly, but sometimes is obtained by results which at first would not have been expected; and it is not improbable that unless some unforeseen improvement can be made in the steam-engine, or at least in our method of supplying it with heat, the gas-engine and other appliances will ultimately drive it out of the field. It is, however, mainly on account of the enormous waste of the theoretical energy possessed by coal which now goes on even in our best furnaces that it is possible to utilise water-gas in an economical manner, and as the use of gas instead of coal would relieve us of the nuisance of smoke and noxious vapours, there is much encouragement to experiment with new ideas. The Strong water-gas is produced by the decomposition of steam in the presence of incandescent carbon, which may be the best anthracite or the commonest slack, the constituents of the resulting gas varying slightly with the quality of the coal. From an ordinary good coal the composition of the gas in volumes would be about 34 carbonic oxide, 52 hydrogen, 4 marsh-gas, and 10 carbonic acid and nitrogen, the last two being the only useless constituents of the gas, which is said to have a calorific value of over 8,000 heat-units per pound, and a flame temperature of over 5,000° Fahr. It may well be doubted whether the temperature has been accurately measured, but it is clear, from the small percentage of non-combustible constituents, that the gas is practically the essence of fuel, and is in such a shape that it can be consumed with the greatest economy, cleanliness, and convenience. The Strong water-gas has a rival in this country which promises to be of considerable value, and as it has been tested by Messrs. Crossley in a series of trials with an Otto gas-engine, an account of it will be of interest, more especially to those who require small motors in districts where coal-gas is not to be had and steam-engines are objectionable. The Dowson gas is prepared by decomposing steam in the presence of incandescent carbon, the novelty or specialty of the invention lying in the apparatus by which the production is carried on. The retort consists of a cylindrical vessel of iron, lined with a thick coat of ganister, to prevent the oxidation of the metal and loss of heat. At the bottom of the cylinder is the grate on which the fire is piled, and under the grate is a closed chamber, into which a jet of superheated steam is forced, drawing air with it, and at the same time forcing its way through the fire. The steam as it passes through the incandescent fuel is decomposed, the oxygen combining with the carbon of the fuel to form carbon dioxide, which is subsequently reduced to the monoxide as it rises through the fire, and the result is a mixture of hydrogen, carbon monoxide, and nitrogen, with a small percentage of carbon dioxide, which is given out in a constant stream while the supply of fuel and steam is kept up. The steam is generated in a boiler, and is superheated in a zigzag coil, the pressure being about two atmospheres. The quantity of water for 1,000 cubic feet of gas is said to be only about seven pints, and the small-size generator makes gas at the rate of 1,000 feet an hour, at an expenditure of 4½d. The quantity of anthracite needed is 12lb., and that, multiplied by nine for the working hours, gives

a consumption of nearly a cwt., the cost of which may be put at one shilling. Repairs and depreciation of plant are put at 5d. a day, and interest at 5d., while the allowance for labour is 1s., or a total outlay of 2s. 10d. to produce 9,000 cubic feet of gas. As 1,000ft. will be used for heating the coil, there remains a net yield of 8,000ft. at 4½d. per 1,000. In larger quantities the cost is materially reduced. The gas produced by the aid of anthracite is sufficiently pure for many purposes; but where great purity is required or is advisable, as in gas-engines, the gas may, with advantage, be passed through hydrated oxide of iron on its road to the holder. Anthracite is, however, completely free from impurities, and the cost of the hydrated oxide is merely nominal, as it is readily revived by exposure to the air. Where the gas is required for heating furnaces coke or any kind of coal may be used; but where the gas is needed for driving an engine or for illuminating purposes, as it can be readily carburetted, it will be more economical to use anthracite, as the resulting product is free from tar and ammonia, and contains little sulphur. The small percentage of carbon dioxide does not sensibly affect the heating power. Smoke is avoided entirely, and there is no deposit of soot when the object to be heated is placed over the flame. As mentioned above, experiments have been made by Messrs. Crossley with this gas in their "Otto" engines. In one case the trial extended over a week, and diagrams were taken every half-hour, the result showing that sufficient of the Dowson gas can be admitted without altering the cylinder. The comparative theoretical explosive force of coal-gas, and the new water-gas is as 3:4:1: that is, coal-gas has 3½ times the energy of Dowson gas; but, experience has shown that, owing to the slow combustion of carbon monoxide, and the presence of diluents in the cylinder of the engine, it is better to allow five volumes of the new gas where one volume of coal-gas would suffice, and then the same uniform power is obtained. If, then, by the most economical method of preparing the gas, it costs 3d. per 1,000 cubic feet, it is much cheaper than coal-gas for the same amount of energy. Coal-gas, however, is extracted at the rate of about 1,000 cubic feet from a couple of hundred-weight of coal, whereas, according to the statements made in connection with the Dowson gas 1,000 cubic feet are obtained from an expenditure of 12lb. of anthracite, the fuel being almost completely gasified: hence the cost of transport and storage in certain circumstances becomes an important item in the calculation. The gas has been successfully carburetted and used for illuminating purposes at a cost of about 4s. per 1,000 cubic feet, consequently taking all points into consideration there are many advantages which will help to turn the balance in favour of water-gas. On p. 86, Vol. XXVIII., we gave an illustrated description of Livesey and Kidd's method of making gas by decomposing superheated steam and enriching the products by means of naphthaline. The process in some respects resembles that employed for the Dowson gas, but in the latter case the retort is protected from the effects of oxygen by lining it as mentioned above with a thick coat of ganister. The Dowson gas was shown in action at York during the recent meeting of the British Association, the steam injector causing the gas to be made so rapidly that a holder is easily filled against a back pressure of 1in. to 1½in. of water, gas being, in fact, continually withdrawn from the holder while it is streaming in from the generator. The use of the holder of necessity retards the production to a certain extent, but for certain purposes it is indispensable. For supplying the furnaces of steam-boilers no holder is needed, as the

gas can be led off to the burners as fast as it is generated.

CART AND WHEEL-MAKING.—X.

By J. CHARLES KING.

(Continued from page 515, Vol. XXXIII.)

REFERRING to illustration 16, page 514. The hind foot-board is formed of solid board serving as a door, hinged to the hind cross-bar at G, and held in position by two light chains E. When this door is shut up, it is made to lock into the under edge of the hind seat-board, sometimes to loops or latches at each end.

The side-rails, of 7-16in. round iron, are made at each end into strong flaps ½in. wide, to be screwed to the edges, or better, the insides of the boot A. Into this side rail is fixed the stays which carry the two curved mud-wings, W, by cross-flaps, these wings are of bent beech or birch usually, and 6 or 7 inches wide.

It is usual with the best work to have two steps, H, fixed to the under side of the body, behind, the fixing being an L-shaped corner plate held to the cross-bar by bolts, and to the boot by strap-bolts, which are iron plates with screw-holes in the strap-part for fixing inside the boot, and bolt-ends and nuts to fix through holes in these step fixings.

Small upper steps, I, are made either in the same pieces as the lower steps, or separately, and serve to make the stepping more easy over the chain K of the back-door, in getting up or down.

The body rests on two fulcrum bearings fixed on the shafts in front, into which the front cross-iron of body turns slightly when the shafts play to the motion of the horse's stepping.

The back ends of shafts may be fixed either by swinging-shackles to a stay, or a cross-spring to give extra ease of motion to the shafts.

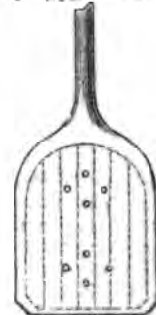
The front steps, like the hind ones, have double treads, or foot-plates, to make getting in and out of the cart safer; it will be found that the square-fronted treads to the steps are safer to prevent the foot slipping, than the round or oval treads, and the jags, or sharp points raised on the face of the tread, should be never allowed to wear smooth, or the foot may slip and cause a serious accident in getting up or down.

Fig. 17 is a sketch of step-tread, designed especially to prevent slipping in getting up or down quickly, and also to prevent it catching a lady's dress in descending it, is about ½in. hollow on its width of 6in. by 8in. length.

The shooting-cart, and village-cart bodies having been described fully, so that any person having a slight knowledge of the use of saw, plane, and chisels and suitable shop and bench, may safely venture to make either one or the other. The carriage, as the shafts, springs, and axle are termed, may be taken in hand with confidence, though it may not equal in all respects a shop-made cart: it will be substantial, and as well proportioned as the average of cheaply-made carts, and certainly more durable in some essential parts.

Do not buy any part of the carriage ironwork till you have planned your carriage to suit your body, you will find a good assortment of ironwork made to measure, for your purpose at most coach ironmongers. The various parts will be de-

FIG. 17.



scribed and illustrated for your guidance, as the details of manufacture, fitting, and fixing, are given.

For either shooting or village-cart bodies, shafts may be sawn out of ash planks, or can

ght ready-shaped at the timber-benders, is mostly preferable from being of choice-lancewood is best. Whenever you can do nothing till you know and the length of shaft, throw-up from horizon of bottom of body to horse's shoulder, side curve, from width of bottom of body contracted measure of the width of the body, just behind the shoulders and at adest part of barrel.

le measuring for these proportions, you, mple system of estimating, obtain the donal widths and depths of all other parts marriage and ironwork.

sterring to the illustrations of full-size rts already given, you will observe that the may be horizontal with, or curved up e body-line to the horse's shoulder.

height of wheel mainly decides this curve, -a low wheel needing much curve, a high one.

ll serve a learner's purpose best to assume is needed for the shafts, so as to be able ain how that is to be measured for, as to explain incidentally the process of bending, in case of a desire to try, or the y for some alteration of the curves of fts.

uch of preliminary thought fer fitting riage to suit the horse.

, a little must be said, before explaining gram, about fitting certain parts for the and safety of the rider. This matter is n left to the haphazard of a guess about ear enough, when a little forethought of ion in relation to the action of the rider's and legs in getting up or down would h risk, which, with a restive horse, is ght at times, to say nothing of comfort, lly for a lady rider.

ference to the drawing of village-cart, the parts of which are drawn propor- y, it will be seen the wheel at $\frac{1}{2}$ in. to the s 4ft. 4in. high. The height of wheel ines the height of steps, as the height of n relation to the level of the bottom of ly determines the upward curve of shafts, hafts are fixed under the body, and also ionally if they are fixed outside the body; , where the body is sunk between the as in some carts, which will be referred

ie trade every workman adopts a simple of planning his carriage and ironwork, rking heights and bearings before he bether to order the bent shafts, springs, tepe, scrollirons, or dashiron, which will lained somewhat fully, with descriptive added, by a chart designed specially for the of the E. M. The cart-maker uses a simple th—to any one out of the trade, this lath encil cross-marks and figures attached to and sometimes a single word on a line, appear mysterious; yet, it is a guide for workmen to follow in their proportional ements, not only of lengths, but dial strengths of parts. Thus, it is obvious, with a stem 21in. long, must be made or than one with a stem 12in. long, to strain. To simplify the explanation of esures of the heights of various parts arings of a dog-cart carriage, two charts introduced and explained: one, Fig. 18, of elevation; the other, of the plan of a e. These will serve, with slight obvious ations, for any cart or two-wheeled and for various sized horses.

ittle forethought and attention to these ave a learner time, expense, and perhaps, rs, which cannot be easily rectified. ing the ground as your base of measure- you commence the measure of your full-rawing on the blackboard, by a vertical awn through the axle to the top-rail iron ly.

Description of Chart, Fig. 18.

is the ground line, C D the vertical line; h the centre of the axle from C to D are and figures, which tell the several heights s of the cart from the ground, all measured ally from the ground. As all the parts it to be fixed on the axle, this is the point of measure in relation to the others. le centred in a 4ft. 4in. wheel, would the first measure 2ft. 2in.; to this is $\frac{1}{2}$ in., the top of a 1 $\frac{1}{2}$ in. axle, above this , the spring bearing-block; a five-plate is $\frac{1}{2}$ in. thick, making altogether

2ft. 4 $\frac{1}{2}$ in. to the top of the middle of the spring. The body need be no higher up than is sufficient to allow these springs to yield without causing the bottom of the cart to strike the axle. 9 or 7in. space is enough, if the body is fixed between the shafts; it is mostly about 10in. if the shafts are fixed under the body, as in the chart. For a low horse, this is best, as it raises the body up out of the mud-splashing of the wheels.

The spring, 3ft. 8in. long, will be about 4 $\frac{1}{2}$ in. curve before the weight of the dog-cart is fixed

the tug bearings, 1ft. 7in. back from the forward point of the shaft, and are 3ft. 9in. under the tug bearings, from the ground.

The next upward measure is the seat line of body, 15 $\frac{1}{2}$ in. from the bottom of the body, and 4ft. 4in. from the ground.

The seat-rail being simply for the purpose of keeping in the cushions and dress of riders, may be any height and form, either straight, curve, or double sweep; here, it is 4in. high, and marked 4ft. 4in. from the ground. The side-rail iron is about 4in. higher than side-rail, and

Chart of the Several Heights of the Bearings and Parts of a Dog-Cart for a Cob 14 hands high.

FIG. 18.

Side elevation.

(Front of Dog-Cart.)

(Back of Dog-Cart.)

Top of Dash-iron 5ft.

Top of Rail-irons 5ft.

Top of Side-rail 4ft. 8in.

Top of Wheels 4ft. 4in.

Seat-line 4ft. 4in.

Under Tug bearing 2ft. 9in. (shaft).

Bottom of Body 3ft. $\frac{1}{2}$ in.Top of Shaft 2ft. 11 $\frac{1}{2}$ in.

Bar, and Bottom of Shaft.

Upper Step 2ft. 9in.

Upper Step 2ft. 9in.

Front Scroll-iron 2ft. 8in.

Hind Scroll-iron 2ft. 6in.

Top of Axle-block 2ft. 3 $\frac{1}{2}$ in.Top of Spring 2ft. 4 $\frac{1}{2}$ in.Top of Axle 2ft. 2 $\frac{1}{2}$ in.

○ Axle.

Lower Step 1ft. 8in.

Lower Step 1ft. 8in.

A

Scale 1in. to the foot.

Ground line.

B

on it. The next upward measure is the scroll-irons, 2ft. 8in. in front and 2ft. 6in. behind, the difference of 2in. is made up by a 2in. swinging shackle behind; this allows the spring to lengthen and play easily. If the eyes of the springs are lined with vulcanised rubber, there is less jar and wear throughout the dog-cart.

The first difficulty in planning will be for a learner to know where to fix the front and hind scroll-irons. In all heavy carts, and many light ones of common make, the scroll-irons are fixed under the shafts, and bolted there; in the lighter and better work, they are fixed to the body quite free of the shafts, in a way which will be described hereafter. The chart admits of either arrangement by measuring either under the body or shaft for the depth of the stem of the scroll-iron, which would be 2in. more if fixed under the body as is recommended: Upper steps, 2ft. 9in., lower steps, 1ft. 8in. from the ground. The next measure upwards is the top of the shaft (1 $\frac{1}{2}$ in. thick), 2ft. 11 $\frac{1}{2}$ in.; the next measure, the underside of body, 3ft. and $\frac{1}{2}$ in. from the ground. The shafts are 5ft. 10in., total length forward from the front edge of body, and curve upwards 8 $\frac{1}{2}$ in. above the horizontal line to

usually matches the line of the side-rail, straight or curve. This is 5ft. from the ground.

(To be continued.)

PRACTICAL NOTES ON PLUMBING. XIII.*

By P. J. DAVIES, H.M.A.S.P., &c.

Traps (continued).

Half U-Traps or Siphon-Traps.

FIRST, you require a block the shape of your trap, or block in two halves, the seam being on the side (that is, if you have many to make), and two rings made in such a manner that they can be slipped over the block and the lead, and with thumb-screws screw together, so as to hold the lead upon the block, while you are working it to the shape of the block.

Now for the size of your lead: Take a strap of lead, say, $\frac{1}{2}$ in. wide, and measure round the trap from M F D to A (Fig. 68, p. 29). This will

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give you the length for the bottom. Now take the circumference of the trap to get the size. Half this will be the width for you to cut the lead, which must be cut truly, and with planed edges. Next, just where the lid is to fit D, take the mallet and hollow your lead a little, not to thin the lead, but just to fit the bottom of the block, then offer it on the block and end up the inlet end; take the ring and fix it on this part of the block. Next bend up the part from D to A, and with the other ring fix it there, then with your tools a bossing-stick will do work the lead to the shape of the block, taking care to drive the molecules of the lead in the direction you require them to flow, and be sure that the lead is of uniform thickness; in like manner do the throat or top part. Care must be used to hollow and fit the lead to as nearly as possible the proper shape, by first turning it back, and with the bossing-stick well drive up the throat part, C in place, Fig. 68. This will thicken the lead; after which place it upon the block and bend over the back to the out-go, and with the rings fix it there, then work it to fit the block.

I have before said this should be in two halves, this will give you a line to trim your lead on, should you require it trimmed off for soldering.

The next thing to do is to solder it up, which may be done with the copper-bit, wipe it, or burn it. The last-named is much the best.

Q-Traps made in Three Pieces.

This is a very old method of making Q-traps: the bottom Q D F is cast, the dip M L soldered on, burnt in, as also the out-go A Q J. A



moving it a way weighting over feet., lately seen out of an old house in Knightsbridge, illustrating the method is shown in Fig. 72.

Q-Trap with Legs for Fixing above Floors Fig. 73.

Fig. 73 is a diagram of an Q or half Q-trap the fitting above floors suitable for short or low narrow drains.

This trap may be made with cleansing cap and screw and can be wiped down to the soil.



Fig. 74 is a diagram of a trap. This style of trap, now made in brass, is the best for use in the house, as it is made of brass and is not liable to rust. The fitting is made of brass and is not liable to rust. The fitting is made of brass and is not liable to rust.

The same style as Fig. 75.

The same style as Fig. 75, but with a different fitting. The fitting is made of brass and is not liable to rust. The fitting is made of brass and is not liable to rust.

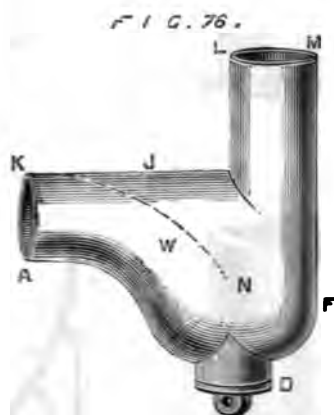
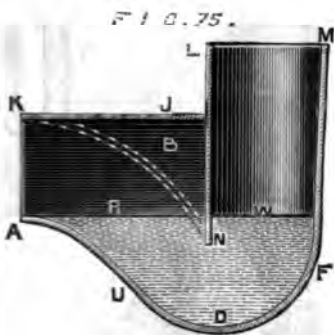
The bottom part, D H R, of this trap may be bossed up on a block or otherwise, and the top



or inlet soldered on, so that the lower part R B, forms the water lock. The foot E is also soldered on. Of course this trap can be fixed below the floor-line with the outgo soldered on in the usual way.

The Eclipse Trap (Figs. 75, 76).

This trap is a good and useful one, having a



dip N, with rounded bottom and top; an air-chamber B, which prevents waving out (the great fault in the Q-trap).

The Eclipse is cast in one piece of lead. Fig. 75 is the elevation of it, showing that the whole is rounded, which, in the estimation of many sanitary engineers, is a great advantage.

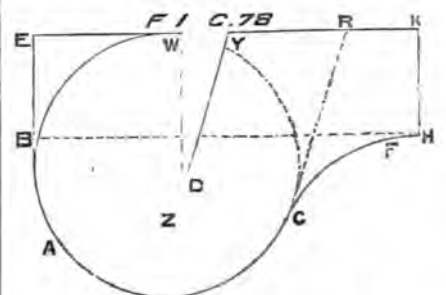
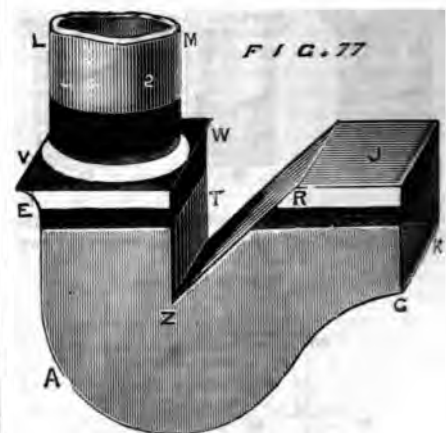
V-Traps (Fig. 77).

This excellent trap is, in principle, part Q and part Z-siphon. Z is the check; T the throat; J the top, which also goes down to form the throat, and up, then over to the top to the top or inlet-pipe is soldered on last.

The method of cutting out this check Z is as follows:—First strike the circle A, W, C, Fig. 77, draw the right line E K, cutting the top of the circle; next draw the line E, square to the top line, and cutting the circle at B; then measure off the outgo R, with the distance from A, to the extreme periphery of the circle at C; now, with a straight-edge, draw the outgo line E, to cut the edge of the circle, as at C, then draw W D square to the top and the slanted line Y D, taking care to go low enough at the throat to make a good dip. Prepare this check and solder on the band, as at K G A E, Fig. 77, then the top, and dip in another piece, after which, solder on the inlet-pipe L M. Of course the throat part and up T W Z to R is soldered from the inside, and the part R E after. Messrs. Beard, Dent, and Heiler make a cast trap somewhat similar to this last described.

Q-Trap.

This trap has stood its ground for at least 200 years, and there can be no doubt it had its origin from the dip pipe and bowl trap, then to



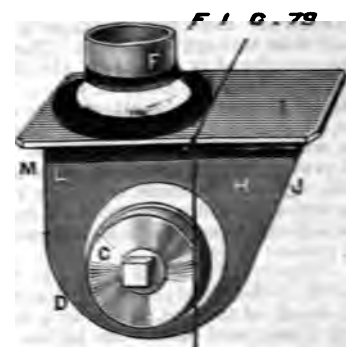
the shape of the Q-trap (to be explained shortly), then altered again to its present shape of a Q.

But, in whatever way this trap first originated, there cannot be a doubt that it has lately got into sad disgrace with many who do not know its merits.

The Q-trap has been made by many plumbers, who never thought it was wanted for anything more than the keeping back of stinks; they have made it to almost any size and shape, not troubling or caring whether it cleared itself or not.

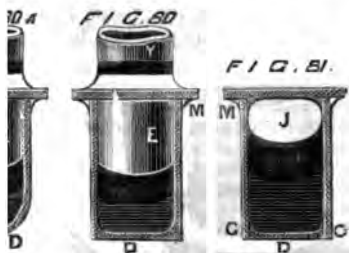
I shall now show the best method of making it, so that it shall be what is generally known as self-cleansing; at the same time I shall keep within the bounds of that principle, which, I suppose, is universally known to be the beauty of the Q-trap—viz., the clearing the soil from the inlet to the body of the trap, and its retaining the water-seal or lock; especially against the waving out caused by strong currents of air blowing down air-pipes or up soil-pipes.

Fig. 79 is an elevation of the Q-trap, having a cleansing cap and screw C soldered into the side or cheek; this latter being fixed here, is

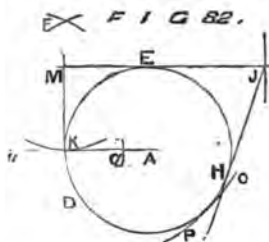


more for sink work than for closets—in fact, the proper place for this cap and screw for closet-work is at I. In order to get at it, I have made Q-traps with the dip to screw in and out, but for sink-work it is best at the side or under the bottom, as at D, Fig. 80. This allows you to take such things as tooth-brushes, &c., out of the dip, which cannot pass into the body of the trap.

shows the outgo from the inside of



shows my geometrical plan for striking the heel of a self-cleansing trap.



of this is obtaining the point J, so I make the same angle in any sized, the angle of 76° .

For this, take a piece of lead, having one edge, as from M to J, open the compass, say, $4\frac{1}{2}$ in., and scribe the circle D E H, a line at E, then with the square M to touching the circle at K. Next and most, place the point of your compasses at meeting point M, and with the other distance to the outside point of the at H, and as shown at O P arc; then, obtained this exact distance, set it off line M E, as at J. This is the length of Next from the point J draw the outgo and this will be the proper angle to water to rush and sweep everything lip, along the bottom of the band, and the soil-pipe.

One thing to be considered is the depth for self-cleansing purposes; this is by the size of the dip-pipe E (Fig. pose the dip-pipe to be 4 in., and the the same, then the 4 in. outgo will take the cheek, that is from the top down -pipe or outgo, as at K J, Fig. 83, so must be 4 in. Then you must have the r than this to get the seal—which ver in any case be less than $1\frac{1}{4}$ in. to re in this case the bottom of the dip is n the trap; then you should have 4 in., e of the dip-pipe, between the bottom nd and the lower edge of the trap. d be a $9\frac{1}{2}$ in. trap, but this is not or $3\frac{1}{2}$ in. will be plenty for the space he bottom of the dip and band, which, t of being, so to speak, here contracted, will have a better scouring action on n of the band, and the band being flat, will allow the soil, paper, &c., to away; in fact, although you have only ween the band and dip, there is more y than through a 4 in. pipe. The next ; considered is the width: this should self-cleansing trap, only just wide admit the dip, whether 1 in. or 6 in.; if you use a 4 in dip-pipe, make the wide enough to admit this pipe. proved, beyond the shadow of a doubt, e trap is made according to the rules, it will never fail in doing its self-cleansing trap, and supersede all present invented.

—Firstly: The depth should be twice ter of the dip-pipe, in addition to the depth of the seal, which, in a former I have said should not be less than $\frac{1}{2}$ in.

Secondly: The band or width of the trap must be wide enough to admit the dip.

Thirdly: The outgo soil or waste-pipe must be less in diameter than the dip-pipe.

Fourthly: That when soldering on the outgo pipe, the top of this pipe should be up to the top of the trap, as at K, Fig. 83, as smooth as possible, and without

Fifthly: Keep the dip-pipe close up to the heel of the trap, as shown at N, Fig. 83.

The Action of the S-Trap.

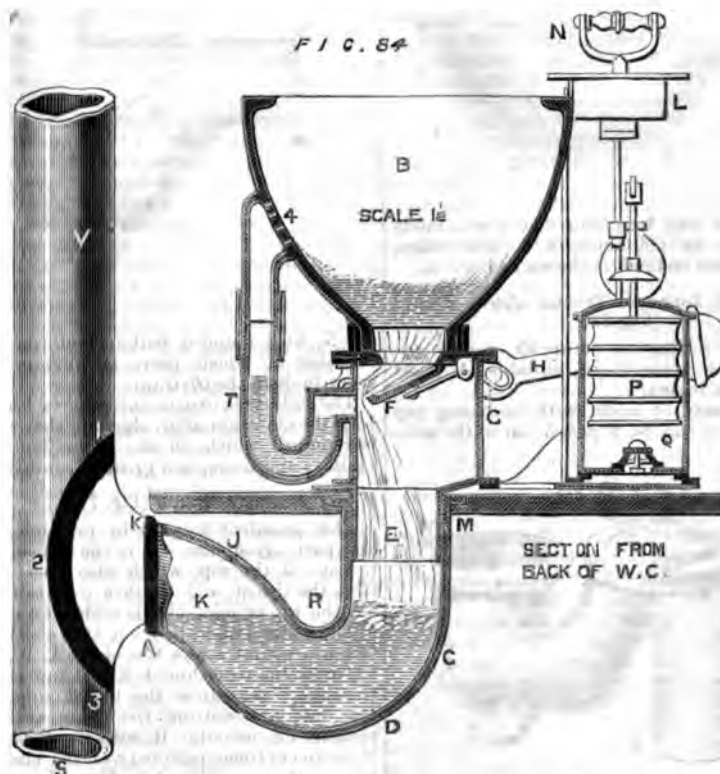
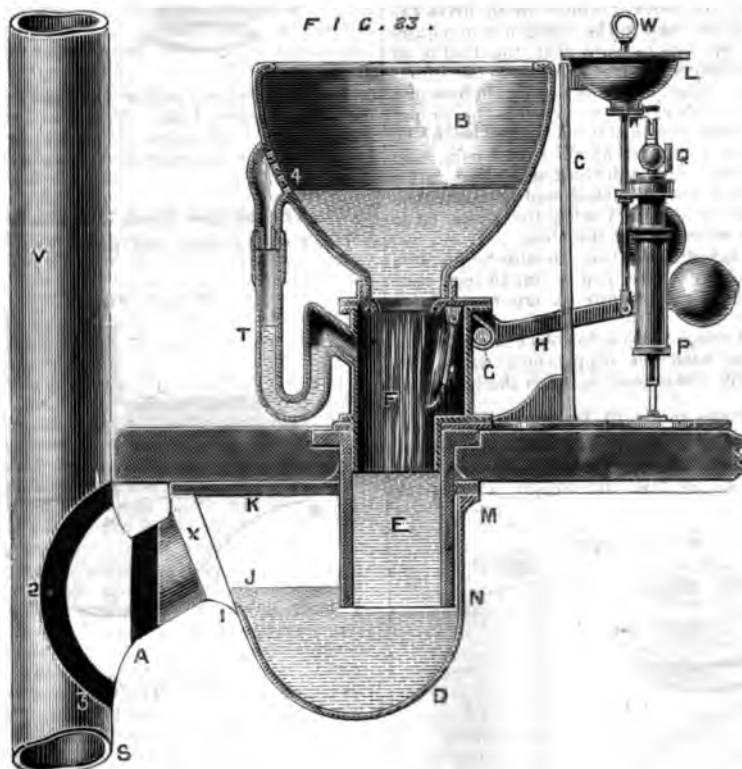
Junior plumbers will do well to notice the details of the action of the S-trap.

On lifting the handle W, Fig. 83, it brings up the lever H, with it the tumbler pin G, and the crank which works an axle having the loose

presses flatly, so to speak, on the surface of the water, and so keeps it steady. Having, I think and hope, made the working of the S-trap clear to my readers, I must now refer them to Fig. 84, in which I shall endeavour to show the working of the S-trap.

The Working of the S-Trap.

So far as the closet apparatus is concerned, you have the same work as you had in the S-



valve F attached; the water then runs the full bore of the dip-pipe into the trap, striking against the band at D; it then flies off at a tangent to the point J, where it again strikes into the soil-pipe X, and down the pipe S; the air-pipe V, allows it to travel onward without dragging air through the trap; but should there be a strong wind blowing down this ventilating-pipe, or upwards from the sewer, &c., the air

trap. But the difference in the action of this and the S-trap is that owing to the shape of the S-trap; the wind, on blowing up the soil or down the ventilating-pipe, plays on the water at K, causing it to rock rapidly owing to the shape of the trap. This possibly goes on for ten or twelve hours, but, perhaps, only a few seconds. This rocking motion of the water causes it to ebb out through the outgo of the

trap; thus, the so-called O-trap ceases to be a trap, and becomes only a snare.

Thus, I venture to suggest, is a sufficient reason for all sanitary engineers to condemn the O-trap, and, until they can find something to supersede it, use the U, which I must repeat and have already proved publicly, is the best trap yet invented.

(To be continued.)

THE WATCH AND HOW TO REPAIR IT.

By SECONDS' PRACTICAL WATCHMAKER.

(Continued from page 561, Vol. XXXIII.)

Geneve Barrel-Ratchet Cover Screws Overturn.

WATCH-jobbers are not surprised to find one or more of the screws "overturn" which should secure the barrel-ratchet cover, and that portion of the hole which should hold the "tapped" portion of the screw, with no thread in it, and too large to enable anyone to make the hole suitable for a larger "tap." The security of the ratchet-cover requires little comment, because, by its soundness of securing the watch, the firmness and upright of the barrel is maintained. When one or more of such screws "overturn," and the should-be "tapped" hole destroyed, the best method to adopt is as follows. Having selected the quantity of screws required with suitably sized "taps"—supposing that such are at hand without the trouble of making them—fit them into a hole of a "screw-plate," so as to be enabled to have a die by which to make a "tap," so that a new tapped-hole can be made by it which will suit the screws selected. Next make a "tap," which should be a trifle smaller at its end, with four sides to it, which will serve to enlarge a hole that might be too small for the intended new screws. The screw, and the "tap" suitable to form the hole for them being prepared, the old hole is next to be "plugged." Such may be suitably accomplished thus. Obtain some "stopping wire," the size of which should be such size that the prepared "tap" form a good thread in it for the intended screws, previously to "plugging" the barrel-ratchet holes—which usually contain a small number of threads. The prepared "tap" and screws being prepared, the "stopping wire" should be slightly "taper" the "barrel-ratchet" with a very smooth file, it then can be fixed in a "tap-hole," and by the aid of a "screw-plate," a light thread can be formed upon it—without leopene. The "tap" referred to is of a fine thread in the screw-like of the tap, which the "barrel-ratchet" may be served. Before the intended "tap" is finally used to such barrel-hole, the "tap" must be marked on by the edge of a very small and fine file, and placed in a groove of a "stopping wire," which by the edge of a knife a slight groove can be formed corresponding to such as is generally upon a "barrel-ratchet," which serves as a guide to separate the required piece which it has been tapped the proper length into the barrel-ratchet. When screwed in and by the "stopping wire" a good screw-hole will be filled up by a screw threaded tapped hole; but in such a state it will not have reached its "full" condition, to use a slight riveting of it will be necessary, after which the protecting portions of it will be done by means of a small "burnisher" or such as an ordinary "burnish" drill which is used for the purpose of turning the hollow of a new upper-pivot to a verge. When the "tap" which the thread "burnish" depends on, have been removed, the screw is then finally completed, care being taken to screw them into the holes, none at all to the "tap" for fear of loosening the new plate. The "tapped" hole should have the sharp edge removed by an ordinary "burnisher" or "burnish" drill.

To Polish and Size Screws for Superior Watches.

How seldom do we see the screws of ordinary watches clean and blue; but on the contrary, their screw-drivers' damages, having slipped from the notch and so spoiled it, that difficulty is experienced in screwing them firmly; therefore, the following remarks, I hope, may enable any class of workman to repair damaged "screw heads": polish them and blue them, so as to be suitable for superior, as well as ordinary work.

In dealing with the subject, we will suppose that a new screw has to be applied, say a "potence-screw," which may serve any purpose of the series. The screw selected and fitted, the attention of workmen is directed to the points following. The soft screw has to be hardened and tempered; a good way of so doing will be to place it upon a piece of charcoal or pumice-stone, and if convenient, it would be better to place it in a small hollow, for reasons that, when the gas-jet from a "blow-pipe" is directed to it, it may be protected from falling; and again, being in such hollow, it becomes "red-hot" more quickly than it otherwise would. Before the screw is placed upon charcoal, a small piece of ordinary soap should be put upon the "tap" of it, the object of which being, by the application of such, after having been hardened, it will be white instead of black, which enables workmen to observe the colour produced while it is being tempered. Many people "harden" screws by making them "red-hot" by means of a "blow-pipe," and "quenching" them in cold water; such is not a good way, because the steel is thereby very brittle, while for such small things as "watch-screws" their toughness is endangered. The best way I have practised is to quench them in oil; by the cold-water method there is a saving of time for those who require rapid production, because, from leaving the water, the screw may be tempered without any other preparation than merely removing the water from it; whereas, when oil is made use of, it has to be cleaned with "soft bread," after which it must be placed in benzole or benzoline for three or four minutes. By the process described the screw will be as hard as "flint," and must be reduced so as to be softer, which is so rendered by placing it in a "blueing"-pan with end of the screw-tap upward, and then held over a gas-flame or "spirit-lamp" until the end assumes the colour blue—in which condition it is prepared for polishing.

The colour produced upon the screw by the act of "hardening and tempering" has next to be removed, which is easily effected by means of a "slip of oilstone" or "Arkansas." Put the screw in the "screw-tool" in such a manner that the edge of its "head" projects a trifle above the part of the tool which secures it, clean out the notch with a thin good screw-head file. The edge of its head should next be polished by the oilstone and oil, after which, the top of its head—proceeded with in a similar manner until the scratches are removed, which were the result of a file. The "threads" of the screw next claims attention, and should be cleaned, which is effected as follows:—A piece of deal wood split half-way, and some oilstone-dust and oil introduced, place the screw—"tap" therein, put the wood into the bench-vice, closing it until it is firmly held, then, by means of good pointed screwdriver placed in the screw-notch and twisted forward and backward, will, in a minute or two, polish the "tap" and the back of the screw-head quite bright; but it may happen that the end of "tap" may be unpolished. Polishing and burnishing it is the work of a couple of minutes. Put the screw into a tool termed a "lantern," revolve it against a cock or such-like fixed in the vice, polish with oilstone, brighten with a clean burnisher.

The screw at this stage of polishing would be "grey," and the next process will be to "gloss" it, before doing which, the screw notch must be seen to, that it is sufficiently deep, for should it be very shallow, the power exerted by the screw-driver might slip out of it and spoil the appearance of its colour, which will spoil the "finish."

To gloss the "screw-head," it must be seen to that by "soft-bread" all previous dirt and grease are removed; an important point to secure as clean, is the screw-head "notch." When the screw has been replaced in the tool similarly as referred to, shape an ordinary "peg" in form resembling the cutting edge of a knife, with which clean out the "notch" with dry redstuff; then a

"bell-metal" polisher about a quarter of an inch broad, charged with redstuff mixed with oil, pressed against the screw with the mandril kept in motion until a smooth surface is produced. Then prepare a small piece of deal wood with smooth surface, charge it with ordinary redstuff and oil, which should be used as an ordinary polisher, after which the "notch" must be cleaned out again with the knife-shaped peg and redstuff; next it requires to be carefully cleaned with soft bread, after which the refuse polishing-stuff must be cleaned by benzoline or spirits-of-wine. At this stage of the process the dampness from the spirit should be wiped off, and left a short time to thoroughly dry. Then have a scrupulously clean brush, by which the screw should be brushed, making use of it in the direction of the "notch."

An important point must here be noticed—viz., after the screw is ready for blueing, the sharp edges of the "notch" should have a burnisher passed from end to end of it, producing a slight bevel which somewhat prevents a burr from the blade of a screw-driver.

The burnisher next claims attention: it must be clean from a good board and flour of emery, and when the screw has been replaced in the screw-tool—having rubbed it upon clean leather, the gloss will appear by little rubbing and light pressure upon it. Having brushed it again, blueing is the completion of the process. The screw-tap being placed in, say, a hole made in the bottom of an ordinary watch-barrel, which, when placed in a blueing-pan held over a gas or spirit-flame, any coloured hue may be produced: a violet is usually admired.

With a little care in proceeding, screws thus polished are the same colour all over, even the screw-notch.

Geneve Lever Occasionally Stop.

The instrument here referred to was useless as a watch. To make use of a familiar phrase, "It was always out of time," and had been accustomed to such for years, and hence I am induced to introduce the defect—for it had but one. When it was in general "pocket use" it would mislead; but when placed in a stand upon a dressing-table or such position with the "bottom" of the case partially open, it would serve its purpose well. After several weeks being in custody of a watchmaker, it was discovered that the "spur" of the fly-spring of the case was, by the closing of the case bottom, pressed against the outer end of the escape-wheel cock; the end of it was shortened, by which the watch was afterwards useful. The fly-spring spur, when pressed against the cock referred to, caused the escape pinion arbor to be bound.

English Lever Stop through Cock-Screw.

Very often watch-jobbers fail to be sufficiently patient when completing their work; instances so often occur to prove such. A lever watch of good quality was complained of as "often stopping." When the testing of it was introduced, the balance had no end-shake, yet it had been a useful watch until its last cleaning. To ascertain the cause why the balance-staff was bound, by the act of unscrewing the cock, it was observed that, as the screw was being "untuned" the cock had a peculiar undulating motion, but its screw did not leave its place as it should; the cock had to be lifted from its position, and upon looking further, it was found that the screw passage-hole was too small, and that such hole had a good tapped hole in which the screw (when screwed down) was secured in it, and that, when it was removed from the cock, it overturned in the plate-hole. The defect was here, for, instead of a screw binding the cock to the plate, it was tight in the passage-hole and loose in the plate, by which the cock was loose, and its gravity caused it to rest on the balance-staff upper-pivot, thereby at times the "staff" had no end-shake. Another properly-fitting screw remedied the defect.

To be continued.

THE PARIS ELECTRICAL EXHIBITION.—V.

FOR projecting light to a great distance, the electric arc, aided by a reflector, is, of course, the only available source of light; but for lighting up a small space, the very power

of the electric arc constitutes a great defect. The eye is dazzled, and it is impossible to work by this too-powerful light. Many attempts have been made to tone down the light, furnished by regulators and candles. The simplest way is to inclose it in a ground-glass globe; much light is lost, but the result is much less fatiguing to the eye. Room No. 15 of the Exhibition is very pleasantly lit up by Jaspar's system, in which the regulator is hidden in an opaque cylinder open at top. The light is reflected on to a large white screen, suspended from the ceiling, and is diffused into the room.

I notice also the *lampe-soleil*, by Messrs. Clerc and Bureau, which lights the picture-gallery just as sunlight would. It may be briefly described as an electro-calcium light; that is to say, the electric arc is inclosed in a sort of calcareous crucible, which being raised to incandescence, adds to the light and gives it a rich mellow tone, which is much appreciated by the public. There is no machinery in this lamp. The two carbons fall by their weight, as fast as they are used up, through the holes in the calcareous block.

The incandescent lamps are also much liked on account of their soft light. Edison's lamp consists of a thread of carbon about 12cm. long and 1mm. section, inclosed in a small glass globe exhausted of air. The two ends of the carbon thread are coppered and fixed to platinum wires which are fused in the glass, and by which the current passes into the lamp. The thread is made of carbonised bamboo. In Swan's lamp it is of carbonised Bristol-board. The latter lamps light the Congress Hall, the small buffet, the British Post Office Exhibition, and the British Commission. Those of the small buffet receive their current from Faure's accumulators. Maxim's lamp differs from the two others in that gasoline vapours have been introduced into the glass globe before exhausting it. The object of this is to renovate the carbon thread by a deposit of carbon on its thinnest parts. The incandescent lamps can give from a dull red to a brilliant white light (25 candles).

C. Details.

ROTATION OF THE PLANE OF POLARISATION OF RADIANT HEAT.

AFTER Faraday discovered the rotation of the plane of polarisation of light by magnetism, it was natural to make the same experiment with radiant heat. According to *Naturforscher*, Wartmann, who experimented with the heat-rays of a Locatelli lamp, inferred from his results a rotation of the plane of polarisation of heat; but several attempts of Parisian physicists, who repeated the experiment, were without success. Later De La Provostaye and Desains took up the question afresh, using sunlight instead of the light of a lamp, and achromatic lime-spar prisms instead of mica-columns in polarising apparatus. They also found an action of magnetism on the plane of polarisation, but the separate experiments showed no satisfactory agreement; besides, they were not quite free from objection, so that the question was still to be regarded as unsettled. Herr Leo Grunmach has lately made a new investigation of the subject, with the help of the more perfect instruments of the present, and he has succeeded "not only in proving beyond doubt the electromagnetic rotation of the plane of polarisation of radiant heat in several solid and liquid bodies, but also determined by quantitative measurements the dependence of the amount of this rotation on the nature of the substance, the intensity of the galvanic currents and magnetic forces acting on it, the length of the layer radiated through, &c."

In these experiments sunlight was exclusively used as the source of heat. It was reflected from an accurately adjusted heliostat and polarised by Nicol's prisms of uncommon size and rare purity, rendering measurements possible; (through ordinary Nicols only very small quantities of heat can pass). The heat-action was measured by means of a sensitive thermopile, consisting of 25 pairs of bismuth and antimony bars, and a Siemens mirror galvanometer. For electrification and magnetisation of the bodies through which the heat-rays passed, the author used a spiral of insulated copper wire, 250mm. long and 55mm. wide, and a very powerful Joule home-shoe electromagnet, with two cubical armatures having axial perforations of

50mm. diameter. The current was always obtained from Bunsen elements, varying in number from 6 to 35.

With regard to arrangement of the experiments, which will be readily understood from the apparatus described, it may merely be mentioned that the two Nicols, one of which was behind the heliostat, the other before the thermopile, were inclined with their principal sections not, as in optical experiments, about 90°, but about 45° to each other, because thus the working of a deflection is at its greatest (in optical experiments this angle is not taken, because the eye is less sensitive for large differences of moderate intensity, than for small differences in the neighbourhood of *nil* intensity). In the experiments the position of rest of the galvanometer needle was determined before the "diamagnetism" was brought between the poles of the electro-magnet; then the magnetising circuit was closed, and the current sent in positive and in negative directions, once when the thermopile circuit was open, then when it was closed. If the magnetising current had no effect on the galvanometer, and the needle with opened thermo-circuit remained at zero, and with closed circuit at the division corresponding to the heat-action, whether the magnetising circuit was closed or not, the diamagnetism was brought between the poles. The position of the rest of the needle with open thermo-circuit was ascertained, then the thermo-circuit closed in positive sense, and the deflection read, then the magnetising circuit was closed in the positive sense, and the deflection read; then the magnetising circuit opened and a fresh reading taken. Then the magnetising circuit was closed in the opposite direction and the deflection noted; then again opened and the deflection produced by the thermo-current observed; lastly, the zero-position of the galvanometer needle was noted. When this series of observations was concluded, the thermo-circuit was closed in the negative sense, and the same series carried out. From the sum of the differences between the deflection when only the thermo-circuit was closed, and when this and the magnetising circuit were closed, both when the magnetic circuit was closed in positive and in negative sense, the electro-magnetic rotation of the plane of polarisation was deduced.

These experiments were made with solid bodies, heavy and light flint glass, and plate glass, and with liquids in a tube closed with plate glass plates, viz.:—sulphide of carbon, oil of turpentine, distilled water and alcohol. The results of the investigation are thus stated:—

1. In solid as in liquid diathermanous substances, there is an electro-magnetic rotation of the plane of polarisation of radiant heat, and it is always in the direction in which the current flows through the spiral, or passes round the magnetic core.
2. The amount of this rotation is, *ceteris paribus*, very different for different substances; the rotation is greater, the greater the index of refraction of the substance.
3. With direct action of a galvanic current conducted round the diathermanous body, the amount of rotation is proportional to the intensity of the current.
4. In a diathermanous body placed between the poles of an electro-magnet, the amount of the rotation is proportional to the magnetic force working on it.
5. The amount of the rotation increases with the length of the layer radiated through, but the relation of the amount of rotation to the length cannot be numerically determined.

ON THE IRRATIONALITY OF THE SPECTRUM IN ITS RELATION TO THE ACHROMATISM OF OPTICAL INSTRUMENTS.—I.

By "ORDERIC VITAL."

EVERYONE who has seen the decomposition of light by means of similar prisms of different substances, must have noticed how different are the spectra thus produced. Not only does the whole extent of coloured space vary in length, but also the space covered by each particular colour, is in no two cases alike. This unequal dispersion is termed *irrationality*, and it has the effect of preventing two prisms from forming a perfectly achromatic combina-

tion. In the present series of articles, I purpose to give an account of the theories and experiments of Sir D. Brewster, respecting this subject. They are recorded in his book on "Philosophical Instruments," to which I must refer the reader for full details; but as the book is out of print, and somewhat difficult to meet with, I trust the following summary may not be out of place in these columns.

Brewster conducted his inquiry, with the view of finding what kinds of glass were most suitable for the formation of object-glasses for refracting telescopes; and although he did not succeed in meeting with a combination which was perfectly achromatic, yet he has shown in what way the greatest amount of correction may be obtained. He made experiments with prisms of a great variety of substances, and during the course of these investigations, many important facts connected with the dispersion of light were ascertained. There is probably no other writer who has done so much for this special branch of optical science; and, so far as I am aware, there is no published account of a systematic course of experiments in this direction, other than that contained in the book above alluded to. The columns of the *ENGLISH MECHANIC* seemed peculiarly suited for the discussion of the present subject; for it numbers among the readers and correspondents of its pages, men of the highest eminence in practical optics. If my humble effort to bring the admirable work accomplished by Brewster into more prominent notice shall succeed in directing attention to this subject, and thus elicit other facts connected therewith, the object of these articles will be accomplished.

In order to account for the unequal dispersion of the colours by different substances, Brewster formed the theory, that it was caused by the various refracting angles of the prisms which were used. But experiment soon convinced him, that this theory must be abandoned, and that the inequality arose from the particular action which each substance exerted on each of the several colours: yet it also became evident that a change in the angle of incidence or in the refracting angle of the prism, caused an alteration in the proportion of the various coloured spaces.

This was contrary to what had previously been considered correct—viz., that the dispersive power of a substance is constant for all values of the incident angle, and for all values of the refracting angle of the prism into which it is formed. But Brewster has proved beyond a doubt that this hypothesis is not supported by facts; for he has shown that two unequal prisms of the same substance, may be placed so as to be practically achromatic, which could not occur unless the direction of the light and the angle of the prism, had some effect upon the dispersive power. This combination showed fringes of colour similar in character, but opposite in position, to those observed when prisms of different substances are made to achromatise. He calls this the *tertiary spectrum*, and proves that its occurrence is in exact agreement with theoretical deductions. With this brief introduction I must pass on to matters of detail; and first, it is necessary to explain what is generally meant by the terms—

Refractive and Dispersive Power.

When a ray of light falls on the surface of a transparent substance, the relation subsisting between the sines of the angles of incidence and refraction is expressed by the constant ratio μ . If i and r represent these angles, then the deviation or change of direction which the ray undergoes is plainly $(i - r)$ or

$$\{\sin^{-1}(\mu \cdot \sin i) - i\}.$$

But if we take a very small value for the angle of incidence, these two angles may be considered as proportional to their sines; so that the deviation may be expressed by $(\mu r - i)$ or $r(\mu - 1)$. If the angle of refraction be constant, the deviation produced by any other substance whose index is μ' is $r(\mu' - 1)$. Thus the refractive index diminished by unity, forms a convenient measure of the refractive power; for it shows what alteration a substance causes in the direction of the original ray. In the optical formulae for the foci of lenses, this quantity is an important factor; and in lenses of the same curvature, but of different media, the degree of convergence or divergence given to the rays

varies directly as the refractive power. But it must be remembered, that $(\mu - 1)$ is a measure of the refraction, only when the angles of incidence and refraction are very small, as they usually are in different forms of lenses. Therefore, when applied to prisms, in which the angles are of considerable magnitude, it will give a result which is slightly in error.

Hence, the refractive index diminished by unity, forms the usual measure of the refractive power of a substance: it is a convenient approximate value, which is in general sufficiently near the truth, but which should not be used for purposes of comparison, when the angles of incidence and refraction are large.

When a ray of light is refracted by a transparent substance, the various constituent colours are sorted out and arranged in the order of their refrangibility. Violet suffers the most deviation, and occupies one extremity of the spectrum; while red, being least affected, occupies the other end. There is a distinct value of μ for each of the different colours; but in obtaining a measure of the refractive power, we must find the index of the middle ray between the violet and red extremities. This, under the same conditions as before assumed, is equal to the half sum of the red and violet indices.

If μ_v be the violet index, then for a small refractive angle r the deviation of the violet ray is $r(\mu_v - 1)$. Similarly, the deviation of the red ray is $r(\mu_r - 1)$. Now the difference of these deviations, or $r(\mu_v - \mu_r)$ shows the angular space over which the colours are spread; hence it is called the dispersion of the substance, and is usually denoted by the symbol $d\mu$. In order that we may compare the dispersions of any two substances, we must refer them to the same mean refraction; or, what is the same thing, we must find what proportion the dispersion bears to the mean refraction of each. This is, of course, determined by dividing the dispersion by the mean refraction; and the numbers thus obtained, are the *dispersive powers* of the respective substances; for they show comparatively, the effect which each has in separating the extremes of the spectrum, when the mean deviation is constant.

These expressions are only approximately correct, for the same assumption is made as in the case of refraction. The mean of the extreme indices is not accurately the index of the mean or middle ray of the spectrum; but this matter will be treated in detail in a succeeding paper.

For the present it will be sufficient to assume that the measure of the dispersive power is $\frac{d\mu}{(\mu - 1)}$, where μ is the mean of the extreme indices and $d\mu$ their difference.

There is another point which it may be convenient to mention here, and this is, that with small angles, the deviation is proportional to the refracting angle of the prism, when the refractive power is constant. As an illustration, take the formula for the principal focal length of a double convex lens. Then, considering the half-section of the lens as a prism, the sum of the reciprocals of the radii, may be regarded as a measure of the magnitude of the refracting angle; and the reciprocal of the principal focus, as a measure of the angle of deviation. Consequently, when $(\mu - 1)$ is constant, the latter quantity is proportional to the former.*

The next question that arises is—how are the different values of the refractive indices to be ascertained? For the spectrum colours are not lines, but bands of varying width, and with no well-defined boundary. It might thus seem a matter of some difficulty to decide upon the exact point, from which the deviation for any particular colour should be measured. But, fortunately, there exist in the spectrum a number of dark lines, crossing it at irregular intervals, but having definite, fixed positions. A well-defined line is found in each of the coloured spaces; and the refractive index of a ray, occupying the same position as one of these lines, is taken as the index of the particular

* Also the formula expressing the value of the refractive index in terms of the refracting angle of a prism and its angle of least deviation, is $\mu = \sin \left(\frac{A + \delta}{2} \right) / \sin \frac{A}{2}$.

small angles $\frac{A + \delta}{A} = 1 + \frac{\delta}{A}$. Therefore $(\mu - 1) = \frac{\delta}{A}$ or $A(\mu - 1) = \delta$, so that when $(\mu - 1)$ is constant δ varies as A .

colour in which this line is situated. Fraunhofer, the celebrated German optician, was the first to employ this system of measurement; and for convenience of reference, he named the principal lines in alphabetical order, commencing from the red or least refrangible end of the spectrum. Thus, line A is near the lower end, and B about the middle of the red portion; C near the junction of the red and orange spaces; D is in the orange yellow, E in the yellowish green, and F near the lower end of the blue or greenish blue; G is in the indigo, and H in the violet. The refractive indices are generally calculated for either five or seven of these lines, that is from C to G, or from B to H. Fraunhofer determined the indices for the lines B to H for ten different media: a copy of this table is given below, and I have subjoined the indices for the lines C to G for some of Chance's glasses. This latter information was sent to the correspondence pages of this journal, by someone, whose name I cannot at present remember; but it is much to be desired that others would imitate his example, and send similar particulars of other kinds of glass, which are in common use among opticians.

FRAUNHOFER'S TABLE OF REFRACTIVE INDICES.

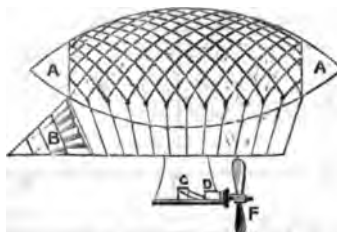
Name of Refracting Medium.	Specific Gravity.	Values of μ for each of the different Colour Lines.							
		B	C	D	E	F	G	H	
Water	1.000	1.3309	1.3317	1.3326	1.3335	1.3376	1.3415	1.3449	
Solution of Potash		1.3668	1.4005	1.4028	1.4056	1.4081	1.4126	1.4264	
Spirits of Turpentine		1.4705	1.4715	1.4744	1.4783	1.4817	1.4882	1.4989	
Crown Glass, No. 13		1.5243	1.5253	1.5260	1.5314	1.5343	1.5399	1.5437	
Crown Glass, No. 9	2.585	1.5258	1.5268	1.5266	1.5330	1.5360	1.5416	1.5465	
Crown Glass, M.	2.756	1.5548	1.5559	1.5561	1.5632	1.5668	1.5736	1.5794	
Flint Glass, No. 2		1.6020	1.6038	1.6065	1.6145	1.6200	1.6308	1.6404	
Flint Glass, No. 30	3.512	1.6228	1.6255	1.6306	1.6373	1.6435	1.6554	1.6690	
Flint Glass, No. 23		1.6236	1.6284	1.6336	1.6405	1.6468	1.6588	1.6697	
Flint Glass, No. 13	3.723	1.6277	1.6327	1.6360	1.6420	1.6482	1.6603	1.6710	
Chance's Glass:—									
Hard Crown	2.485		1.5146	1.5172		1.5282	1.5290		
Soft Crown	2.550		1.5119	1.5146		1.5210	1.5263		
Light Flint	3.210		1.5700	1.5740		1.5839	1.5922		
Dense Flint	3.660		1.6175	1.6224		1.6348	1.6453		

From this table it is obvious, that different substances produce spectra, varying very much in their extent and internal proportions. We may take the difference between the numerical values of B and H, as showing the comparative length of the spectrum; and the difference between any two consecutive letters, as the proportion of space allotted to any particular colour. In the case of water and flint-glass, the difference of B and H for the latter, is about three times that of the same letters for the former, so that it will produce a spectrum three times as long.

(To be continued.)

TROUVE'S ELECTRIC MOTOR APPLIED TO A BALLOON.

THE following account of M. Gaston Tissandier's method of utilising the Trouvé electric motor for the propulsion and steering of balloons, is extracted from *Engineering*. The visitor to the Paris Electrical Exhibition will see, above the nave, and travelling to and fro between the galleries, the model of a balloon of an elongated egg-shape, with conical ends. This little aerostat is 11 ft. 6 in. long and 4 ft. 3 in. in diameter in the centre. It has a capacity of about 78 cubic feet, and, filled with hydrogen, possesses a lifting power of 4.4 lb. The annexed sketch, indicates the general arrangement.



The Trouvé motor weighs only 483 lb., and is driven by a current from a Planté battery weighing 2.86 lb. The power is transmitted to a very light two-bladed screw, 15.75 in. in diameter, which makes 6½ revolutions per second, and which in still air gives to the balloon a constant speed of nearly

200 ft. a minute for three-quarters of an hour. In the sketch A is the balloon, B the rudder, C the Planté battery, D the Trouvé motor, and F the screw.

As it is impossible at the Palais de l'Industrie to leave the aerostat free, it is provided with a light cord having a ring at one end which slides over an iron wire stretched between the two opposite galleries. M. Tissandier recently described in a note to the Academy the practical results he has obtained. In the course of this communication he stated that he had measured the work done by the little motor in the simplest manner, by ascertaining its lifting power. With a single battery and a speed of five revolutions per second, the work done was equivalent to .65 foot-pounds. With two batteries and twelve revolutions it was 3.03 foot-pounds, and with three batteries it reached 7.22 foot-pounds. Under actual conditions an electrical motor developing six horse-power could be made with a weight of 660 lb., with 1980 lb. of battery. It would be easy to raise this in an elongated aerostat of 106,000 cubic feet capacity filled with hydrogen, similar to those experimented with in 1852 by M. Giffard and in 1872 by M. Dupuy de Lôme. Such a balloon would be 131 ft. long and 44 ft. in diameter in the middle, and its ascensional force would be 7,700 lb. The weight (without motor and battery)

would be about 2,500 lb., leaving for passengers and ballast 2,200 lb. In calm weather such a balloon should have a speed of from 12 to 15 miles an hour, and in currents its course could be directed to a certain extent. Evidently the time during which the battery would last is very short, but such a balloon might be of great value for purposes of experiment. So far M. Tissandier, and it will be evident at once that, in the at present extremely unlikely event of power being applied to balloons, the Trouvé motor could not compete with steam.

A COMPACT BATTERY.

THE desiderata in a galvanic battery may be briefly stated as compactness and ability to produce a strong and constant current of electricity, cheaply, without giving out poisonous or corrosive fumes. The form of battery described below was designed to cheaply overcome some of the annoyances commonly attendant upon the use of large or intense batteries as well as to economise space and labour of maintenance. In Fig. 2, A is a sheet of copper, about eighteen inches long and ten-and-a-half inches in width, bent U-shape lengthwise, and provided with a short copper strap or ear, at a. B, Fig. 2, is a strip of zinc, about fifteen inches long and four and three-quarter inches wide. The flannel envelope, C, is made of one piece, nine inches wide and twenty-one inches long, doubled upon itself and stitched together at g and h, so as to snugly envelop the zinc plate. In setting up the battery, the copper is coated thickly with a paste of calcined lampblack and dilute sulphuric acid; the plate of zinc is fitted into the cloth envelope, previously moistened with dilute sulphuric acid, and this in turn is put into the copper, so that the cloth projects an inch or more above and below the latter. It is necessary that the copper should firmly press upon the cloth envelope, but it must not touch the uncovered zinc plate. The couples thus arranged are packed tightly together in a wooden frame or case, with a sheet of paper saturated with paraffin between each, as shown in Fig. 1. The plates are then joined in series—the zinc of one with the copper of the next, and so on—the ears, a and b, Fig. 2, serving for connections. The tube, P P', Fig. 1, is made of glass, or of pieces of glass tubing joined by vulcanised rubber tubing, and is connected with a reservoir, D. At points, s, s, s, along this tube, and just over the expanded ears of the projecting cloth envelopes, are arranged glass dropping tubes, so that when a liquid flows from the reservoir, D,

gh P P, an equal quantity of it escapes
gh each of these upon the cloth below. The
of liquid from the reservoir can be controlled
ie stop-cocks at E and T. The battery is

cal lines two inches apart, or one eighteenth of the
entire length of the base-line. Set off the length
of the guitar strings on the first vertical, and draw
the diagonal; from the point where the diagonal

his own way (which may be done in various forms
and in infinite proportion), rather than to follow an
example.

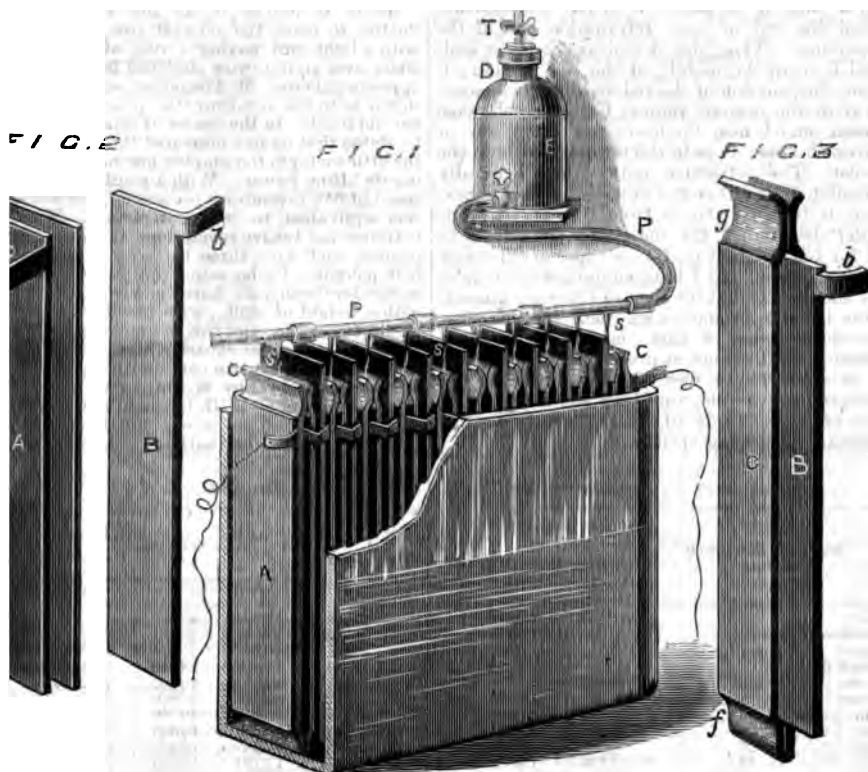
Another application, and one more nearly inter-
esting the machinist, is shown applied in Fig. 19.
Let it be required to so proportion the cone-pulleys
of a lathe that the speeds shall vary in the same
ratio; that is, if the speed with the belt on the
small pulley is a given number in a minute, and
two-thirds as fast on the second pulley, it shall be
two-thirds as fast on the third pulley as when on
the second, and when on the fourth two-thirds as
fast as when on the third.

If the proportion was just two-thirds or three-
fourths, which is rarely the case, it would not be
a very complicated problem to solve by arithmetic;
but assume the proportion is 68 to 96, to settle the
speeds by figuring them out might require a good
deal of time, and a deal of a mathematician. By
the graphic method, no matter what the proportion
or what the fractions, the solution is equally simple.

To begin, the student must possess himself of the
fact that the length of a line may represent a num-
ber. That is, a line one inch long may represent
16, in which case the unit is 1-16th of an inch.
With this as a unit, a line one and one-half inches
long would represent 24, one two inches long, 32,
etc. Or, the unit might be the one-hundredth of
an inch; then lin. would represent 100, 1 1/2 in. 125,
2 in. 200 which may be feet, pounds, or revolutions.
Having mastered the above principle, assume the
lathe spindle to make 380 revolutions in a minute
at its fastest speed, to have a four-step cone, and to
vary in speed as 68 to 96.

Draw the base-line A B 96 units. That is, if you
have room, make a line 24 in. long, which will
represent 96 with 1/4 in. as unit. Now, with A as a
starting-point, measure off 68 units to C. From
B and C draw the two verticals. Measure up from
the base-line B with any convenient unit, 380. The
unit in this case may be 1-20 in., or 1-32 in., and 380
with 1-32 in. as a unit would be 11 1/2 in. Draw the
diagonal D A, and where the diagonal crosses the
line C draw the first horizontal, and as many times
as 1-32 in. is contained in the distance from B to E,
so many revolutions will the spindle need to make
when the belt is on the second pulley. In like
manner can the two other speeds be obtained
by drawing the other diagonals and horizontals
E, F, G.

If the lathe is to have a back gear, the other four
speeds can be obtained by continuing the diagonal
and horizontal lines, and the proportion of the back
gear be determined by dividing the speed of the

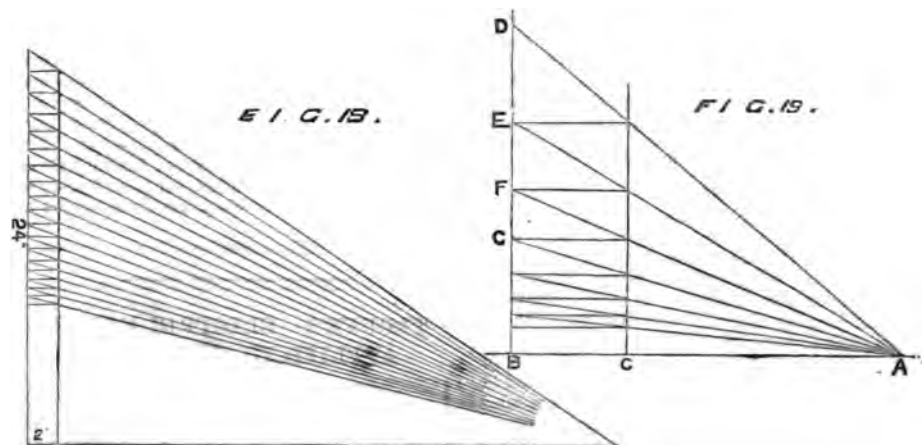


ted as follows: The reservoir, D, having been
with a solution of three-quarters of a pound
stassium bichromate and about one pound of
uric acid in a gallon of water, the stop-cock,
opened, and the solution allowed to trickle
y upon and down through the cloth envelopes,
ing at the bottom into a leaden or enamelled

The battery thus arranged develops a con-
siderable electromotive force, and, when the
voltage is properly adjusted, is remarkably con-
stant. Should it become clogged up with chrome
(and this does not often happen), or when it
is required for use, it can be cleaned without
removing it by allowing warm water, instead
of solution, to flow through the pipe, P P'. The
plates can be easily taken out without remov-
ing the envelopes. A battery of this kind of one
red cell can be put up in a box three feet
one foot wide, and two feet deep. It can be
run on a single reservoir, and will produce a very
bright light.—Scientific American.

strikes the second line, draw the first horizontal
and from it draw the second diagonal, and so on to
the full extent required.

The result is a perfect graduation of spacing;
and should it be required to lay out a curve that
shall have a uniform ratio of increase, it can be



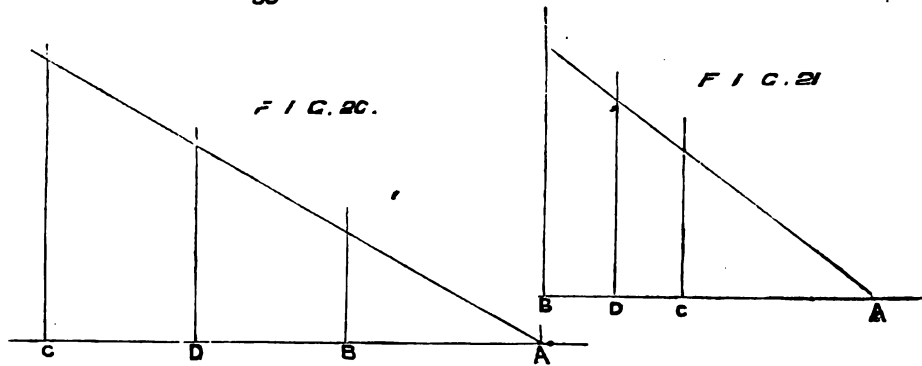
MECHANICAL DRAWING.—VI.*

By PROF. JOHN E. SWEEZEY.

(Continued from p. 33.)

Increasing or Diminishing any Distance
by a Fixed Ratio—Proportioning Cone
Pulleys.

ANOTHER form of diagram for solving prob-
lems, and a very useful one, though not of
great application, is shown in Fig. 18. It shows
how of increasing or diminishing any distance,
or number by a fixed ratio. That is, if it be
required to lay out a shaft for a water-wheel 20 in.
so that, in each inch of its length, its capac-
ity should increase one-twentieth of itself. That
it was 20 in. broad at the beginning and 21 in.
at the end of the first inch, to continue the same
ratio it must be 22 1/2 in. at the second inch, and
so on, which would complicate figures quite exten-
sively by the time the 20th inch is reached. Or, on
the other hand, if it be required to reduce a thing
by successive steps, at a given propor-
tion this is equally applicable, and it would be
more difficult to figure. This is the form in
Fig. 18 is applied, that is, the laying off of
steps or frets of a guitar. A string in such
a case to produce a musical tone will, when re-
duced one-eighteenth of its length, give a note
half-tone higher; and when reduced one-
seventh of the remaining seventeen-eighteenths
a note one half-tone higher still. To make
divisions, draw the base-line 36 in. long, or
other convenient distance, draw the two verti-

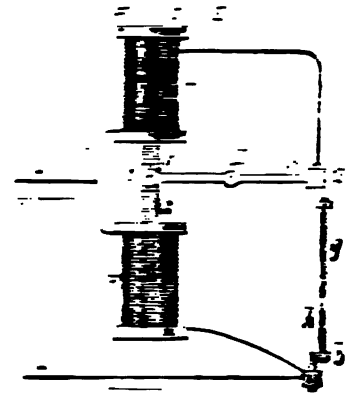


done by taking the spacings so found and applying
them in succession to a series of vertical lines,
spaced equidistant, or to a series of radial lines
diverging from a centre. The student is advised
to make an application of both of these suggestions.
I would give examples of both, but it is better
for the student or apprentice to study out what is
meant by the last paragraph, and carry it out in

first gear by that of the fifth; or if the cone has five
steps, or changes of belt, divide the first speed by
the sixth slower. The ratio I have given of 68 to
96 is not a proper one for a four-step cone, and
probably not the best for a five-step cone, and is
not given for the student to follow. In fact, he
should by all means use some other figures than the
ones I have used.

* From the American Machinist.

the current passing through the coils of the magnet, the direction of the current being indicated by the arrow. The current is supplied by a battery of cells, and the strength of the current is regulated by a rheostat.



The direction of the current in the coil being indicated by the arrow. The current is supplied by a battery of cells, and the strength of the current is regulated by a rheostat.

SCIENTIFIC NEWS.

TELESCOPE of telescopes who are not many, and who are not in the way of the telescope, may be reminded that the telescope is a machine which is used to see things which are far away. It is a machine which is used to see things which are far away. It is a machine which is used to see things which are far away.

In 1870 and 1871, the Government have been awarded a grant of £10,000 for the purpose of purchasing a telescope.

The College of Science and Arts at Glasgow has commenced its first session under its new constitution, and its future success may be judged by the results of the past. In general mechanics, and building construction, 44 per cent. of the students passed at the last May examination, 44 per cent. gaining first-class certificates. In theoretical and applied mechanics 80 per cent. passed, with 41 per cent. first-class. In steam, all the students passed, 40 per cent. being first-class. In electricity and magnetism, there were 94 per cent. of passes, 70 being first-class. Results such as these speak for themselves. We understand that the Principal, Mr. A. Jamieson, will start a class for "electrical engineering" this winter, the opening lecture being given on Oct. 3.

The examination for the Gilchrist Scholarships at University College, London, will be held this year on Sept. 25. We give particulars of these scholarships elsewhere.

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A Technological Society has been started at Peckham, meeting every Friday evening at the Goldsmith-road Mission. An introductory

SCIENTIFIC EDUCATIONAL CAMPS.

A very interesting and valuable scheme has been started at Peckham, meeting every Friday evening at the Goldsmith-road Mission. An introductory

lecture will be delivered by Mr. Hugh Clements on Sept. 30.

Messrs. Longmans have issued a popular edition of Lady Brassey's "Voyage of the Sunbeam," price sixpence, in order to bring it within reach of all for whom the record of travel in foreign lands has any interest.

The portfolio of drawings and descriptions of living animals sent out by Mr. Bolton, of Newhall-street, Birmingham, for September, is full of interest to the biologist and microscopist. It contains 16 plates and descriptions of animal organisms including *Raphidomonas semen*, *Conochilus volvox*, *Daphnia pulex*, and *Cercaria*, and one plate of a vegetable organism, *Bacillaria paradoxa*.

The race between the rival safety bicycles—the "Facile" and the "Sun and Planet"—took place last week, the former winning easily in 1h. 58m. 5s. for 25 miles, a capital performance considering the road and the weather. At one time the "Sun and Planet" was 500 yards or so ahead, and there is no doubt the "Facile" won by the ease with which its rider surmounted the hills.

Mr. H. S. Maxim has patented an improved method of preparing carbons for electrical purposes (639, 1881.) In practice the unfinished carbon, made in any ordinary manner, is treated in an exhausted receiver provided with proper electrical connection; a current of electricity is passed through it to expel the occluded air and gases, which, when released, are pumped from the receiver, after which pure hydrocarbon or other carbonaceous gas is admitted, of a pressure equal to about 1 in. of mercury. After that the current is increased, carrying the temperature up to a high point; the heat dissociates the elements of the gas, and the carbon set free is deposited in a state of fine subdivision in the pores and upon the exterior of the carbon, gradually reducing its resistance and changing its illuminating capacity. The process is useful for manufacturing lamps of a standard illuminating power, the process being carried on until the light emitted exactly balances the light of a lamp whose terminals are maintained at the same potential.

It is stated that the Messrs. Siemens will light Mr. D'Oyley Carte's new theatre with 600 Swan incandescent lamps.

The Siemens electric railway in Paris is now stated to be so successful that arrangements will be made to render it a permanent feature of the French capital. When the novelty of the invention has ceased to attract customers, the railway will be on its proper footing as a commercial speculation, and we shall then be able to judge of its real value.

Mr. Willoughby Smith having made some experiments with a battery constructed on M. Faure's plan, says that the "potential of an ordinary Grove cell is 1.94 volt, and 36 such cells are necessary to give a light equal to 29 candles by means of a Swan's or other incandescent lamp. In a secondary battery it is, I believe, impossible to obtain a higher potential than 1.92 volt; consequently, for a 29-candle-power light, 36 secondary batteries would be required. Therefore, I do not anticipate for these batteries the great future that was shadowed forth at York."

The Electro-Technical Society of Berlin (*Electrotechnischer Verein*) offers a prize of a thousand marks (shillings) for the best essay on the transmission of power by electrical and mechanical means, which must be sent in before the 1st of October, 1882.

Application has been made in the United States for a patent for a system of sextuple telegraphy.

The classes at the City and Guilds Institute commence on October 4th, those on electrical matters, which are under the charge of Professor Ayrton, being held on Monday, Wednesday, and Friday evenings, at the rooms in Cowper-street, Finsbury.

It is stated that the Minister of Agriculture and Commerce in France is refusing the usual permits for the introduction into France of specimen machines to serve as models for construction under French patents.

Mr. Büttgenbach, of the Lintorf lead mines near Düsseldorf, has devised a disintegrator

which separates zinc blende and pyrites ore with great nicety. By specific gravity this cannot be effected, but the difference in the cohesive force of the two minerals enables Mr. Büttgenbach to crush the zinc ore to a fine sand and leave the pyrites in its original volume, so that they can be separated by a sieve.

The Italian Expedition for the exploration of the Antarctic Seas leaves Genoa on the 3rd of October for Buenos Ayres. Lieutenant Bove, the commander, has already left for that city, in order to make preparations, and some of the professors who are to take charge of the different branches of work are at present residing in South America. The results of this expedition will be looked for with much interest, for although we know something of the Arctic regions, the Antarctic are at present comparatively unexplored, the only regular visitors being a few whaling and seal-hunting vessels from the Atlantic ports of the United States.

According to Prof. Simony, the greatest depth of the Lake of Constance is 276 metres, that of Lake Lemán 309 metres.

Strychnine affects animals differently according to the state they are in as regards nutrition. Thus, according to recent experiments by M. Delaunay, the same dose being given to a large and vigorous frog as to a small weak one, the phenomena of poisoning are much more rapid and intense in the former (in case of recovery, it recovers more quickly). A frog always well fed is much more sensitive than one that has fasted several weeks. In frogs the right side is most developed, and after injection of strychnine is the first and more gravely affected. Of two similar frogs receiving the same dose of strychnine, but one of which has been walking and leaping half an hour, this one is sooner and more severely affected. The same holds in general for exercise or stimulation of any part of the animal; and a frog forced to exercise after poisoning is sooner affected than another at rest. A frog suspended by the hind-legs is thrown into convulsions by a given dose of strychnine twenty minutes before a similar frog hung by the head, and receiving the same dose, and the convulsions are much more violent. M. Delaunay thinks the horizontal position may be a cause of death in persons poisoned by strychnine, and suggests keeping them vertical as better. Again, a frog previously weakened by bleeding is less rapidly and gravely poisoned with strychnine than one that is intact, and bleeding helps recovery. Lastly, a congested limb is more sensitive to poisoning than one not congested.

A firm of machine-makers at Leobersdorf, near Vienna (we learn from the *Deutsche Ind. Zeitung*), has taken up the manufacture of steam-engines without boilers, according to Höck's patent. In this system, the steam-furnace (so-called) is closed on all sides to the atmosphere by solid fireproof masonry, and steam is formed in it from a spray of water. A blast of air is sent in under the grate. The resulting mixture of steam and gases cooled by the water, is called "air-steam"; it passes to the engine through a sieve system, which keeps back dust, &c. There is a regulating cylinder behind the air-compressing pump; it is connected with that and the atmosphere, and has a piston with weighted lever, which, on rising with excess of pressure, shuts the valve of the pump and stops the blast. Water is sprayed in the compressor to keep it cool, and then passes to the furnace for fuller vaporisation. The consumption of fuel for the smallest (and so least economical) engines is stated to be 1 kilog per effective horse-power per hour. Fuel is saved in virtue of the combustion being in a closed space, where expansion of air cannot occur; and with constant volume of furnace, the tension of steam must increase. Another advantage alleged is in the utilising of the gases of combustion with the steam. An Austrian specialist pronounces the mode of vaporisation to be without risk of explosion.

In forty Government schools in Saxony, observations have lately been made as to the temperature, carbonic acid, and moisture of the air with different kinds of heating—hot-water, air, and stove. It is proved that air-heating gives the best results: the least variation of temperature, much the least proportion of carbonic acid (as measured in the middle of the room, at the height of a table), and the smallest variation of the moisture. The ventilation in both the other systems was unsatisfactory.

The evaporation of glycerine has been recently studied by M. Couttolenc, of Amiens, and with the following results: (1) Aqueous glycerine loses its water after five hours' heating in a water-bath at about 90°. (2) The evaporation of the glycerine then continues pretty regularly at the rate of about 0.00317 gr. per square centimetre of surface and per hour. (3) This evaporation diminishes rapidly with lowering of temperature. (4) The evaporation is sensibly proportional to the surface; hence it increases rapidly when sand is added. (5) Quantities of water put into the glycerine make the evaporation vary so, that to a greater quantity of water corresponds a greater quantity of glycerine carried off; without, however, this removal being directly proportional to the volume of water added. (6) Thus, an exact determination of glycerine cannot be made by desiccation at this temperature.

According to the *Scientific American*, large quantities of salmon are now being caught in the Columbia River, Oregon, by means of a water-wheel, in a sluice-way, sweeping within a foot of the bottom, and scooping them up in buckets which let out the water as they ascend. The wheel is at the end of a jetty of rocks; this produces a long piece of slack water, which the fish take advantage of in large numbers, in going up the river. Rounding the point, they rush into the sluice-way and are caught, raised, and dropped into a gutter, leading to a pen, where they remain till taken to be canned. Unfortunately young fish are taken with adult ones (which alone are canned), and no provision is made for their escape.

The galvanic current has for many years been applied successfully in quantitative determination of copper, lead, cobalt, nickel, and manganese. The case of zinc presents peculiar difficulties, however, and none of the series of methods proposed for it have found general acceptance. From a paper in the *Journal für Praktische Chemie*, it appears that Herr Reinhardt and Dr. Ihle, have succeeded, even with a weak current, in getting zinc, in a form well suited for weighing, from an oxalate solution. They chose oxalic acid, as being an acid easily decomposed by the current, and not formed again by secondary action. Since, however, oxalate of zinc could not be used because of its insolubility in water, they had recourse to the soluble potassium double salt.

In a communication to the Paris Academy, M. Cruls, of the Imperial Observatory of Rio, gives the results of observations of meteors at that place from the 25th to the 30th of July last. (These meteors have received from some astronomers the name of *Aquarides*.) The radiant point of more than 90 per cent. was found to be in the neighbourhood of Fomalhaut (about 5.2° to the north). The hourly averages increased rapidly between the evening and morning hours, and there seems to have been a remarkable increase a little before sunrise. It is inferred that the stream moves in opposite direction to the earth; the meteors at that time entering the atmosphere under the most favourable conditions of velocity and visibility. All those seen after 5 a.m. especially, were very brilliant and swift. These latter were all sensibly displaced in the plane of the ecliptic.

China ink is known to consist chiefly of lamp-black made into cakes with some binding material. Dr. Precht, of Staasfurt, says the lampblack is got by burning different oils, with limited access of air; the quality depending partly on the raw material, partly on the kind of oven used. The inferior products are applied in printing. As binding material, the Chinese often use the sap of various plants; but it has been ascertained that the black ink contains only animal gelatine and no gum-arabic. The usual addition of camphor and musk does not affect the goodness of the ink. In making the black ink, the drying mixture (which is compounded according to precise rules) is carefully watched. Most of the China ink sold is imported from China; but some German houses make the ink, and of excellent quality. China ink, used in drawings (which often receive water-colours), should be highly insoluble in water. It is seldom so; but, according to Dr. Precht, if bichromate of potassium (say, a 2 per cent. solution) be used instead of water in the rubbing process, the drawing, after one or two hours' exposure in daylight, becomes resistant to water.

Sunlight

SATELLITES OF SATURN—JUPITER—MARS.

[19213.]—THE apparent major and minor semi-axes of the disc of Saturn, of the outer rim of the ring, and of the ellipses described by the five inner satellites, will be:—

1881.	Oct. 16.	Nov. 5.	Nov. 25.
Disc	9.8 9.0	9.9 9.0	9.8 8.9
Ring	22.7 7.5	22.8 7.4	22.5 7.1
Mimas	31.9 10.3	31.1 10.1	30.8 9.7
Enceladus ..	39.7 13.2	39.9 12.9	39.5 12.5
Tethys	49.2 16.3	49.4 16.0	48.8 15.4
Dione	63.0 20.9	63.2 20.4	62.6 19.8
Rhea	87.9 29.1	88.3 28.6	87.4 27.6

The satellites move in their apparent orbits in the direction of decreasing position-angles, and will be at their inferior N. (north), and superior S. (south), conjunctions with the centre of Saturn, about the following Greenwich mean times:—

1881.	Gr. M.T.	1881.	Gr. M.T.
Oct. 1	9.1 Te. N.	Oct. 21	10.7 Mi. N.
	10.2 En. N.	22	3.2 Te. N.
	15.9 Mi. N.		6.0 Rh. N.
	20.7 Di. N.		9.1 Di. S.
	22.6 Rh. S.		9.3 Mi. N.
2	7.7 Te. S.		15.8 En. S.
	14.5 Mi. N.	23	1.9 Te. S.
	19.1 En. N.		8.0 Mi. N.
3	5.5 Di. S.		8.2 En. N.
	6.4 Te. N.		17.9 Di. N.
	11.5 En. S.		19.3 Mi. S.
	13.1 Mi. N.	21	0.5 Te. N.
4	4.8 Rh. N.		12.2 Rh. S.
	5.0 Te. S.		17.1 En. N.
	11.7 Mi. N.		17.9 Mi. S.
	14.3 Di. N.		23.2 Te. S.
	20.4 En. S.	25	2.7 Di. S.
5	3.6 Te. N.		9.5 En. S.
	10.3 Mi. N.		16.5 Mi. S.
	12.8 En. N.		21.8 Te. N.
	23.2 Di. S.	26	11.5 Di. N.
6	2.3 Te. S.		15.1 Mi. S.
	10.9 Rh. S.		18.3 Rh. N.
	21.7 En. N.		18.4 En. S.
7	0.9 Te. N.		20.5 Te. S.
	8.0 Di. N.	27	10.8 En. N.
	14.1 En. S.		13.7 Mi. S.
	23.6 Te. S.		19.1 Te. N.
8	6.6 En. N.		20.4 Di. S.
	16.8 Di. S.	28	12.3 Mi. S.
	17.1 Rh. N.		17.7 Te. S.
	22.2 Te. N.		19.7 En. N.
9	15.5 En. N.	29	0.5 Rh. S.
	20.9 Te. S.		5.2 Di. N.
10	1.7 Di. N.		10.9 Mi. S.
	7.9 En. S.		12.1 En. S.
	14.7 Mi. S.		16.4 Te. N.
	19.5 Te. N.	30	9.6 Mi. S.
	23.2 Rh. S.		14.0 Di. S.
11	10.5 Di. S.		15.0 Te. S.
	13.3 Mi. S.	31	6.6 Rh. N.
	16.8 En. S.		8.2 Mi. S.
	18.2 Te. S.		13.5 En. N.
12	9.2 En. N.		13.7 Te. N.
	11.9 Mi. S.		19.5 Mi. N.
	16.8 Te. N.		22.8 Di. N.
	19.3 Di. N.	Nov. 1	12.3 Te. S.
13	5.4 Rh. N.		18.1 Mi. N.
	10.5 Mi. S.	2	7.6 Di. S.
	15.4 Te. S.		11.0 Te. N.
	18.1 En. N.		12.8 Rh. S.
14	4.1 Di. S.		14.8 En. S.
	9.1 Mi. S.		16.7 Mi. N.
	10.5 En. S.	3	7.2 En. N.
	14.1 Te. N.		9.6 Te. S.
	20.4 Mi. N.		15.3 Mi. N.
15	7.7 Mi. S.		16.5 Di. N.
	11.6 Rh. S.	4	8.3 Te. N.
	12.7 Te. S.		16.1 En. N.
	13.0 Di. N.		19.0 Rh. N.
	19.0 Mi. N.	5	1.3 Di. S.
	19.4 En. S.		6.9 Te. S.
16	11.4 Te. N.		8.5 En. S.
	11.8 En. N.	6	5.5 Te. N.
	17.7 Mi. N.		10.1 Di. N.
	21.8 Di. S.		17.4 En. S.
17	10.0 Te. S.	7	1.1 Rh. S.
	16.3 Mi. N.		4.2 Te. S.
	17.7 Rh. N.		9.8 En. N.
	20.7 En. N.		18.9 Di. S.
18	6.6 Di. N.	8	2.8 Te. N.
	8.7 Te. N.		8.4 Mi. N.
	13.1 En. S.		18.7 En. N.
	14.9 Mi. N.	9	1.4 Te. S.
19	7.3 Te. S.		3.8 Di. N.
	13.5 Mi. N.		7.3 Rh. N.
	15.4 Di. S.		7.3 Mi. N.
	22.0 En. S.		11.1 En. S.
	23.9 Rh. S.		18.3 Mi. S.
20	5.9 Te. N.	10	0.1 Te. N.
	12.1 Mi. N.		12.6 Di. S.
	14.5 En. N.		16.9 Mi. S.
21	0.2 Di. N.		20.0 En. S.
	4.6 Te. S.		22.8 Te. S.
	6.9 En. S.	11	12.5 En. N.

1881.	Gr. M.T.
Nov. 11	13.4 Rh. S.
	15.5 Mi. S.
	21.4 Te. N.
	21.4 Di. N.
12	14.2 Mi. S.
	20.1 Te. S.
13	6.2 Di. S.
	12.8 Mi. S.
	13.8 En. S.
	18.7 Te. N.
	19.6 Rh. N.
14	6.2 En. N.
	11.4 Mi. S.
	15.1 Di. N.
	17.8 Te. S.
15	10.0 Mi. S.
	15.1 En. N.
	16.0 Te. N.
	23.9 Di. S.
16	1.7 Rh. S.
	7.5 En. S.
	8.6 Mi. S.
	14.6 Te. S.
17	7.2 Mi. S.
	8.7 Di. N.
	13.3 Te. N.
	16.4 En. S.
18	7.9 Rh. N.
	8.8 En. N.
	11.9 Te. S.
	17.1 Mi. N.
	17.5 Di. S.
19	10.6 Te. N.
	15.8 Mi. N.
	17.7 En. N.
20	2.4 Di. N.
	9.2 Te. S.
	10.1 En. S.
	14.1 Rh. S.
	14.4 Mi. N.
21	7.9 Te. N.
	11.2 Di. S.
	13.0 Mi. N.

1881.	Gr. M.T.
Nov. 21	19.0 En. S.
	6.5 Te. S.
	11.5 En. N.
	11.6 Mi. N.
	20.0 Di. N.
	20.2 Rh. N.
23	5.2 Te. N.
	10.2 Mi. N.
24	3.8 Te. S.
	4.8 Di. S.
	8.8 Mi. N.
	12.8 En. S.
25	2.4 Rh. S.
	2.4 Te. N.
	5.2 En. N.
	7.5 Mi. N.
	13.7 Di. N.
26	1.1 Te. S.
	6.1 Mi. N.
	14.1 En. N.
	17.4 Mi. S.
	22.5 Di. S.
	23.7 Te. N.
27	6.5 En. S.
	8.6 Rh. N.
	16.0 Mi. S.
	22.4 Te. S.
28	7.3 Di. N.
	14.6 Mi. S.
	15.4 En. S.
	21.0 Te. N.
29	7.9 En. N.
	13.2 Mi. S.
	14.7 Rh. S.
	16.2 Di. S.
	19.7 Te. S.
30	11.8 Mi. N.
	16.7 En. N.
	18.3 Te. N.
Dec. 1	9.2 En. S.
	17.0 Te. S.
	20.9 Rh. N.

JUPITER.—The following is a list of the times when the assumed First Meridian of Jupiter passes the middle of the illuminated disc. It is a continuation of the list given on page 355 of the ENGLISH MECHANIC of June 17.

1881.—Greenwich Mean Time.

Oct.	h. m.	Oct.	h. m.	Nov.	h. m.
1	10 20.8	22	2 35.5	11	18 49.4
	20 16.3		12 30.9	12	4 44.0
2	6 11.8		22 26.4		14 40.4
	16 7.4	23	8 21.9	13	0 35.9
3	2 2.9		18 17.4		10 31.4
	11 58.4	24	4 12.9		20 26.8
	21 53.9		14 8.3	14	6 22.3
4	7 49.4	25	0 3.8		16 17.8
	17 44.9		9 59.3	15	2 13.3
5	3 40.4		19 54.8		12 8.8
	13 35.9	26	5 50.3		22 4.3
	23 31.4		15 45.7	16	7 59.8
6	9 26.9	27	1 41.2		17 55.2
	19 22.4		11 36.7	17	3 50.7
7	5 17.9		21 32.2		13 46.2
	15 13.4	28	7 27.7		23 41.7
8	1 8.8		17 23.1	18	9 37.2
	11 4.3	29	3 18.6		19 32.7
	20 59.8		13 14.1	19	5 28.2
9	6 55.3		23 9.6		15 23.7
	16 50.8	30	9 5.1	20	1 19.2
10	2 46.3		19 0.5		11 14.7
	12 41.8	31	4 56.0		21 10.2
	22 37.3		14 51.5	21	7 5.7
11	8 32.8	Nov. 1	0 47.0		17 1.2
	18 28.3		10 42.4	22	2 56.7
12	4 23.8		20 37.9		12 52.2
	14 19.3	2	6 33.4		22 47.7
13	0 14.8		16 28.9	23	8 43.2
	10 10.3	3	2 24.4		18 38.7
	20 5.7		12 19.8	24	4 34.2
14	6 1.2		22 15.3		14 29.7
	15 56.7	4	8 10.8	25	0 25.2
15	1 52.2		18 6.3		10 20.7
	11 47.7	5	4 1.8		20 16.2
	21 43.2		13 57.2	26	6 11.7
16	7 38.7		23 52.7		16 7.2
	17 34.2	6	9 48.2	27	2 2.7
17	3 29.6		19 43.7		11 58.2
	13 25.1	7	5 39.2		21 53.7
	23 20.6		15 34.6	28	7 49.2
18	9 16.1	8	1 30.1		17 44.8
	19 11.6		11 25.6	29	3 40.3
19	5 7.1		21 21.1		13 35.8
	15 2.6	9	7 16.5		23 31.3
20	0 58.0		17 12.0	30	9 26.8
	10 53.5	10	3 7.5		19 22.3
	20 49.0		13 3.0	Dec. 1	5 17.9
21	6 44.5		22 58.5		15 13.3
	16 40.0	11	8 53.9	2	1 8.9

MARS.—The angle of position P of the axis of Mars, the areographic latitude of the centre of the disc, the diameter of the disc, and the amount q , and the position-angle Q of its greatest defect of illumination, are the following:—

1881.	P.	Lat.	Diam.	q .	Q
Sept. 26	334.4	+2.1	9.0	1.2	270
Oct. 6	336.7	+4.6	9.6	1.2	272
16	338.7	+6.0	10.3	1.2	274
26	340.4	+7.0	11.1	1.2	275
Nov. 5	341.6	+7.5	12.0	1.1	276
15	342.2	+7.5	13.0	0.9	275
25	342.0	+6.9	14.0	0.7	274

The present season of Mars corresponds approximately to that of the beginning of February on the Earth, the Martial season

on Sept. 10, 1881, corresponding to that of Feb. 1 on the Earth,

on Nov. 1, 1881, corresponding to that of March 1 on the Earth.

In order to enable observers to know beforehand what regions of the surface of Mars will be under view, and to be prepared accordingly for exact observations, I give a list of the approximate times when some of the most marked spots are near the central meridian. The four selected spots are, for the present, designated by the letters attached to them in Mädler's map of 1830.

a is "Dawes' Forked Bay" in Mr. Green's chart of Mars, published in Vol. XLIV. of the *Memoirs of the Royal Astronomical Society*, the promontory between the two bays being the "Fastigium Aryn" of Schiaparelli's chart in his "Osservazioni di Marte," published at Rome in 1878.

d is Green's "Terby Sea," or Schiaparelli's "Lacus Solis."

r is Green's "Trouwelot Bay," or Schiaparelli's "Sinus Titanum."

f is Green's "Kaiser Sea," or Schiaparelli's "Syrtis-magna."

By means of this list of conjunctions, and of the little table given on p. 547 of the "E. M." of Aug. 12, approximate places of Rhea, Dione, Tethys, and Enceladus may be easily found for any hour for which they are required.

As regards Mimas, I have just received a letter from Dr. W. Meyer, of the Geneva Observatory, in which he communicates the result of his measurements of the satellite which he has obtained in the exceptionally fine night of Sept. 4. Mimas was clearly seen a little before its greatest western elongation, and could be micrometrically compared with the planet without hiding the latter. From eighteen measurements made within half an hour, Meyer deduces Sept. 4, 13h. 13m. 27s. Greenwich M.T. as the time of the greatest elongation, while the ephemeris gives it nearly half an hour later. Mimas appeared not much fainter than Enceladus, and was by no means at the limit of visibility in the Geneva refractor of 10 $\frac{1}{2}$ in. aperture. As Meyer has searched for Mimas with the same instrument in 1880 without success, he is convinced that the light of the satellite is variable in long periods. It is to be hoped that the possessors of powerful telescopes will do their best to observe the conjunctions of Mimas with the ends of the ring. Allowing for the correction of the ephemeris indicated by the observation of Sept. 4, the "n.f." and "s.p." conjunctions occur about 3.5 hours before, and the n.p. and s.f. conjunctions about 2.5 hours after the times of the N. and S. conjunctions with the centre as given in the preceding list.

Differences of right ascension between Iapetus and the centre of Saturn, at Greenwich noon:—

1881.	$\alpha - A$	1881.	$\alpha - A$	1881.	$\alpha - A$
Oct. 1	+18.0	Oct. 22	+34.5	Nov. 12	-22.6
2	20.8	23	32.8	13	25.1
3	23.4	24	30.9	14	27.3
4	25.9	25	28.8	15	29.5
5	28.3	26	26.5	16	31.4
6	30.5	27	24.1	17	33.1
7	32.4	28	21.5	18	34.5
8	34.2	29	18.8	19	35.8
9	35.8	30	16.0	20	36.8
10	37.1	31	13.1	21	37.5
11	38.2	Nov. 1	10.1	22	38.0
12	39.1	2	7.1	23	38.3
13	39.7	3	4.0	24	38.2
14	40.1	4	+0.8	25	37.9
15	40.2	5	-2.3	26	37.4
16	40.1	6	5.4	27	36.6
17	39.8	7	8.5	28	35.5
18	39.2	8	11.5	29	34.2
19	38.4	9	14.4	30	32.6
20	37.3	10	17.3	Dec. 1	30.8
21	+36.0	11	-20.0	2	-28.8

Iapetus passes the parallel of the centre of Saturn on Oct. 5, and remains north of the parallel till Nov. 15, when it passes to the south side.

Sept.	h.	h.	Oct.	h.	h.
23	11.4	17.2	28	9.4	15.2
24	12.1	17.9	29	10.1	15.9
25	12.7	18.6	30	10.7	16.6
26	13.4	19.2	31	11.3	17.2
27	14.0	19.9	Nov. 1	12.0	17.8
28	14.7	20.5	2	12.6	18.4
29	15.3	21.1	3	13.2	19.0
30	15.9	21.7	4	13.7	19.6
Oct. 1	16.5	22.3	5	14.3	20.2
2	17.1	22.9	6	14.8	20.8
3	17.7	23.5	7	15.4	21.4
4	18.3	24.1	8	16.0	22.0
5	18.9	24.7	9	16.5	22.6
6	19.5	25.3	10	17.1	23.2
7	20.1	25.9	11	17.6	23.8
8	20.7	26.5	12	18.2	24.4
9	21.3	27.1	13	18.7	25.0
10	21.9	27.7	14	19.3	25.6
11	22.5	28.3	15	19.8	26.2
12	23.1	28.9	16	20.4	26.8
13	23.7	29.5	17	20.9	27.4
14	24.3	30.1	18	21.5	28.0
15	24.9	30.7	19	22.0	28.6
16	25.5	31.3	20	22.6	29.2
17	26.1	31.9	21	23.1	29.8
18	26.7	32.5	22	23.7	30.4
19	27.3	33.1	23	24.2	31.0
20	27.9	33.7	24	24.8	31.6
21	28.5	34.3	25	25.3	32.2
22	29.1	34.9	26	25.9	32.8
23	29.7	35.5	27	26.4	33.4
24	30.3	36.1	28	27.0	34.0
25	30.9	36.7	29	27.5	34.6
26	31.5	37.3	30	28.1	35.2
27	32.1	37.9			

These predicted times are considerably uncertain. In observing passages of any spot across the central meridian, it is, of course, essential clearly to specify the part or point of the spot to which the observation refers. A. Marth.

35, Lambeth-road, S.E., Sept. 10.

EVOLUTION OF COMMENSURABILITY OF MOTION IN THE SOLAR SYSTEM.

[1924].—There are at present known in the Solar system three cases, or classes of cases, of motions of bodies, but of functions of commensurability, whose amplitude has in course of time become degraded to an insensible quantity. This is the only way by which the present status can be conceived to have arisen.

A very apt analogy, but merely an analogy, would be a pendulum, at first revolving in a circle; then under the action of a medium, or anything which dissipates energy, oscillating in a large arc, then in a small, and finally coming to rest. The cases above-mentioned are—First, that the planes of the Lunar equator and the Lunar orbit cut that of the Earth in the same straight line; with this is connected the circumstance that the Lunar inclination has only periodic variations. Second, the identity of the periods of Lunar rotation and revolution about its primary: a similar commensurability, perhaps, obtaining with all satellites. Third, the complicated system of commensurability which occurs with regard to the three first satellites of Jupiter, and possibly also in the system of Saturn. The general principle underlying these cases is equivalent to the disappearance of free oscillations in the motion of bodies through forces of dissipation. In the second case the dissipating force has been presumed by some to be the tidal action of the Earth upon the Moon.

In dissipating force has been, so far as I am aware, placed its component to produce the result of the third case, and until that has been done, in explanation, properly speaking, has been given. It is worth noting that Laplace is supposed to have given an explanation, but in fact, he has only shown that under certain initial circumstances, in oscillation would be possible of increasing amplitude. He has not shown how these initial circumstances might arise—and they could scarcely be the result of any disturbance, which are the genuine difficulties of the explanation.

It is the case, we may consider the case of a planet disturbed by Jupiter, whose mean motion is not far from twice that of Jupiter. Take, for instance, the case of the mean longitude, supposed subject to an inequality due to action of Jupiter, expressed by $2\lambda - \lambda_J$, where λ is the mean longitude of the planet from epoch, and the constant part of the effect of a disturbing motion on the mean longitude during one revolution is 2π , which would be the form of such resonance, a body mean motion of planetary bodies we have the equation—

$$\frac{d^2\lambda}{dt^2} = -\frac{d^2\lambda_J}{dt^2} \cos \beta$$

These would be nearly true depending upon the nature of the disturbance which produces the commensurability. But I have made the equation as simple as possible without violating the exactness.

For a moment, suppose $a = 0$, and we obtain C, being a constant.

$$(2) \dots \dots \begin{cases} \frac{d^2\lambda}{dt^2} = C + 2b \cos \alpha \\ C = \frac{d^2\lambda}{dt^2} - 2b \cos \alpha \end{cases}$$

r and α are initial values of $\frac{d\lambda}{dt}$ and α respectively.

If C greater than $2b$, we have the case of ordinary long inequalities, due to near approach to commensurability. If C less than $2b$, b being positive, α oscillates about zero. If b be negative, α oscillates about π . So that the condition of commensurability is C less than $2b$. Thus far, Laplace. In this case α is the amplitude of an elliptic function, which, as $C + 2b$ becomes smaller, degrades into a circular function, which vanishes entirely with $C + 2b$. The point to be explained is, how does C become small enough to admit of commensurability, and how does $C + 2b$ come to vanish? We have $\frac{d\lambda}{dt} = n - 2n_1$; n_1 is mean

motion of Jupiter. Whence $n = 2n_1 + \frac{d\lambda}{dt}$. n_1 is supposed invariable, because whatever be the effects of a medium on a planetoid, the effect on Jupiter being incomparably smaller, might be rejected in comparison.

In equation (1) put $u = r + \alpha$, $(2n_1) \frac{d^2\lambda}{dt^2} \sin \beta = \frac{d^2\lambda}{dt^2}$

$d^2\lambda (2n_1) = \frac{d^2\lambda}{dt^2}$ and we obtain (3) . . .

$$\frac{d^2\lambda}{dt^2} + c \frac{d\lambda}{dt} + b \cos \beta \sin \alpha + 2b \sin \beta \left(\sin \frac{\alpha}{2} \right)^2 = 0.$$

If $\sin \beta$ be so small that the equation may be solved by continued substitution in the last term, the character of the solution can be determined by that of the three first terms.

An exact solution of these three terms equated to zero cannot be given, but the nature of it can easily be seen. It will be the amplitude of an elliptic function continually diminishing which becomes zero after the lapse of an infinite time. In fact, the equation represents the motion of a point constrained to move in a vertical circle under the action of gravity, subject to a retardation varying as the velocity.

We know that whatever be the original velocity of the body it will ultimately come to rest, that is, $r = 0$. That is, in our case, commensurability will be established after the lapse of a sufficient time with merely an insensible oscillation, as in the case of Jupiter's satellites. Before the oscillation vanishes, although after the establishment of commensurability, the oscillation is represented by the amplitude of an elliptic function, and in its last stages by a circular function whose period is $\frac{2\pi}{b \cos \beta}$.

The condition for this is that there should be a medium so constituted in relation to the body resisted that β should be less than $\frac{\pi}{2}$, and much smaller.

When commensurability is just established the arc of oscillation varies from $-\pi$ to $+\pi$, and whenever the arc is much less, the effect may be reasonably ascribed to a medium, for I know of nothing but something of that nature which can produce such a result.

There is one conclusion which may be drawn from equation (1) which is extremely remarkable.

At the present rate of acceleration, about 600 years ago, Encke's comet's diurnal mean motion was about 1047.9, the ratio of which to Jupiter's is 7 to 2. Now B augments with the denominator of ratio (in this case 2.7), and β would be, I think, too great to establish that ratio; but from equation (1), it appears that if, by some singular accident, $-B$ and $\frac{d\lambda}{dt}$ were simultaneously very small, α would always remain very nearly $= \pi$ (supposing the absence of abrupt collisions).

And the medium after that time would have produced no effect whatever on the major axis, and would consequently have remained undetected. A very small effect upon the eccentricity would have still remained, but would probably not have been noticed.

If we imagine an asteroid to have initially a diurnal motion of 410, and that a ratio with a denominator higher than 15 would make β too large, then, under the action of the medium, the ratio 410 would be established without sensible oscillation, after the lapse of a sufficient time, which would probably be very great, and the diurnal motion would remain permanently 410 (if not subject to abrupt disturbance). But owing to the enormous number of invisible fragments in the planetary ring, the diurnal motion in all bodies or later, be accelerated by collision beyond the limits of commensurability for the ratio proposed. Then, after a comparatively short time the ratio 410 would become possible, and, after a very great time would be without sensible oscilla-

tion, and so on continually. This would happen, provided collisions acting upon particular asteroids were separated by sufficiently large intervals. If, however, they happened much more frequently, then, although commensurability ratios might be for a time existent, yet the oscillations would be always sensible.

In examining the diurnal motions of the planetoids for these ratios, we must remember that the osculating values, which are given in the tables usually, must not be taken, but must receive a correction for that purpose. The value of c must also be suitable.

It would be interesting to examine what cases or traces of former cases of commensurability exist in the Solar system besides in the systems of satellites. Likewise, what must be the maximum density of the medium, say, in the neighbourhood of the Earth, in order that its effect on the Earth should be too small to have been hitherto noticed. This might give us some idea of the enormous time required to extinguish a free oscillation about commensurability. I may mention there are almost certainly cases of commensurability among the comets and planetoid system with the amplitude of their oscillations much diminished, although not extinguished, by some process of dissipation.

W. O. R.

NEW ORGAN FOR CHRIST CHURCH CATHEDRAL, NEW ZEALAND.

[19215].—BRING well aware of the interest with which organ matters are taken up in your journal, I beg to inclose the specification of an organ just completed by Messrs. Hill and Son, for Christ Church Cathedral, New Zealand, and at which Mr. W. T. Best gave a recital at their work the other evening.

It is worthy of remark that this well-known firm have fitted up the instrument with all the latest improvements in the way of the pneumatic action, &c., in order to give the colonists as good a specimen as possible of English organ-manufacture.

DESCRIPTION OF THE ORGAN.

Manual Compass, C C to G (56 notes). Pedal Compass, C C C to F (30 notes). 42 Pipes to each Stop.

GREAT ORGAN.

1 Double Diapason	16ft.
2 Open Diapason	8ft
3 Viola	8ft
4 Hohl Flute	8ft
5 Principal	4ft
6 Harmonic Flute	4ft
7 Twelfth	3ft
8 Fifteenth	2ft
9 Mixture of Four Ranks	—
10 Posanne	8ft

CHOIR ORGAN.

1 Gambs	8ft.
2 Dulciana	8ft
3 Voix Celeste	8ft
4 Claribel	8ft
5 Gemshorn	4ft
6 Snabe Flute	4ft
7 Flautina	2ft
8 Vox Humana	8ft
9 Clarinet	8ft

SWELL ORGAN.

1 Bourdon	16ft.
2 Violin Diapason	8ft
3 Salicional	8ft
4 Rohr Flute	8ft
5 Principal	4ft
6 Lieblich Flute	4ft
7 Fifteenth	2ft
8 Mixture of Two Ranks	—
9 Cornopean	8ft
10 Oboe	8ft
11 Clarinet	4ft

PEDAL ORGAN.

1 Open Diapason	16ft.
2 Bourdon	16ft
3 Quint	12ft
4 Principal	8ft
5 Trombone	16ft

COUPLERS.

1 Swell to Great.
2 Do. .. Octave.
3 Do. .. Sub-Octave
4 Swell .. Choir
5 Great .. Pedal
6 Choir .. Pedal
7 Swell .. Pedal
8 Pedal Octave

COMBINATION PEDALS.

4 to Great Organ. 2 to Swell Organ: Pneumatic action to Great and Couplers; separate bellows for Pedal: Manual and Pneumatic action: oak case.

F. O. R.

DOMESTIC SANITATION.—LANDLORD AND TENANT.

[19216].—A SHORT distance from my residence is a street of houses, some of which have been recently built, and are of course liable to the defects and deficiencies of work done by contract upon the lowest estimate tendered to the owner of the land at the time being. Four of these houses were purchased by a gentleman in the City, and let out to very respectable tenants at a fair rental, and good feeling was the prompter to honourable conduct with all parties. But in the course of time, and with constant wear, disorder became apparent in several of the appurtenances, and questionings arose as to the remedies, and as to whom the payment belonged; for expensive repairs meant diminution of the interest on the capital expended, and so far a loss to the landlord; whilst, if the cost of repairs fell alone on the tenant, the increase of interest on the capital expended would be a burden to the tenant, and as it seems to be expected that the landlord, in the rent-charge, has considered and allowed for every item of repairs, the rent-payer looks to the rent-receiver to be indemnified in every instance when it may be necessary to the tenant's interest that payment may be made for anything done to the landlord's property; so thus disagreements arose, the landlord became disgusted with his tenants, and gave up the collecting of his own rent and the abuse of his tenants to the polite attention of an agent. One of the tenants was a friend of mine, and through this friend of mine, as a recommendation, I was sent for to attend to such repairs as came within my line of business, and as I had a real interest in my friend's welfare, I did my best for my friend as far as I could without loss to myself. These houses were built with the drainage through the back premises, and out through one house into the sewer in the street; at the backs of the houses were the conveniences, built up about 3ft. above the area level, but outside of the house, so of course were built on made-up ground; this made-up ground settled in the settlement of the houses, and had drawn out the drain-pipe from the socket next the trap to the w.c. apparatus. Though the w.c. was built up outside the house, the flooring to the scullery was continued into and formed the floor of the w.c.; the kitchen was also a continuation of the same floor, and from the kitchen there was access to the floor of the basement of the house which contained the living-rooms of the family. My friend consulted me, because of the intolerant smell from the drain. I referred my friend to the agent. The agent said the landlord would not do anything more, then I said to my friend, "Do it yourself." My friend gave me the task, and what I did was satisfactory; but the next-door tenant was in the same predicament. I myself drew the attention of the agent to the cause and to the remedy, and offered to make the next door good at the same cost as I made to my friend; but I did not get the job then, for which omission I had to thank either the landlord or the agent, or perhaps both of them. In the bare matter-of-fact law of landlord and tenant I do not intend entering. I have read somewhere of there being a written law and an unwritten law which have claims upon all, and bind all. On the written law affecting domestic sanitation I here remark that it seems to me the whole burden of all those things which come under the Metropolis Management Act is placed on the landlord as the owner of property, and that all the subsequent Acts which affect the same subject are worked out upon the same principle. Nor do I object to this, for I consider that the supreme authority ought not to be bandied about like a shuttlecock between landlord and tenant; but even though it be so, it does not absolve the tenant from all responsibility. If you borrow £500 for twelve months, you pay back the £500 in good gold, and the interest you have agreed to pay as well. So also should a tenant act with the landlord—that at the end of the tenancy, with the allowance of fair wear and tear, the value of the property should not be depreciated, and in the "beneficial interest" in the tenancy the landlord ought not to be held responsible for every item of repairs which the tenancy causes and the tenant does nothing to remedy. My friend before referred to had his drain attended to at his own cost; his neighbour did nothing, because it was the landlord's business. My friend acted under the unwritten law, and did for himself what benefited himself and has actually been to him a source of satisfaction—although the landlord in his case was benefited as well, for events have proved my friend to be right and his neighbour wrong in acting on the written law, though backed up by a little force of Acts of Parliament, which, with its "ifs" and "buts" and "shalls," generally speaking, comes into operation when the mischief is done. Acts of Parliament to enforce domestic sanitation, if made, would be inoperative. The Acts of Parliament we have are sufficient for every purpose, if properly applied. As it is, the "Local Management Act" and the "Nuisances Removal Acts," with their subse-

quent amendments, just serve to keep decency among us; but both of these Acts are evaded and played with, so that the conditions which might be brought about in our sanitary arrangements may, like some other good things, be prayed for, but are not yet to be found, nor will ever be found whilst an antagonism betwixt the landlord and tenant exists on these matters. As the question at the present time stands, the landlord evades his responsibilities and the tenant suffers, or the tenant evades his responsibilities and the landlord suffers, and of the two sufferers the landlord is the greater sufferer, but the least to be pitied; for the landlord puts his property in the care of an agent, whose time and attention must be paid for in an open and business manner, as agreed on between principal and agent; and, as a rule, the landlord, in addition, has to pay from 15 to 25, or more, per cent. on such repairs as must be done, if done through an agent, than the landlord would have to pay if he attended to his own business. I have met with one or two to whom 10 per cent. discount is satisfying; 15 per cent. is the rule, and more, if it can be got. Now, is there any sane person in London who thinks that I can honestly put £20 worth of work into, or on, any other person's property, and getting £20 for it, allow from £2 to £5 to the middle man, and live? But, as it must be done, who suffers the most? Why, the landlord; and it serves him right, for trying, in this manner, to evade his responsibilities. For the discount allowed to the agent is like the nails: "Boy," said the owner of the house to the carpenter's son, "pick up those nails, or they will be lost." "No, Sir," said the boy; "you will find them in the bill." And the tenant evades his responsibilities in a number of ways. Very frequently he stops in the house until it is knocked, and broken, and dirtied, and then takes his belongings off to another house, at a cost for removing his goods which would have made his late home comfortable, or, perhaps, like the neighbour to my friend, the tenant, will grumble and suffer with the same or similar results. The result to my friend's next-door neighbour I will give as follows:—The agent had been applied to, and nothing done until one of the neighbour's family was taken ill; the doctor was sent for, and, to the consternation of the family, the case was pronounced as one of the very dangerous typhoid class of fevers, attributed solely to impure sewer-gases. A man was sent for immediately, and the drains were attended to at a cost, to the landlord, of over £3. After a time the child got better; but the smell from the drains remained. A short time elapsed, and another child was taken ill with the same loathsome and dangerous disease, and the doctor, of course, had another patient; and I was then sent for to examine the drains, and I also charged over £3. So that in the end this job cost the landlord nearly seven pounds, which I had offered to do at the sum of 9s. when I attended to the same sort of job for my friend, and my friend is my friend still, and still in the same house, and has always been pleased that he paid me 9s. out of his own pocket, for it saved him two very heavy doctor's bills, and all the anxiety attached to serious illnesses in the house; and at the very moderate cost of 9s. he avoided that which next door to him was a serious matter between landlord and tenant. Jo Boomer.

TINNING OR WHITENING METALS.

[19217].—I SAW, not long ago, a query asking how brass-wire is coated with white metal resembling silver, and having recently come across the following recipes, I send them to you. I believe that in Birmingham wire is tinned as it comes from the drawplate, but it is not such a good coat as that obtained by boiling the articles in the solution. The amalgam process is not used so much as it was formerly. It consists in applying to the clean and dry metallic surface a film of a pasty amalgam of tin with mercury, and then exposing the surface to heat, which volatilises the latter, leaving the tin adhering to the metal. The immersion process is best adapted to coating articles of brass or copper. When immersed in a hot solution of tin properly prepared the metal is precipitated upon their surfaces. One of the best solutions for this purpose is the following:—Ammonia alum, 17½oz.; boiling water, 12½lb.; protochloride of tin, 1oz. The articles to be tinned, first thoroughly cleansed, are put into the hot solution until properly whitened. A better coating can be obtained by using the following bath, and placing the pieces in contact with a strip of clean zinc, also immersed:—Bitartrate of potassa, 14oz.; water (soft), 24oz.; protochloride of tin, 1oz. It should be boiled for a few minutes before using.

The following is one of the best solutions for plating with tin by the battery process:—Potassium pyrophosphate, 12oz.; protochloride of tin, 4½oz.; water, 20oz. The anode or feeding-plate in this bath consists of pure Banca tin. This plate is joined to the positive (copper or carbon) pole of the battery, while the work is suspended from a wire connected with the negative (zinc) pole. A mode-

rately strong battery is required, and the work is finished by scratch-brushing.

In Weigler's process a bath is prepared by passing washed chlorine gas into a concentrated aqueous solution of stannous chloride to saturation, and expelling excess of gas by warming the solution, which is then diluted with about ten volumes of water and filtered, if necessary. The articles to be plated are pickled in dilute sulphuric acid, and polished with fine sand and scratch-brush, rinsed in water, loosely armed with zinc wire or tape, and immersed in the bath for ten or fifteen minutes at ordinary temperatures. The coating is finished with the scratch-brush and whitening. By this process, iron—cast or wrought—steel, copper, brass, and lead, can be tinned without a separate battery. The only disadvantage of the process is that the bath soon becomes clogged up with zinc chloride, and the tin salt must be frequently renewed. In Hern's process, a bath composed of—Tartaric acid, 2oz.; water, 100oz.; soda, 3oz.; protochloride of tin, 3oz., is employed, instead of the above. It requires a somewhat longer exposure to properly tin articles in this than in Weigler's bath. Either of these baths may be used with a separate battery. Essar.

ANNEALING STEEL.

[19218].—MOST of your readers who have worked in steel must have come across events which it would puzzle them to explain; and although I have looked up all the hints and wrinkles I could discover I am frequently at a loss to account for the behaviour of steel. I have read that "Annealing at a high heat is injurious. Annealing at a low heat can do no harm to steel which is to be hardened afterwards, and if applied to steel which has been heated too hot for either forging, annealing, or hardening, will, to a great extent, restore such injured steel. Heat low, thereby keeping steel which is good all right, and making that which has been injured better." I have reason to believe that this advice is good; but different brands of steel seem to work on different lines; some will cut as easily and clean as cheese, when annealed, while others crumble away under the tool. Can any of your readers explain why this is thus? Can Mr. Evans throw any light on it? We know that the percentage of carbon makes a great difference; but I am inclined to think it is not everything, and that much must depend on the processes employed in manufacturing the metal, as well as on its subsequent treatment in the workshop. A friend writes me in answer to some questions—"My experience is that any good standard steel will work about the same when annealed under the same or like conditions. I get very good results by cutting steel to the sizes required, placing them in a cast-iron pot or crucible, filling in with sand, ashes, or charcoal, fastening on the cover, and luting it with clay, putting it in a furnace and heating for about ten hours, banking up the fire so that it will not cool for about 48 hours, after which process I can cut the steel very easily with a pocket knife. I once tried this plan with a lot of small pieces, 4in. by 2in. by 3in., and one large piece, 7in. long, 4in. diameter, all of the same make, in the same pot. The result was that the small pieces were properly annealed, and had not lost any of their cutting or tempering properties, and the large piece came out as coarse grained, as soft pig-iron. It was unfit for use, and could be tempered only by a chemical bath. Query: Was the large piece overheated or not; and if it was, how could it have occurred, having been surrounded by the small pieces which were all right? Regarding the breaking of twist-drills in the centre, I recently gave a machinist a new twist-drill, and in about five minutes afterwards was informed that it was broken in the centre. My experience and observation is that seventy-five per cent. of them break in the same way, and I think that the twist or torsional strain has about as much to do with the breakage as the uneven temper. Another cause of breakage results from forcing a drill through the bottom of the hole, as the drill catches and is supported by the hole it has made, and will break above or in the centre. The old saying in a machine shop to 'rush your roughing work and take time enough to do your finishing and fitting well' will hold good, I think, while reeding a twist drill through a hole." I imagine that many of your lathe amateurs must have experienced similar difficulties to mine. If they kindly give of their experience, we may ultimately get at some definite knowledge of value all round to workers in steel. Jas. Illingworth.

MILLING TOOLS.

[19219].—SEEING some inquiries in your paper about milling tools, I send you the following, cut from the *American Machinist*, which may be of interest, and, possibly, of some value to your readers.

"For various reasons, such as poor steel, overheating, improper grinding, &c., much trouble is experienced in getting milling cutters to work

AURORÆ.

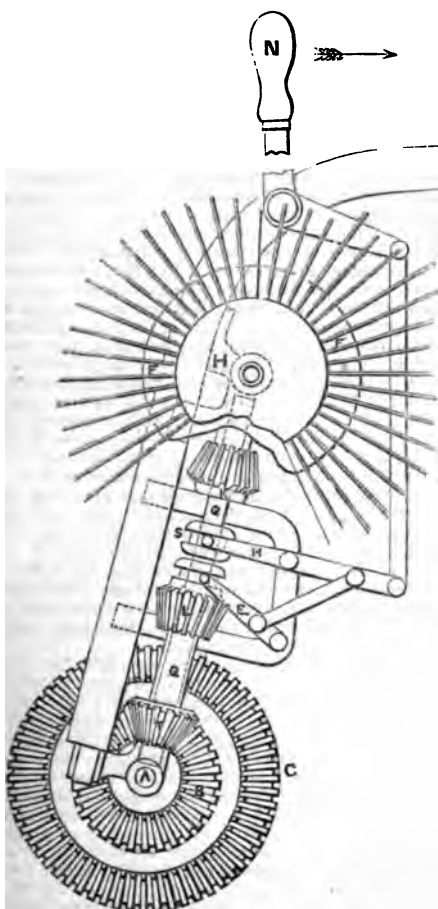
[19226.]—Aug. 29, 10 p.m., dense clouds driving before a strong east wind. Luminous patches occasionally visible about 30° above the northern horizon, with rapid motion westward. Probably Aurora seen through breaks in the clouds. Sept. 14, 1 a.m., Coruscations of a pale greenish hue; sky rather hazy, with moon shining brightly.

J. A. Westwood Oliver.

Athenæum, Glasgow, Sept. 17.

TRICYCLES.

[19227.]—I AM sure that all your readers who are tricyclists will be very glad to find that such a practical man as "Sunlight" has given us his experience of tricycles. I venture, therefore, to send you drawing and description of a machine which I



endeavoured to describe in a former letter. I have had a week's touring on it, and can safely say that the hill-climbing gear is a great help. Anyone who knows the road from Winchester to Southampton, knows how hilly is that district. Yet I managed to ride the machine all the way. The wheels are about 40in. and speeded to 54in., or with the hill-gear to about 30in. I use a saddle, and can sit right over the pedals, but I find that this method, although it gives me great power, impairs the use of the steering-wheel behind when travelling on very greasy or very dusty roads, as, I presume, there is not sufficient weight upon it. This could be remedied by double driving-gear, but such a method would add greatly both to the cost and weight of the machine. My idea is that with this gear attached to such a machine as the "Salvo," in place of the driving-chain, it would make one of the best yet produced; the great objection to it being that the steering-wheel would then be in front. The means by which the Salvo is made to drive both wheels is, I think, more efficient than the use of two separate driving-chains or other similar gear. I venture to think that this gear would be more effective than "Sunlight's" suggestion, as, if I understand him correctly, it would be necessary to have four driving-chains if the machine is to be double-driving, and a single driving-machine is not so effective for hills as a double-gear one. In either case it would be necessary to have a lever at each wheel to alter the speed, whereas in the one I describe one lever would be sufficient. My experience is that in going up-hill my machine has a tendency to turn round towards that side on which the driving-gear is placed, even when the steering-wheel is quite straight. If I had double driving-gear [this could not happen. As regards spoon-

brakes, I must emphatically say that I do not like them at all; if from any cause one should press more on its wheel than the other does, the machine is sure to turn suddenly round. I have myself been twice run into the ditch from this cause. Moreover, they injure the rubber tires and tend to loosen them. There is nothing better than the brake similar to that fitted to the Salvo; a steel band acting round a pulley fixed on the axle.

Description of Fig.:—F is a bevel cog-wheel forming part of the inner hub of one of the driving-wheels which drives the pinion K, keyed on the spindle Q Q. B and C are keyed on the pedal shaft. As represented in the figure, the smaller speed is in gear. The wheel B drives the pinion T, which is keyed on a ferrule which slides on Q, and is raised in or out of gear by the lever H, the end of which is forked and catches in the grooved wheel S. When the lever N is pulled to the right, S is raised up and draws the pinion T with it into the space between the wheels B and C so that it is out of gear. By the same movement the lever E is depressed, and so throws the wheel L into gear with the wheel C. When the lever N is placed half-way both pinions T and L are out of gear with their respective wheels, when the pedals form a rest for the feet in going down-hill.

Charles F. Steel.

[19228.]—YOUR correspondent "Guido" is quite right in what he states respecting the size of chain-wheels. I consider it a great mistake to have them so small as one sees on many new machines. Take for instance the "Cheylesmore" or the "Singer." The first of these I know to be very troublesome from the chain jumping off. In this case the pitch-wheels are made so that there are not cogs or teeth properly so-called, but the wheels have depressions, as it were, only. I consider the form of tooth, if we may so term it, as well as the small diameter of the pitch-wheels, bad. And I should think that, if not already done, the maker will alter these two points. The Singer machine having pitch-wheels very similar, it no doubt suffers from the same defect. But I cannot speak as to this from actual experience, whilst as to the "Cheylesmore" I can. I do not wish to speak against either machine, please remember. And to give it its due, I would say the "Cheylesmore" certainly is a fine machine; otherwise, I am mentioning these as they have come under my own personal notice. Exception might be, perhaps, taken to the fact of the larger wheel on several scores. But I would say that a most important consideration is involved—viz., the number of teeth always in contact with the links of the chain. If these are few, the strain per tooth and link must be more, whilst, if many, it is more equally divided, and the chain is likely to wear longer; is not liable to jump off when riding a hill. And there is the minimum of risk, of danger, or excessive wear to either chain or pitch-wheel. In my own machine the pitch-wheels are of steel—very light in section. The small wheel is 7½in., and the larger one 9in. diameter respectively. Whilst, owing to the way the chain is made to gear, there are no less than 10 links engaging with the same number of teeth always in contact to transmit the strain on the smallest wheel. And the gears do not look at all cumbersome, whilst they have never given trouble, neither has the chain ever run off with me. And with the remarks of "Guido" I thoroughly concur as far as the tricycle matters go.

To our good and able contributor, Mr. W. H. Staepole Westropp, I should like to add a few words. From my point of view, his remarks are most direct to the point on all but one item, which I feel sure he bases his assumptions on, but which is not stated in his letter—viz., that the length of throw of the crank depends on the length of the rider's leg. Therefore, what would suit a tall man would not be so well for a short one, as the latter would find the 6in. throw hard, whilst our tall friend would work it with ease. Theoretically, a 6in. crank should drive the machine easier than the 4½in. But like many other points, theory is not proved by practice. I would also mention that in the case of a short man with good muscular power a short throw crank would enable him to ride as fast as a person of greater height and somewhat less muscle, on a 6in. throw-crank. Will Mr. Westropp kindly state his height? In my own case I am not very long in the leg, and am of opinion that a somewhat shorter throw than 6in. would be best suited to my requirement, although I ride a 6in. at present pretty easily.

I am quite with him as to the question of hill-climbing, and hence the evolution of the idea as described in letter 19173. No doubt, also, a level gear has advantages in hill-riding; therefore, a 40in. wheel, level geared, is likely to ride easier up an incline than the same wheel geared or speeded up to equal a 50in. And I think further that this question is really one of endurance, as the 40in. wheel speeded level, although the rider makes more turns to the mile than if speeded higher, it rides easier if the rider has the staying power to

withstand the extra revolutions per mile, the speed being (in both) the same. The decreased circle through which the feet travel, no doubt, helps to counterbalance the extra revolutions. Travelling up-hill is the one point that is, I think, greatly to be desired by riders. As on a level, a good machine will run pretty freely, and I find that the increase of speed over a certain rate, up to pretty rapid travelling, tires one but very little more. But it is the hill I do not like; and, where I am residing, we cannot go any distance without up or down grades.

"T. F." has, however, started a fresh question. As to the size of wheel, I am still of the opinion I expressed in my former letter. The smaller the wheel, the more turns it makes to the mile. Hence the velocity of the rim is greater, and it runs over obstacles quite as easily as the large wheel, owing to the stored up force due to its weight and velocity. I am quite willing to admit that the smaller wheel, travelling at the same speed, or I should say, making the same number of revolutions per minute as the larger one, especially at slow speeds, would fall into small depressions of the road more freely, but its extra velocity enables it to run over these just as easily as the big wheel.

I should like to hear more from friend "T. F." on the seat question. I am somewhat inclined to think as he does. My machine has the double flat spring, as also a three-point support arrangement, which I find fairly elastic. But still there is some considerable side "joggling" as he mentions. I was about to try a plan with an inclined cushion filled with a rubber and spring combination to obviate this.

I should like to have his views on one or two points as practical comparisons. They are, what is, in his opinion, the best size wheel for riding in a hilly country, and up what grade he finds it practicable to ride without very great exertion on his machine as now altered. And if he thinks I can, by the alterations I have just mentioned, and which are, in detail, the fitting of three rubber loops from the present points of suspension, so that the wood seat is carried, as it were, on C springs, with rubber suspenders, and also the application of a slightly sloping seat with spring stuffing, make my present steel machine, with 40in. wheels, ride easier up hills?

I would just (to trespass on your space a little further) like to mention, as bearing on the question of crank-throw, that there is the "Hercules," which can be had, to allow the cranks to be altered in the length of throw. Has any friend ridden one? If so, will he kindly state his ideas on it?

I have also been favoured with particulars of a new machine made by the "National Tricycle Co.," Coventry. Their "National," No. 5, is not only, I think, a novelty, but also a vast improvement. The idea is to abolish the chain, or any system of gear, and drive direct on the main wheel shaft. The woodcut shows a most slightly machine, and built on a principle that I have long thought would be a great advantage. Both wheels drive. Absence of gear, an open front to the machine, back steering, powerful brake, and many other advantages. It looks to me so likely a machine that at the earliest date practicable I shall arrange to see and test one. After which I shall be happy, should no one else do so previously, to state my opinion of it after a practical trial. This firm also do another thing that meets my views, viz., they fit wheels of 52in. diameter to their special tricycles, but speeded down to 48. This certainly is likely to be an advantage, and should meet the views of our friend "T. F.," to some extent, as well as myself, as tending to easy riding. I am mentioning this not as a gratuitous notice in any way, as I am perfectly ignorant who the firm are or anything about them beyond their price list; but make mention of this new machinery as being likely to interest your tricycle readers.

Sunlight.

[19229.]—"SUNLIGHT'S" letter (19173) ought not to be passed over without remark. In the first place, I should like to know how there can be more of what "Sunlight" calls centrifugal force stored in a small wheel, than there is in a big and consequently a heavier one, the periphery of which travels at the same speed? As a matter of fact, the centrifugal force in either case would be precisely the same. But what "Sunlight" evidently means, is not centrifugal force at all, but angular momentum, for (as is plainly seen by the derivation of the word) centrifugal force is a force which pulls from the centre, and such a force could never help the wheel round.

Again, if we take a small wheel, and a large one, with the same section of rim, and with the peripheries travelling at the same rate, then the angular momentum is directly proportional to the radius of the wheels. That is, in the large wheel the angular momentum, or power stored up, is proportionally greater than in the small one, and not less, as "Sunlight" tries to make out! But, as everyone will agree, the momentum of the weight which a

tricycle carries is of far more importance than the angular momentum of the wheels (which are made as light as possible) and would be more than sufficient to go over a stone. Again, "Sunlight" must know that to raise a weight any height, a certain amount of work must be done, and whether you have a big wheel or a little one the work done is just the same; and if you do it in the same time, the power exerted during the whole of that time is the same in both instances. There would be a little extra friction in the one case certainly, but that would tend to favour the big wheel. From the practical experience which I have had of different kinds of tricycles, I certainly think the big one goes the easier, though I do prefer the kind of make in which the small wheels are used (the "meteor" for instance), as I like to have everything clear in front. The brake certainly ought to be on the driving wheels, and not on the steering wheel, and, I should think "Sunlight's" arrangements of slow gearing would be a good one, but I should like to see a drawing of it. J. H.

HORSE-VELOCIPEDES.

[19230].—MAN'S natural progressive movement is produced by alternate projection of his two feet—it is applicable not only to walking on level ground, but ascending and descending hills, stairs, ladders, crossing rocks and every kind of surface. But as man became civilised he constructed smoother roads, where the traffic was great, and wheels to run thereon. On such roads, divested of the diversity of surface which made progress on foot essential, he introduced wheels, and latterly, not only wheels which revolve on smooth axles for the purpose of heavy burthens, but bicycles, tricycles, &c., for his own progress.

The alternate putting forward of the feet of a horse is as regular as that of a man, and there is probably no sufficient reason why the advantages of a road, divested of its natural irregularities should not be made as available in increased degree for horses—i.e., why horse-velocipedes should not be made—the horse to ride and work on treadles, and thus add two-fold to the speed, and two or three-fold to the daily distance, a horse might, without more fatigue than now, be enabled to perform. Horses readily acquire steady action of various kinds by training and habit, and would probably easily be trained to work a properly-constructed velocipede, in which case a rider or driver might reasonably achieve 15 to 20 miles per hour, or 100 to 120 a day, without entailing more exertion on the horse than is now required for one-third the speed or distance. Penketh.

THE PRODUCTION OF ELECTRICITY IN THE BATTERY.

[19231].—I DESIRE to draw attention to the following phenomena:—It is of course well known that a gaseous film, say, of hydrogen, on a platinum plate, when plunged into acid and opposed to a clean platinum plate, evolves electricity; this being the proximate cause of so-called "polarisation." It has never been made clear to my mind why such an action should occur, and I venture to think that upon the elucidation of the principles involved depends the introduction of that gas-battery which may supersede all the various magneto-machines used for producing light, motive power, &c.

All existing batteries use zinc, and all zinc batteries must inevitably get choked by their own secondary products, thus precluding the possibility of constancy. But no such disadvantage would attach to gas if it could be employed in the place of zinc. When opposing a gas-coated plate to a clean one the current is but momentary, and it occurred to me to try the state of the "quasi" clean plate afterwards. This I did by opposing it to a fresh clean plate afterwards. This I did by opposing it to a fresh clean plate in another cell. I found that it too yielded a current, from which I infer that there is an actual transference of the gas between the two opposed plates, doubtless by "polarisation" through the acid, and that it is only when both plates have similar gaseous films upon their surfaces that electrical equilibrium is arrived at. There must in all this be some expenditure of force made apparent as electricity, for no material matter seems to be changed throughout the entire operation. The gas simply seems to be transferred, thereby producing electricity.

W. T. R.

THE LATHE.

[19232].—I OUGHT to have replied to E. P. Aintree (letter 19168, p. 14), last week; but have been so busy that I could not find time.

I hope shortly to be able to write another article upon the details of Gilray's lathe, in respect to its fittings for special purposes, and will bear in mind queries. O. J. L.

MILLING MACHINE.

[19233].—So far as I can understand Mr. Young's drawing (letter 19197, p. 40) he does not help us to

a "milling machine" but simply to a modified cutting frame. The advantages of his modifications also are by no means obvious. Will he favour us with further explanations? What will it do beyond what is done by the ordinary vertical cutting frame or the old crown-wheel cutter? I fail to see. Will some practical turners say, also, whether, in their opinion, there is any cutting instrument better than the old crown-wheel cutter, when well made and of adequate dimensions? For myself, I doubt much whether anything is better.

A little-known apparatus for wheel-cutting, milling, shaping, &c., based upon one designed by Professor Willis, is made by Holtzapffel and Co., and is, I believe, an efficient instrument. But it costs 25 guineas. It is thus described in Holtzapffel's catalogue:—"It has a vertical slide, upon which the cutter-spindles are mounted in various positions; or the work may be attached to the vertical slide and presented to drills, &c., carried by the mandril, which capacities, combined with the two horizontal movements of the slide-rest and the dividing plate of the lathe, constitute a most comprehensive and useful arrangement." I have only seen this shaping-machine at Holtzapffel's; but it is a charmingly-constructed apparatus, and one which would be a most valuable appendage to a strong metal-turning slide-rest. If any reader is in possession of this, perhaps he would report. Hines, of Norwich, also makes a milling-machine for using upon the lathe-bed. His machine is a kind of slide-rest which rises bodily upon the lathe-bearers, as well as having the ordinary horizontal movements. Holtzapffel's shaping-machine affixes to their metal-turning slide-rest, and seems to do everything except allow the work chucked upon it to rotate in a vertical plane by means of a tangent wheel. This is, I fancy, essential for completeness. Some such apparatus is much needed. As to the principles upon which it should be designed, I venture to submit:—1st. That the lathe mandril should be used to carry the cutting-tool so as to get rid of the complication, vibration, and loss of power involved in the use of pulleys from the overhead motion. 2nd. That the basis be a strong metal-turning compound slide-rest, as with the Willis shaping-machine by Holtzapffel. 3rd. That the horizontal movements of the slide-rest be supplemented by a vertical slide giving a range of three or four inches vertically. 4th. That the screw-nose or plate upon which the work is chucked rotate in a vertical plane by means of a tangent wheel-base, such as that which forms the horizontal base of the spherical slide-rest. The Willis-Holtzapffel shaping-machine fulfils many but not all of these requirements. It fixes on to their slide-rest by means of the ordinary Willis' tool-holder, and so as to hang over the end or side of the rest according as cylinder or surface-work is needed. With lifting-blocks under the lathe-head its vertical range may be increased. Will other readers favour us with further information? James Edmunds.

8, Grafton-street, Bond-street.

MEDICAL REPLIES.

[19234].—LOSS OF VOICE.—"Lizzie," who "has always had a weak voice, has been drastically treated for several illnesses, and whose profession demands much public speaking, is liable to lose her voice in various degrees on taking cold." She asks me for a remedy. What I should advise is that she take up some profession which does not demand much public speaking, and that, meanwhile, she learn to use her voice more skillfully than at present she probably does. She probably has the "parson's throat," a form of weakness in which the larynx has either never been adequate for the work of public speaking, or in which it has been strained and ruined by a bad method of speaking, or simply foundered by overwork. Now a new larynx cannot be put into her, nor can a weak larynx be made to do large work without breaking down; nor can any voice be used improperly without being damaged. Careful feeding, regular hours, avoidance of hot unventilated rooms and of the chilling effect of night-air, plus a skilful use of the voice, will carry her as far as possible in her present work. James Edmunds, M.D., &c.,

8, Grafton-st., Bond-st.

PHOTOMETRY.

[19235].—IN letter 19202, W. J. Rendell asks why should not the intensity of light be measured by its penetrative power? Several forms of photometers have been constructed to act on this principle; one of the best that I have seen consisted of a long wedge or prism of dark glass of similar quality to that used for the sun-glasses of sextants and telescopes; this was made to slide at the end of an eyetube, and the thickness of glass that just admitted light represented the intensity, which was read off on a scale engraved on the slide. In order to obtain direct vision and neutralise chromatic effects, another short prism of transparent glass

was fixed behind the first. But all photometers on this principle are unreliable, because they give different indications according to the sensitive state of the eye for receiving rays of light; for example, if a person remains for a time in a room with an electric light, and then tries its intensity by such an instrument, the indications will be minus—but let him remain previously in a dark room for ten minutes and then apply the photometer without allowing the main light to reach the eye, then the reading will be greatly in excess of the previous one. This same objection will apply to Mr. Rendell's ingenious idea. The oldest method still appears to be the most reliable—that of bringing the light to be tested side by side with another of known value, because in this comparison the sensitive state of the eyes of one or more persons does not influence the comparison. F. H. Wenham.

DEEP-SEA SOUNDING.

[19236].—A NEW apparatus for sounding the depth of the sea was invented some time ago by a Portuguese, Senhor H. de Lima e Cunha. It consists of a hollow cone of copper with a perforated base, the latter constructed so as to screw on and off. A vertical wire of pure silver joins the apex of the cone with the centre of its base. In order to prepare the instrument for use, the base is unscrewed and the silver wire dipped into nitric acid. The chemical action ensuing from this operation covers this axial wire with a coating of nitrate of silver. The wire is then readjusted in its place, and the base of the cone screwed on again. The instrument is then attached to a line by its apex, and so weighted as to retain an erect position. As the cone sinks, the water penetrates through the perforations in the base, and rises in the interior of the cone to a height proportionate to the pressure of the water. The salt (chloride of sodium) of the sea-water enters into chemical combination with the silver nitrate which envelops the axial wire, and replacing the nitric acid, converts the silver salt into chloride of silver—an opaque white substance. This covers the portion of the wire which has been in contact with the water, and thus clearly indicates the maximum height to which the water has risen, and, consequently, registers the pressure upon the air in the cone, and from this datum the depth of the water can be deduced by calculation. The old way of sounding, by sinking a cannon-ball, or other weights, attached to a line, proved very fallacious, owing to a circumstance which does not affect the above-described automatically-registering contrivance.

In other modes of sounding generally in use, and which suffice well enough for practical purposes of navigation, if not for scientific ones, and may be depended upon for depths under 1,000 fathoms, a heavy weight, either globular or long in shape, is let down as rapidly as possible. According to one American system, the line is cut at the surface, when it is felt that the weight has reached the bottom, and the depth computed from the length remaining on the reel. Indeed, the line not unfrequently proves unequal to the strain of hauling up the weight of itself, and the metal ball or prism from the bottom, and snaps. In Mr. Brooke's system, which has been variously imitated, the weight is disengaged from the line by the shock of contact with the bottom, and the line is hauled in without it. Sometimes, however, no impulse is felt, though the weight may have reached the bottom. This may happen owing to great depths, or to currents. These soundings are marked in charts, no bottom at such-and-such a number of fathoms, according to the line let out. Several miles of cord have sometimes been immersed in this way and counted, whereas in reality the line had been "paying out" owing to its own weight merely, or to the under-currents, long after the weight had reached the bottom.

Anonymous.

GRINDING AND POLISHING GLASS SPECULA.

[19237].—I FULLY agree with the fourth par. of "A. J. S.'s" letter 19131, and as to the sixth par., we ought all to thank him for suggesting the lightening the speculum by celling its back. I have written to Chance Brothers and Co., and they are going to try experiments in this direction, and I have offered them my services in working and testing an experimental speculum, to ascertain the proper mode of celling and the proper proportion; therefore, I should advise all intending buyers of specula to wait a few weeks, when I hope the above firm will be able to supply a much lighter, and yet as strong and perhaps stronger, speculum, than a solid one. I could hope we shall be able to save two-thirds of its weight, as "A. J. S." supposes, but I rather doubt this. As to what he says about the latter half of his fifth par. in the latter half of his sixth par., I most heartily agree with him.

I see "Prismatique" is going to describe the grinding and polishing of specula by hand. I think this is well, especially as he will give us the

way the trade does it. I hope he will not spare details, even though he has to extend his interesting letters to a few more than he at first intended. I shall take up grinding and polishing specula by machine, and so our readers will have both processes before them, and thus a mass of information will be contributed to, and contained in, our columns, that cannot be found anywhere else. I am glad to see a nice spirit pervading the whole correspondence; in fact, I think we could justly thank one another all round, for I believe we all wish to help one another. Will "Prismatique" please describe the bulb and candle test?

I must now proceed with my part of the subject, and in doing so I would just remind the learner of what I said in a former letter, that there is a felt need of working large specula under the tool; I therefore prefer working even small ones in the same way, since the experience thus gained will serve us as we advance to larger sizes, for it is in the nature of the amateur to feel, soon after he has mastered a 6in., that he is thinking about the possibility of making a 9in. or 12in., and that he will want a larger after that, if his means will allow. This is all right in itself, for it is the way discovery and invention are furthered, and so it is well to commence in a way that we can go straight on to any size we may require. Therefore, our next question is, how are we to fix our speculum to the face-plate of our machine? This is a most important question, as it brings us for the first time to face our most fearful enemy—namely, flexure; the importance of this is overlooked by most amateurs. I, therefore, feel it necessary to impress the importance of this subject on his mind by a diagram, which, of course, must be exaggerated so as to show to the eye the minute deviations which the lines of the rays of light are forced to take by minute imperfections of the surface of the speculum.

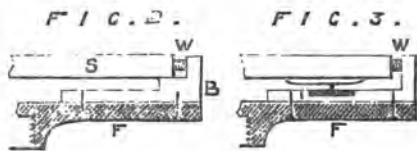
Now, let A B (Fig. 1) be the speculum, and C



the focus; now it is evident that the rays F from the centre, may cross a little to the right or the left of the focus C, and yet not enlarge the crossing of the lines at the point C to any perceptible degree, because they cross at so small an angle, and this we find in actual practice to be true, for the centre rays may be a little shorter or a little longer, and yet if the speculum be free from flexure, the definition will not be materially injured, so that to get a speculum perfectly free from flexure is of more importance than getting it perfectly parabolic. Let us now suppose there is a small amount of flexure on the outside of the speculum at A and B, so that the crossing of the rays A C and B C, that is their focus, is caused to be a little on one side, above or below in the figure, of the crossing of the rays F C, a perceptible thickening of the line is at once seen to take place, and bad definition to be the result of an infinitely small amount of binding of the surface at A and B, and therefore the shifting of their focus a little on one side or the other of the focus of the centre rays F C; of course an equal amount of flexure of the centre F would produce practically the same bad definition, but in actual working it is the outside of the speculum that is in most danger; in fact, I might almost say the flexure is always found in the outside portions of the speculum; the above example is, of course, not the only form that flexure takes.

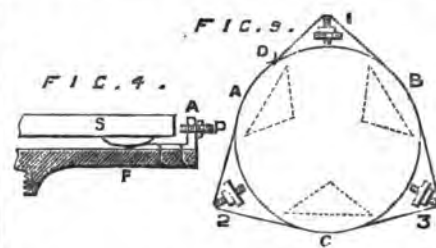
The cause of flexure is the speculum being unequally supported round its edge, while being ground and polished, during which it has to bear the weight of the tool on different parts of its surface during different parts of the stroke of the tool, hence the importance of the support of the speculum, on the faceplate during its being worked. Now, to investigate this subject, I placed myself under the following favourable circumstances for the production of flexure. I choose a 6in. speculum only $\frac{1}{8}$ thick, one-half Mr. Calver's thickness, and I used a tool that pressed with a weight of 4lb., while Lord Rosse's tool for his 3ft. speculum was only 10lb., i.e., mine was proportionately fourteen times as heavy. I commenced with the simplest form of support, represented in section in Fig. 2, where F is half the faceplate, S half the speculum, and B a block of wood screwed from beneath the faceplate; W is a little wedge to keep the speculum from moving; now, with this mode of support, I found flexure was distinctly visible, and intolerable; this I had expected, but tried the experiment to become acquainted with the amount. I knew

the cause to be the unsupported parts between the blocks yielding to the weight of the tool. I now divided the speculum into three equal segments, found the centre of gravity of each, then divided each segment into three equal areas, and found the centre of gravity for each; then I made three iron triangles $\frac{1}{8}$ thick, so that the angles would just support each equal area on its centre of gravity; I put a stud projecting 1-16th in the triangle where the centre of gravity of each segment came; I altered the wooden block B, so that the stud of the triangle would rest



on it, and thus support the speculum; I used the wedge W as before. I polished (see Fig. 3) and found the flexure much reduced, but still intolerable. I studied the conditions when the tool was at the extreme of its stroke, and therefore where it had its greatest effect in producing flexure, and I soon saw that I ought at least to have the stud of the triangle under the centre of gravity of the whole weight when the tool was at the extreme of its stroke; this I now did by putting the triangles further out towards the edge of the speculum, in fact I brought the two outer angles of each triangle to within half an inch of the edge, and thus the edge of the speculum was supported at six nearly equidistant points. I think I had to alter the triangle a little to meet these conditions. I polished and found the flexure still more reduced. I now observed that the wood on which the stud of the triangle rested was slightly indented, and therefore was not a rigid support, but would allow the speculum to sink when the tool came over a triangle, and thus throw part of the weight at least on the point of contact where the wedge W is in the figure, and the two corresponding points of the two other blocks, thus reducing in part this form of support to being still the same as the first, and most imperfect, form of support of Fig. 2. I now let a piece of flat iron into the blocks at I, and thus a hard support was substituted for the soft wood. I polished, and found the flexure further reduced. I may just observe that, during all these experiments, I was studying figuring, and various forms of polisher, &c.; and, during each form of support, I made many experiments, always watching the effects of flexure, and distinguishing it from the various plans of figuring, &c., these experiments ranging over months. I now give them in detail, that each amateur may see at what stage he has arrived, and where the difficulty that now troubles him as to flexure is. I shall deal with the difficulties of figuring further on—but one thing at a time; and let us remember it is important to report failures, for the next best thing to being told what will do, is to be told what will not do. Now, I had observed that in nearly all instances the chief point of flexure was in one part of the speculum; and, as I always put the speculum on the faceplate in one way, I was enabled to look out for the cause in the right place, and I could see that the really weak point of this form of support was the rigid contact of the edge of the speculum with the block B, at the point W, and the two other corresponding points of the two other blocks. To test the influence of these points, I put a card between the stud of one of the triangles and the iron I of the block B, and forced in the wedge W with my thumb and finger, as though I were going to polish. I then drew out the card; the speculum was held up by the wedge. I now placed weights on the edge of the speculum, and found that it took 3lb. to force it down to its bearing on the iron I. I then tried in like manner the other two supports, and found that in one it took 6lb. and in the other 1lb. to force them down; and, further, that the chief point of flexure was where it took the 6lb. Now these weights were the average of several trials. Here, then, I had revealed to me the great source of my remaining flexure. I saw that I should have to resort to the mode of support that I had adopted some 15 years ago when working a 6in. object-glass, for we cannot have the lenses one-sixth of their diameter, but about the thickness of the specula I was now experimenting upon. So I removed the blocks B, and put three right-angled pieces of iron A in Fig. 4, with a clear hole opposite the middle of the speculum, with a threaded pin P passing through and having a nick filed in its end and a small threaded nut moving easily on it. I show this in plan at Fig. 5. I then take a piece of string, and hold its end opposite the middle of the edge of the speculum at A, and pass it over the nick in the end of the pin I to the edge of the speculum at B, on to C, then in the nick of pin 2,

then to A, round to B, and in the nick of pin 3 to C, round to A, when I tie it as tightly as I can at D. I now screw the nuts so that the pins are



brought out, and thus tighten the string to about as tight as a fiddle-string, seeing, of course, that the edge of the speculum runs true, when the faceplate is turned round, and screwing one nut more than another, so as to produce this truth. The triangles were fixed on the speculum in a very simple way. I laid them in their place, then took one and warmed it, put it back in its place, and put a piece of pitch about the size of half a bean at each angle, and melted it with a hot iron; this I did to all the triangles, so that there was no further trouble with them, and the pitch, as a yielding substance, allowed the speculum to take its own bearing on the triangles. I now polished and figured to a parabola, and tested, when, to my delight, the general truth was wonderfully improved, and the signs of flexure were very doubtful, although I just suspected them; and there was no point of the edge that I could detect flexure distinctly in more than another, as with the previous form of support with the rigid side-blocks. I could lift the speculum up at each triangle, and it would go down with its own weight till the stud in the triangle reached the face-plate, so that there was no side-strain whatever, and the weight rested on, and was distributed through the triangles to the studs. The definition was very good indeed. There was one test yet for it to pass, and that the severest I know. I had tested all along with a hole about the 1-300in. with Foucault's test, and this was as small a hole I could use so as to get light enough to see the shadows. I now felt I must reduce this hole to 1-1,000in., for the smaller the hole the greater the test. Now, to get enough light, I silvered the speculum, when about 15 times as much light would be reflected, and consequently allow me to proportionately lessen my hole. This I did and tested, when, not to my surprise, flexure showed itself slightly again, apparently not as much as before with the previous support; this shows the almost infinite delicacy of Foucault's test when pushed to its limits. Of course the flexure was not increased by the silvering, it was only made visible by the more delicate test, it being invisible by the larger hole the faint amount of light the plain glass surface could reflect required. All this testing I hope to describe, and put amateurs, by simple means, in the way of better reading the figures of their specula; this may make them dissatisfied with their former work; but it will urge them on to greater perfection.

To sum up, I must say that the result of all my experiments goes to show that if we do not have our speculum inconveniently thick, i.e., more than 1-6th its diameter, we cannot avoid injurious flexures if we have rigid side supports.

H. A. Wassell.

Addenbrook-villa, Love-lane, Stourbridge.

LOCOMOTIVES.

[19238].—I READ, with much interest, the continuous brake returns supplied to the MECHANIC through the kindness of Mr. Stretton. The absence from the list of one important company, the London and North Western, is very much to be regretted. Not only is none of their stock fitted with an efficient brake; but only their main-line trains are, I believe, fitted with the chain-brake now in use.

In my letter 19157 I was under the impression that "Carstairs" had previously alluded to Caledonian expresses of another type than their ordinary 8ft.

Whilst thanking "Xpress" for his detailed description (p. 44) of the G. W. R. engines I may mention *à propos* to his remark about my sketch, that it is only recently they have altered the shape of the cab so as to correspond with those of other companies' engines. They originally possessed only storm-boards, and an apology for a cab composed of a storm-board, and what one might call splashers at the sides, and entirely without roof.

The coupled engines mentioned by the same correspondent are used on the Oxford, Worcester, and Wolverhampton, and Worcester and Cardiff sections. They are mostly 6ft. coupled, and possess the motley cabs alluded to. Can any one say whether the G. N. R. have any 8ft. engines now stationed at Leeds? I constantly see their best expresses

coming and going with 6ft. 6in. coupled attached. The G.N. are causing this latter class to have cabs covering the whole of the footplate, and coming down flush with the handrail. They have "spectacles" in the sides as well as the front.

The "Scotchman," too, has lately been running into York behind a 7ft. single.

All the G.N.R. engines are having the splashers unperforated, being merely painted over. Can anyone say anything *re* the N.B.R. engines?

J. T. Lawrence.

NORTH-EASTERN ENGINES.

[19239.]—PERHAPS an account of the various classes of engines on the N.E.R. may not prove uninteresting to others as well as "E. P." (query 44707). The passenger-engines are distinguished by size of wheel, having drivers of 5ft. 6in., 6ft., 6ft. 6in., and 7ft. diameter (all coupled). The first of these are only in use on the smaller branches.

The next class (with 6ft. wheel) are by far the most numerous. Some have inside frames, some outside. They also differ much in shape of cab, in external boiler fittings, &c. Many of them have splashers so constructed as to include the whole of the connecting-rod. They are chiefly in use on the Leeds and Thirsk branch, which, for heavy gradients, curves, and all that makes railway travelling unsafe, stands, perhaps, unparalleled.

It is, however, their express engines with 6ft. and 7ft. drivers that I have particularly noticed. They are built all to the same model, differing from those which have been some time in existence, in shape of cab, height of boiler centre, painting, and get-up generally. They have very short black funnels, cylinders 17in. by 24in., inclined about 15° to the horizontal, and painted a very light green. All the springs are underhung. It

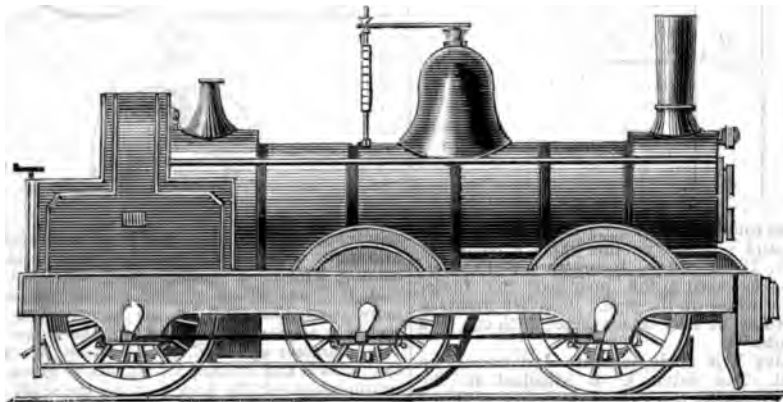
so upon the impulse of the moment, to save half a minute."

The accident, and this explanation, show beyond doubt that the existing arrangements require improvement.

The Board of Trade inspectors, and also the general reports upon accidents, have upon many occasions called the attention of the companies to the systems in use upon the Metropolitan District, and London, Chatham, and Dover Railways, the adoption of which we are officially informed "would undoubtedly reduce the number of these mistakes to a minimum, and would, moreover, simplify the duties of the signalmen, and render them more free from anxiety in the performance of their duties."

It is to be hoped the railway companies will pay attention to the subject, because it is now admitted that the frequent errors in the working of the present block system permit it to fail in its object of preventing collisions. It has often been urged that *too much* reliance is placed upon the block system, and, certainly, recent events show that this is the case, at least, in some instances. Upon many occasions when a train breaks down, or comes to a stand upon the line, the inquiries proved that the "rear guard" went up to the engine to see what was wrong. This has caused many accidents, and it cannot be too strongly urged upon the rear-guards of trains that their *first duty* when their train, from any cause, comes to a stand upon any part of the line (not protected by semaphore signals), is to at once obey the companies' rules, and go back and protect the train by hand-signals, precisely as if the block telegraph was not in use.

Clement E. Stretton.
Saxe-Coburg-street, Leicester.
September 17th.



was the new goods-engine I described as a picture. I inclose a sketch (from memory). I have a sketch of the express, but am afraid it would take up too much room. I am induced to send the goods, since, amongst all the engines described in "ours," this class is lacking. Every information as to details can be had from Mr. Ramsey Kendal, N.E. Loco. Department, Gateshead.

John T. Lawrence.

THE BLOCK SYSTEM.

[19240.]—THE recent accidents which have resulted either from defective systems for securing intervals between trains, or from the mistakes of signalmen in working the absolute block system, have again called serious attention to this subject.

The theory of maintaining a certain interval of space between all trains is no doubt perfect; but, unfortunately, in practice we find that the most experienced signalmen sometimes make an error in the block-working, and in many cases a collision is the result. Some persons are always ready to blame the men, and even to charge them with "manslaughter," but, in my opinion, nearly all the "mistakes" made in working the block system might be prevented by the use of proper appliances to combine the interlocking and block systems.

The engine-drivers are guided by the "out-door" signals, and if these are worked in accordance with the electric instruments, there can be little fear of collisions between following trains; but, unfortunately, there is nothing to prevent a signalman from lowering his signals for a train to proceed at a time when the instruments indicate "line blocked."

At the inquest held to inquire into the circumstances of the collision at Bow, the signalman stated "that he pulled over the lever for the second train to pass on to Bow-road without first looking at his instrument in the box to see whether he really had received 'line clear,' and that 'he did

the station than the present system of signalling at the east and west cabins affords."

In my letter, p. 599 of last volume, I mentioned that, pending the verdict, I should not, of course, express the opinions which I formed when upon the scene of the disaster. The signalman at the west cabin was very greatly to blame for lowering his "home signal" at a time when another engine was standing in the station only about 172 yards beyond. The signalman at the old junction also made a great mistake in taking off his "home signal" when he actually saw from his cabin that the line was obstructed.

These two wrong signals did, no doubt, tend to lead the driver into danger; but still there is the fact that his sight of the station is about 470 yards.

I should be most unwilling to think that an experienced driver culpably neglected his duties; but there is no doubt that an unfortunate error in judgment caused him to enter the station at an excessive speed, thinking, that as the signals were "off," that the station was "clear" through to the "home signals" at the other end. When passing the west cabin he appears to have become aware of the danger, and then to have put the Westinghouse brake full on; but it was too late to avoid the collision as the distance was very short.

The driver, as an excuse, stated "that the brake failed"; but, from the first, all impartial persons were convinced that this was not the case.

The Westinghouse brake was used to stop at Darwen Station (about three miles from Blackburn), the fact that the driver was able to take off his brake and start his train, is a most convincing proof that it was in proper working order. When passing the Bolton Junction, about 671 yards from the point of collision, the driver tells us that he had "an air-pressure of a little over 80lb."

Now, it must be remembered that if the brake had failed it would have brought the train to rest automatically, not have permitted it to run on to destruction. There is the evidence of the passenger who felt the brake-blocks grinding upon the wheels of the carriages in which they sat, just after passing the west cabin; the statements of those who were upon the platform and saw the "wheels skidded"; also the evidence of the guard that when he opened his valve there was "no air," showing that the brake was already full on.

After such a very severe collision the rear carriages rebound with great force, but in this case they did not do so, proving conclusively that the powerful brakes upon each of the four rear carriages (Nos. 226, 224, 1,446, 1,447) held them firmly and prevented it. This point is important, because in such cases "rebounding" can only be prevented by automatic continuous brakes.

Then, again, there is the fact that when tested after the accident the brake was found in perfect order, and most satisfactory "stops" were made with the four rear carriages when the experiments were conducted; and the most minute examination of every part confirmed the statement that the brake performed its duty well.

The verdict of the jury undoubtedly gives a most true and concise view of the whole circumstances.

Fortunately, "excessive speed" is not a frequent occurrence on the part of experienced drivers; and in this instance it must have been an error, because no man ought to think of running at a speed of about 40 miles an hour up to about 30 yards from the end of a station platform, without putting on his brake, or assuring himself that the line in the station was clear.

Clement E. Stretton.
Leicester, Sept. 17.

OXFORD FRAMES.

[19243.]—SEVERAL correspondents speak of using the chisel to form rebate. If you think it worth insertion I beg to say I find a gauge made from a piece of old handsaw, say 6 teeth (not too coarse), or about 1/4 in. wide, shouldered into a common gauge, tops of teeth about 1/4 in. from shoulder, answer well. It cuts clean, and can be adjusted to any depth or width.

T. Ellis.

[19244.]—I NOTICE that nearly every correspondent on this subject advises the final touch to be made with sandpaper. Now there are Oxford frames and Oxford frames. One sort may be bought at six shillings a dozen in the cheap shops, and the other kind may rank as works of art on account of the proportion of the various parts, and the finish of the whole. If "F.E.A.S." wishes to produce the former, he will be able to do so with the aid of a spoke-shave, rasp, and sandpaper. If the latter, then the work must, in the finishing stages, be touched by nothing but the plane and chisel. The use of these in skilful hands leaves the work with that clean-cut appearance, and with that sharp edge on it, without which carved work (and as such I include Oxford frames) cannot rank as "high-class." Nothing but constant practice can give skill in the use of the chisel, and where "plane-work" ends and "chisel-work" begins,

CALEDONIAN ENGINES.

[19241.]—IN order to correct a false impression which my last letter conveys, I beg to state that 113 only had (and, indeed, still has) steam-brakes on driving and trailing-wheels. When first these engines came out, I was informed that all four (113—116) had been so fitted, but soon after observing that neither 114, 115, nor 116 were braked, I naturally concluded that they had been removed. The 8-footers are stationed as follows: seven at Carlisle, one at Edinburgh, and eight at Glasgow. Nos. 79, 80, 81, 83, 84, 113, and 114 are at Carlisle, No. 78 is at Edinburgh, and Nos. 76, 77, 82, 85, 86, 87, 115, and 116 are at Glasgow; 87 and 116 are in the shops at St. Rollox just now.

The loads on the driving-wheels of the older 8-footers seem to have been by no means constant; in some cases it seems to have been as high as 15tons 8cwt., as I have the weight of one (84, I think) as follows: leading-wheels, 8tons 14cwt.; driving-wheels, 15tons 8cwt.; trailing-wheels, 6tons 8cwt.; total, 30tons 10cwt.

To show what size of trains these engines sometimes have, I may state that on the 17th inst. No. 77 brought in the first portion of the 5.15 ex Carlisle, consisting of 23 coaches, even making up some time.

Sept. 19.

Carstairs.

THE BLACKBURN ACCIDENT.

[19242.]—YESTERDAY, Friday the 16th inst., the adjourned inquest was resumed at Blackburn, and the jury returned the following verdict:—"That Charles L. Tiplady and others lost their lives in a collision between the Manchester and Liverpool and Liverpool trains in the Blackburn Station on the 8th August, and that such collision was caused by the loose working of the signals and the excessive speed at which the Manchester train was being driven into the station. The jury are further of opinion that there ought to be more protection to

as in the corners of the bevels of Oxford frames, the amateur is generally sadly at fault, and is tempted to resort to sandpaper, which effectually removes all "character" from the work, and gives it a dull, leaden appearance. As ample instructions in details have been given by other correspondents (those on page 43 being specially reliable), I will only add that the finishing touches can only be given in a satisfactory manner with a chisel that is thoroughly sharp.

A Country Parson.

HOW TO BEVEL OXFORD FRAMES IN LATHE.

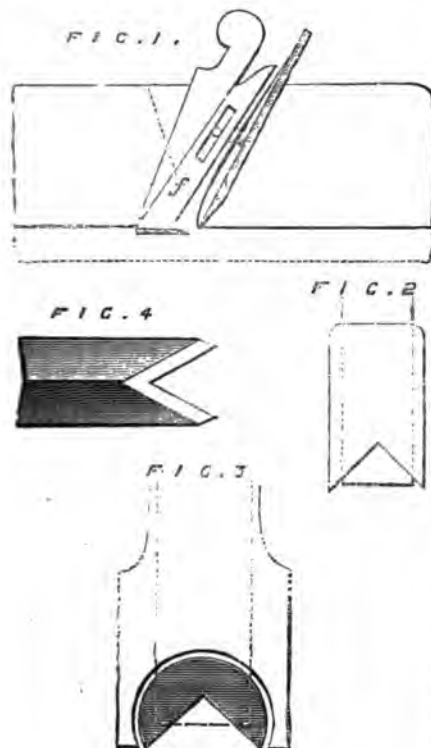
[19245.]—PLANE your stuff up square, cut into lengths about an inch longer than wanted, fix one in a true cone-chuck, the other true on poppet-centre. Then with flat-faced (flying) cutter bevel the corners, and when they are all done you can with a right-angled nosed cutter cut out the rabbets. If the pieces are weak, use a saddle-collar at back, with a right-angled notch in; if sweep ends to bevels, use a carver's compass-chisel, as it is much easier to use than a "dabbled up" firmer, which is apt to chatter the work.

Kentish-town.

J. Hildersley.

CHAMFER-PLANES.

[19246.]—WHEN good work is required in chamfering, it is usual in the trade to use a plane similar to Fig. 1, although frequently modified in

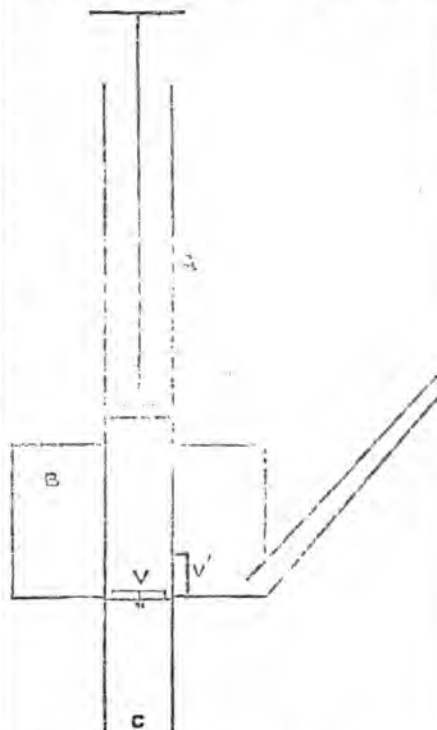


its arrangement. What is required is a tool that will finish the work at one operation, no chiseling or glasspapering or gauging the width of the chamfer. Fig. 1 is a double-iron plane, usually of beechwood, with a sliding piece of hard wood (soled with metal if preferred) placed in front of the cutting-iron, and provided with a set-screw working through a slot in the side of the plane, so that it can be raised or lowered with the cutting-iron, and consequently making a larger or smaller chamfer. This piece and the cutting-iron are fixed in any position by the wedge, a portion of wedge and mouth-piece are removed, as shown by the dotted line, to allow the shavings to pass. Fig. 2 is an end section. The dotted line indicates the cutting-iron and mouth-piece. This plane will make a chamfer at the angle of 45° only. Fig. 3 end section of a plane with a revolving bottom-piece the whole length of plane, which piece is secured in position by suitable means at the ends; and consequently will cut the chamfer to any angle. This last device has, I believe, been the subject of a patent, but, like many others, never put in the market, as very few workmen would care to pay the price for a tool used perhaps once in three months. These planes finish the chamfer from the commencement of the stroke, starting at the point of the stop or bevel, which stop is completed with a chisel on a suitable template as Fig. 4.

Joiner.

GARDEN-ENGINE FORCE-PUMP.

[19247.]—IN looking over the last part of the MECHANIC, the other day, I saw a question asked by someone, but I cannot find it now, about making a small pump of this kind, and saying that he could work in tin. I suppose he wishes to make one for himself, and cheap, too; so I send a description of one I made, years ago, with which I could throw a continuous stream some forty or fifty yards. It is cheaply and easily made. A is the barrel, about 6in. diameter—if it is made larger, it is not so easy to work; B is a cylinder



which goes round the barrel; V is a valve opening upwards, and V' is also another valve attached to the barrel; B, of course, forms an air-chamber. The air is condensed in the upper part and forces a stream of water up the pipe. C either stands in a tub of water, or may be connected with one by a flexible tube.

The valve V is made separate and forced up the barrel. The valve V' is attached to the barrel previous to the cylinders being soldered round.

Edwd. Thos. Scott.

SMALL ELECTRIC MOTOR.

[19248.]—YOUR correspondent, R. T. Lewis (letter 19191, p. 39), seems to have misunderstood the description of my electromotor (19182, p. 16); his and other observations might discourage some amateur in attempting the machine, and as 20lb. covered copper wire and 12 Bunsens will be discouragement enough, without criticism, I hope you will allow me to say that I gave the design without stating its advantages, the least of which is, that it can be made with the help of a blacksmith and a clockmaker's lathe, without requiring an engineer's shop or the assistance of an American dynamo Co. There are too few experimental amateurs, to seek to dishearten any. Another and important advantage is that the electro-magnet can be used separate for experimental purposes.

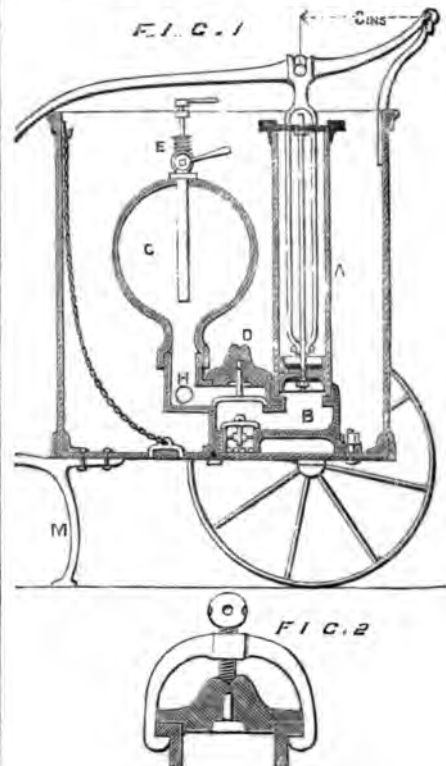
J. Sutcliffe.

Electric Accumulators.—On Friday last these were brought into play in connection with the lighting by electricity of the smoking-room of the Junior Carlton Club. The lighting is intended to be carried on at present by overhead wire from the Heddon-street works of the British Electric Light Company, but in order not to delay the lighting, the electricity for the illumination of the smoking-room was supplied by accumulators. The room, which is a large, square one, has hitherto been lighted by one central gaslight, with about twenty-five burners. The electric lamps, to the number of fifteen, of the form known as the "British Incandescent Lamps," are placed in an umbrella-shaped shade, and the light seemed to be about double that of the gas as regards actual quantity, but the illumination of the room was clearer and purer than with gas. The number of accumulators used, which were of the most recently-developed form of M. Faure, was forty, sufficiently charged to keep the fifteen lights going about six hours.

REPLIES TO QUERIES.

* * * In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[44286.]—**Hand-Pump.**—I beg to send you a sketch of hand-pump such as "M.B." evidently



requires. As it is about the handiest useful little article in a house that can be made during the coming winter, I quite expect that not only "M.B.," but others of your readers wishing for more particulars, will let me know. The pump stands in a reservoir made of 1/4in. sheet iron about 14in. diameter and 15in. or 16in. deep; it rests on two wheels and a foot, M, 8in. above ground, the continuation of the foot forming the shaft about 3ft. long, bent upwards and ending in a T large enough to admit both hands. The pump-barrel is 3in. in diameter and 11in. long. The plunger consists of two cup-leathers, put together as shown, with two brass plates 3-16th inch thick to fit inside of cups, the whole being secured by a 1/4in. nut to the end of spear. The barrel A is made of drawn seamless brass tube, soldered and secured by pins screwed in. The guide of spear and upper flange is secured by three small screws and consists of one casting. The valve-box B of brass; the two seats are placed one above the other, the one 1 1/4in., the other 1 1/2in. The cover serves as guide for top valve and is secured as shown in Fig. 2. A few seconds suffice to remove and clean both valves. The air-vessel is of copper; it screws in its place; it has an internal pipe with stopcock and screwed end to attach small hose; swan-neck, if required; diameter is 1/2in. Diameter of C is about 8 1/2in. H is opening of stopcock, not shown, actuated by the rod and lever E. A communicates with the screwed end for attaching fire-hose. The pump-handle is bent to about 2ft. 6in. above ground. The plunger is shown disengaged from handle and partly turned in the barrel. The fire-hose may be 1 1/2in. diameter and about 18ft. long. The nozzle should be made proportionate; but to this interesting subject I will, if requested, return in another letter.—P. F. OTTO, Liverpool.

[44354.]—**Organ-Pipe Making (U.Q.)**—One mandril will do for several pipes. Log or "timber"-pine is largely used by Hill and other organ-builders, as it makes the voyage before being cut into boards; the effect of the salt water and air is confined to the edges of all but the outside boards. Stuff which comes over in the form of 3in. plank obviously undergoes a larger amount of exposure to saline influences than does timber stuff.

—J. W. W.

[44441.]—**Force-Pump.**—To "SUNLIGHT."—I am afraid you will have some further trouble with your pump. The stroke is so short that there is little wonder it does not work. Not only this, but I fancy you have got your valve-surfaces far too large. The remedy I should apply would be to fit

the plunger of the pump so that it worked almost water-tight, without the packing on the gland. Also, see that when it is at the end of the instroke, the ram almost touches the end of the pump-chamber. The passages to the valves also to be as short, and the valve-chamber to have as little capacity, as possible. Beyond this, I should use valves with either conical faces, or, better still, to use valve-box faces, with just the least cone, and to turn the valves so that the edge of it only bore on the sheets, and that for hardly more than 1-32nd. All this, I know, means very careful fitting—in fact, more than amateurs generally bestow on models. But, unless the work be good, and the valve-faces perfectly cylindrical, you will not get the faces tight, and, therefore, you could not pump against the boiler-pressure. I do not say the alteration I have named will make your pump work. But it is the only thing that is advisable, excepting the adoption of a larger, or longer-stroke pump.—SUNLIGHT.

[44462.]—Steam-Engine.—To "SUNLIGHT."—The difference of pressure would vary, consequent on the length and proportions of steam-pipe, as also the bends in it would, in some smaller degree, affect the question. Then we have the throttle-valve, which would cause a further loss, and when we get to the slide-valve we get a still further cause of loss. With ordinary proportions, very probably a loss of some 8lb. to 10lb. pressure would occur; that is, supposing the valve was properly proportioned and set. In fact, what the pressure on the piston really is, and how the steam is distributed, is a matter only to be solved by the indicator. As to the best point of cut-off, that is a question that there exists such a difference of opinion on, that I think I can best help you by stating the rule propounded by Professor Marks. He states that the fractional part of the stroke, giving the most economical point of cut-off, equals the absolute back-pressure per square inch, divided by the absolute initial-pressure of steam on the square inch. Therefore, if we take the absolute initial steam-pressure as 45lb., and the back-pressure as 15lb., we find that if C represents the part of the stroke at which steam is cut off, that we obtain $C = \frac{15}{45 \times 15} = \frac{1}{45}$ of the stroke. Therefore you might try this rule as applied to your engine.—SUNLIGHT.

[44464.]—Chloride of Zinc Battery.—A chloride of zinc battery is one in which a chloride of zinc solution is used as the excitant. This salt of zinc may be made by dissolving scraps of zinc in hydrochloric acid until the acid will dissolve no more, and then driving off the excess of acid by evaporation. The grey deliquescent salt remaining must be dissolved in water to form the battery solution; 2oz. of salt will form one pint of solution. Chloride of zinc has already formed in one of "Aleph's" batteries, and will continue to form in the solution; but the other will contain a salt of sodium, too.—EDWIN.

[44496.]—Chemical Food.—The formula quoted on p. 625, No. 858 ENGLISH MECHANIC, is for the Pharmacopœia syrup of phosphate of iron—a totally different preparation to "chemical food," which is a compound syrup containing iron, lime, soda, potash, and phosphoric acid in proper relative proportions, thus supplying all the necessary elements of a bone and tissue-former in a soluble state.—R. E. A.

[44505.]—G.W.B. Engines.—In my last reply to above query, the following misprints, &c., occur: Line 10, instead of reading "grate area, heating-surface, &c.," should read, "grate area, 17 sq. ft.; heating-surface, in tubes, 1145.5 sq. ft.; in firebox, 133 sq. ft.; total heating-surface, 1278.5 sq. ft." "C. R. M." (15562) kindly promised to send a tracing of this class, and also Mr. Cadworth's 7ft. singles. May I remind him (while thanking him for his courtesy in placing before us so many types of English and Colonial locos.) that these will be very acceptable. I also beg to thank Mr. Lawrence for his drawing. The above dimensions do not, however (I think), apply to that class. When did they (last mentioned class) come out first?—CARSTAIRS.

[44515.]—Chemical.—The crystals you speak of are most probably sulphate of iron. The nitrate of iron generally used by dyers is really a nitro-sulphate, containing an excess of sulphate, which latter often forms a crystalline deposit.—R. E. A.

[44531.]—Electrical Contact.—I have used a dental alloy very much resembling gold, but very hard and suitable for springs. I think it was an alloy of platinum with gold, and should think it would be very suitable for electric contacts where the colour of platinum was not approved.—EDWIN.

[44531.]—Electrical Contact.—In answer to S. B. McClellan, I have made one on the following plan: The "scope-wheel" carries a small projecting-pin, which has a piece of flat platinum soldered to it; now the pallet arbor carries a brass spring,

having a platinum fork-like piece, which, when the wheel comes round to a given point with the projecting-pin, the fork-like piece comes in contact with the edge of the flat piece, making a good contact. I should be glad of a description of your arrangement, with rough sketch.—AN OLD SUBSCRIBER.

[44551.]—Hydromotor.—The hydromotor invented by Dr. E. Fleischer may possibly lead to the abolition of steam-engines in ships under certain conditions, but it is scarcely so wonderful an invention as the newspapers made out. On each side of the vessel's keel is a pipe terminating in a nozzle at both ends, and each pipe is in communication with a large cylindrical vessel placed vertically in the hold. Each of these cylinders is fitted with a float, above which steam is admitted, while, as its name implies, the portion of the cylinder below is full of water. The steam-inlet and exhaust-valves are worked by rods attached to the floats, and the water is admitted by valves and pipes through the condenser. Assume that the float is at the top of the stroke and steam is admitted. The float is then forced down and the water is ejected through the pipe and nozzles, thus propelling the vessel. As soon as the float is forced down to the end of its travel, it opens the exhaust-valve and the steam rushes out into the condenser, when a partial vacuum being formed the water rushes in beneath the float and carries it up to the top of the cylinder again ready for another stroke. The number of reservoir cylinders may be increased to any desired extent, but there must be two working alternately in the smallest hydromotor. By means of valves the water can be ejected either ahead or astern. The hydromotor has been fitted in a vessel having a mean displacement of 105 tons, with which a speed of nine knots has been made on a coal consumption of 255lb. per hour, the indicated horse-power being 100. The water discharged per minute is 700 cubic feet at a speed of 66ft. per second, the area of the nozzle being about a third of a square foot. There are many advantages appertaining to the system; there is no screw to be damaged or become entangled with wreckage; no screw-shaft to break, while the pumping power would suffice to clear the vessel of leakage that would quickly seal the fate of an ordinary steamer. The system is economical, according to Dr. Fleischer because there is little loss from friction; and the experiments made show that the indicated horse-power being 100, 80 per cent. was accounted for in the water discharged, leaving a loss of only 11 per cent., or about one-sixth of that experienced with the *Waterwitch*, which is propelled by an engine driving a centrifugal pump. Some details, with drawings, will be found in *Engineering* of Sept. 9; but we shall probably hear more about the hydromotor soon, as the inventor is in this country, and has patented the invention.—S. R.

[44559.]—Staining Ivory.—For ivory-staining I should recommend, in preference to nitrate of silver, boiling first in a decoction of logwood and afterwards in a solution of sulphate or acetate of iron.—R. E. A.

[44559.]—Staining Ivory.—To "Os."—The ivory I wish to operate upon is very highly polished, and when it will be figured with "over-head, &c., lathe-work," the sunken pattern will appear mat white. Staining the ivory in the first instance should not affect the gloss, which the "lye" would most assuredly. The desideratum is that the dye must be durable, as well as capable of taking a fine gloss—not varnish—perhaps hyposulphite of soda would permanently fix the nitrate of silver, which otherwise becomes prismatic.—DELROS.

[44560.]—Paste.—Use common gum-arabic dissolved in water, and add to the prepared gum a few drops of solution of chloride of antimony.—R. E. A.

[44563.]—Relations of Side of Square to Diagonal.—I have to thank "Paugni" for reply; had it been by logarithms instead of the well-known proposition 47, book 1, Euclid, it would have saved him from the obvious mistake of saying, "twice the square of the sides equals the square of the diagonal." Euclid clearly says the square root of the sum of the squares of the two sides gives the length of diagonal. The mistake occurs in scientific works; that is why the question was asked.—A. A.

[44569.]—Yellow Dye.—Saffron dissolved in water, though expensive, is by far the best substance for your purpose.—R. E. A.

[44572.]—Electro-Magnets.—An electro-magnet to lift 20lb. can be made from a bar of $\frac{1}{4}$ in. round iron 8in. long, and bent so as to leave $\frac{1}{4}$ in. of space between the arms of magnet. Varnish the iron with brunswick black, then wrap it from one end to the other going round the bend, and in layers one over another, with 1lb. No. 16 cotton-covered wire; make the armature of $\frac{1}{4}$ in. square iron. It will work with a bichromate battery having a working zinc-surface of 4in. by 2in. To lift 50lb. use $\frac{1}{4}$ in. round iron 12in. long, and proportionate wire.—J. SUTCLIFFE.

[44574.]—Glacialine.—Will "H. W." advertise his address? I think I can furnish him with the desired information.—R. E. A.

[44594.]—The New Violin.—"Fiddler's" explanations, page 45, have nearly sent me mad. Why this beating about the bush to explain what ought to be a very simple matter? I shall take it as a favour if you will outline your new violin as at page 579 last vol. Mark off upon the outline the length, breadth, and angles in inches; then, I think, all is plain. No more of the horizontal and perpendicular bars, if you please. Also, is the leg of bridge to come down outside or inside of sound-board, and screwed to treble soundpost; and is the other bridge to be in a line with first, and screwed to bass soundboard, with a small space between?—YOUNG GLASGOW.

[44594.]—The New Violin.—In reply to "Fiddler," I may say that I have made three necks of violins with the aid of a vice, a fret saw, and a few files and chisels, and cut the scroll as well. The way I set about it was to cut the wood out roughly with the fret saw, and then rasp to the required size and shape, then smooth it and finish with glasspaper, and polish. The scroll is the most difficult part, but it can be done with a couple of chisels and a half-round file, using the end of the file to work it to shape. Cut the peg box out before you finish the scroll, because that is the part where it is most likely to split, and then if you should make a waster you will not have all your work to throw away.—T. HARRIS.

[44594.]—The New Violin.—I am rather disappointed that "Fiddler" has not thought it worth his while to give some information as to the way in which he manages to hold his fiddle. It is easy to say "with respect to the holder there is no difficulty." The difficulty I find is to manage to make it so that it can be well held without either increasing the entire length of the instrument and so making it awkward and tiresome to finger, or lessening the effective length of the soundboards, and I cannot imagine how "Fiddler" can get over the first of those difficulties with his instrument; any increase of the length makes it much more difficult "to bring the violin well over the left arm and elbow." "Fiddler" ought to have sufficient experience of the "E. M." to know that the surest way to "get our friends to suggest their ideas on the subject" is to give his own. By the way, I cannot make anything of the view of the fiddle which he now gives: it does not appear to have the remarkable raised part behind the bridge, shown in his previous side view. It seems to be decked, and the sides certainly are not parallel to each other unless it is decked and the deck projects beyond the sides, which I do not suppose can possibly be the case. The necks and scrolls of fiddles must, I should say, be carved by hand. Any I have ever examined were certainly so done. It is not very hard to do it, but to one unaccustomed to the work it is rather slow. I have made a very nice one of well-seasoned sycamore. I wish I had any chance of doing the rest of the fiddle as much to my satisfaction, but I greatly fear I have not. I have let the work lie by in hope of getting some intelligible directions from "Fiddler" how to make it, so that it can be easily and conveniently held; but after his last communication I fear I have little chance of it, and it would be ridiculous for me to give my ideas on the subject when I have not any which I think likely to prove satisfactory in practice, whilst "Fiddler" evidently thinks his plan quite satisfactory.—G. J. H.

[44621.]—Sulphur Moulds.—Cut some slips of stiff paper about an inch broad, and long enough to go twice round the medallion. Pour a little water into the plate, and in it place the medallion, face upward. The water must be only sufficient to reach about half-way up to the face; let the medallion remain for half a minute, or until it is perceived that its face has become slightly shining from the water absorbed. When this is the case, take it immediately out of the water, put a slip of paper round it, and fasten the end of the slip by a wafer, or other means. The sulphur should now be in readiness to pour, and care is requisite in the melting of it. An earthen pinkin is very good to melt it in, and putting a roll of sulphur into it, place it over a slow, clear fire. As soon as sufficient is melted, pour it on the face of the medallion to the depth of a quarter of an inch, or more, according to the size, and when the sulphur has set, remove it from the medallion, when, if the operation has been successfully performed, it will possess all the sharpness of the original. Certain precautions must be observed in order to attain success. The medallion must be of the proper degree of dampness, for if too wet, the water will occupy the fine lines and angles of the plaster cast, and destroy the sharpness of the mould. If the plaster be too dry, then the sulphur will adhere, and on removal break up the face of the medallion. Should this occur, hold the plaster part in warm water for a few seconds, when a film of water will insinuate itself between the surfaces, and tend to separate them. The sulphur must not be made

too hot, as it then becomes thick and pasty. Should this occur, let it stand off the fire, when, as it cools down to the point of crystallisation, it will become almost as liquid as water, the condition best adapted to the purpose. If the first mould taken be deficient in sharpness, through the medallion being too wet, a second one may be taken without reworking the plaster, but it would be necessary to do this if a second mould be required, and the first was just right. In taking a plaster cast from the mould, the face of it must first be very slightly oiled.—W. W.

[44646].—Collapse of Flues.—Although "Glatton" has answered my query, he has failed to work out the problem I asked for, which will be as essential to me as the answer itself. I hope "Glatton" or "Boiler Inspector," or some of your readers will oblige me. I am obliged to "J. D." for answering in logarithms. As the collapsing pressure is found by him equal to 648-948lb. per square inch this must be an error. Hope he will correct this, and reply in logarithms as before.—S. E. O.

[44648].—New L. and Y. Express Engine.—It seems to me that there would be a danger of the pilot-engine breaking away if a powerful continuous-brake, fitted to the second engine and the coaches, were put on either automatically or by second driver or guards, unless the driver of the pilot smartly applied his own engine brake, or unless both engines were fitted, as described by "C. E. S." with the brake-power under the control of both drivers and acting upon both engines.—V.

[44649].—Faulty Common Well-Pump.—"Working Tom" has got six replies, but they do not meet his case. The action of his pump is, he says, that after four or five strokes of giving water it, all of a sudden, and without any warning, misses stroke, and then gives water again, and so it continues. Now it is evident the pump draws air. If it drew air through a fault in the suction-pipe, it would be felt at every stroke; it would be nearly uniform. That leads me to believe that a fault will be found in the well. The supply of water in the well is not sufficient to feed a pump of that size, so the pump draws water as long as it can get it, and then the water is reduced so as to come to the edge of the suction-pipe and then draws air, and so it keeps on.—P.

[44649].—Faulty Pump.—Let "Working Tom" lay a rod of iron (or anything else) 40ft. long on the ground and try to drive it forward with a hammer, and he will get a very good notion of the kind of resistance his 40ft. of suction offers. The whole column of water comes to rest every stroke, and has to be started again. His pipes hold nearly 1000 gal. of water, which has to be started from a state of rest to one of comparatively rapid motion in a very short space of time, as the whole stroke of the pump would probably not occupy more than three seconds or so. A vacuum is formed above the water before the necessary motion is obtained. The action of a rotary pump is altogether different. The water is in continual motion, and it wouldn't matter much if the horizontal length were 40 yards instead of 40ft. By adding the air-vessel as I suggested, the column of water will be prevented from coming to rest during the working of the pump. When the upward stroke of the pump causes the tenuity of the air in the vessel keeps the water in motion and draws it up into the air-vessel from which it is again drawn during the early part of the succeeding stroke. This is not a "theoretical suggestion," but I promise "Working Tom" that it is of as much value as if it were.—W. WYATT.

[44651].—Air-Vessel.—To "SUNLIGHT."—There is a pumping-station close to where I live, and I often visit it in the evenings, and every time I go there the glass on air-vessel shows full of water. I have spoken to the man in charge about it, but he seems to know as little about it as myself. He told me that there is always air in it, and when he starts I cannot see how it gets out, unless it gets along the delivery-pipe. Can you give me any more information on the air-vessel, also the price, and where to get the book you refer to on page 23, and oblige.—AN IMPROVER.

[44655].—Condenser.—To "SUNLIGHT."—As you have a water-main it is easy to manage matters. But are you charged for the water used for the engine? If so, to save the expense, why not take a small pipe from the water-main and connect it to a jet in the main injection-pipe, so that a jet of water be thrown in it to act as an ejector, and thus, by accelerating the flow of water on the lower lift, make up for the inferior vacuum; or, to describe it in another way, fit a water-jet injector on the main injection-pipe, to increase the delivery. If, however, the water company do not charge extra for the water-supply, then use it direct from the main at once.—SUNLIGHT.

[44660].—Astronomical.—I am much obliged to "Aconite" and "Charles Grover" for their replies to my question re reflecting telescopes,

and also to Mr. Grover for his kind offer. I have since realigned the mirror, and have seen companion to Polaris; but Jupiter's belts and division in ring of Saturn, as well as comes to Vega, remain invisible. I am inclined to think it is owing, in a measure, to the very bad weather we have been having. The atmosphere is not by any means transparent on any night lately. That it is not my eye that is deficient I am tolerably certain, since I can divide a Lyra with the naked eye on any decent night; but lately I can seldom see that pair at all. Now let me ask two questions. On pushing the eyepiece in and drawing out beyond the focus, the image of a star expands, not into a circle, but a square—apparently the luminous image of prism. Is this right? I can adjust to get smaller image central with this in centre of field; but on moving to the side of field, the image of star also moves, as thus:—

A centre of field.

B when out of centre.



On moving to other side, the image moves to other side also. Is this as it should be? The other question has also reference to prism: it appears to me that only the central ray from mirror can strike prism at a perpendicular incidence. The rays from circumference must impinge at an angle, and after total reflection from diagonal surface of prism must emerge at an angle also from the face of prism which fronts the eyepiece. Now, can these rays enter and leave the prism obliquely without chromatic dispersion, and will not this affect the definition? Would it not be better, then, to employ a flat mirror instead of prism? Perhaps "F.R.A.S." will correct me on this point if I am wrong in inferring chromatic aberration being produced in a converging cone of rays by passing through a right-angled prism. With respect to what "Aconite" says of small diaphragm in front of eyepiece being out of place, there is no diaphragm there. In fact, the lenses of two are too small for any diaphragm to be used outside.—INEXPERIENCED ASTRONOMER.

[44671].—Punching-Machine.—In the back of the slide to which the punch is fixed there is a groove, and it revolves a cam which runs on a key fixed on the shaft. A turn of the lever on the slide pushes the cam out of the groove; of course, it continues to revolve, but, being outside the groove, does not move the slide.—L. C. D.

[44679].—Non-Economical Compound Engine.—"Young Engineer."—Taking the diagrams first published on page 221, last volume, with the boiler-pressure at 50lb., and compare them with those published on page 23, present volume, with the boiler-pressure at 60lb., and the steam cut off at half-stroke in the high-pressure cylinder, the diagrams appear more defective than the first, particularly the low-pressure diagrams. Now, in the first place, the engine is too powerful for the weight it has to drive; therefore, to raise the boiler-pressure from 50 to 60lb. is altogether unnecessary. To raise the boiler-pressure only causes the steam to be more throttled at the throttle-valve, which necessitates the steam to be wire-drawn to bring it equal to the weight. Now, taking the figures of the high-pressure steamchest, I should say the throttle-valve is all but closed when the port is opened to admit steam upon the piston, then the pressure in the steamchest falls, which is caused by the throttle-valve not being sufficiently open to keep the pressure up, thereby causing the variation. With respect to compression, in the high-pressure diagrams I can find no fault, but the low-pressure diagrams show too much. "Young Engineer" says: "How can those diagrams be improved?" My opinion is as follows:—Reduce the boiler-pressure to 50lb. as before, cut the steam off in the high-pressure cylinder at 12in. from the commencement of the stroke, and let the exhaust open at 2in. Low-pressure cylinder: cut steam off at 10in., and let the exhaust open at 30in. By the above alteration the diagrams should show an improvement, the compression in the low-pressure diagrams should also be reduced. I do not wish to convey the idea to "Young Engineer" that the engine will work with economy after he has made the alteration, for the engine will not; either the high-pressure or the low-pressure cylinder will drive the weight without working compound, therefore, if one cylinder will do the work, there is no economy in working two. Take the high-pressure diagrams, page 221, last volume: we have a gradual fall of pressure from the commencement of the stroke; there is no indication where the steam is cut off. This plainly shows the steam to be wire-drawn with the boiler-pressure at 50lb. Now, to raise the boiler-pressure to 60lb., and cut steam off at half-stroke, we cannot expect to see any improvement.—J. BROADLEY, Bradford.

[44683].—Waste of Soda and Soap.—If "Engineer" advertises his address, I will communicate with him.—F. C. S.

[44698].—Novelty.—Thanks to "Sunlight" for his courteous and most interesting reply. I should think that 37 pipes would answer my purpose. This number would make a compass of three octaves, including the semitones. There is one difficulty though. How are the whistles or pipes to be tuned? As regards a qualified ear I am quite safe, but I should like to become acquainted with the method of tuning them. If they were organ-pipes I should know how to go about it; but as it is I have not a shade of an idea what to do with the whistles to make them sound higher or lower. Will a good thick tin boiler do for the steam? I can do a little in the soldering line, but I must inform "Sunlight" that I know little or nothing about steam-engines or any other engine. I should like an instrument of the kind proposed, because it would be a novelty, and would be a source of amusement to many of my musical brethren as well as myself.—G. FRYER, Swansea.

[44704].—A Process for Rendering Chalk Non-Effervescent.—Burn it until all the carbonic acid is driven off, and use it before it reabsorbs it again from the air.—W. W.

[44711].—Gas-Lighting.—A good rule for the size of gaspipes is to allow one square eighth of an inch for each light; thus, square the number of eighths in the diameter, multiply by .7854, or approximately by .8, and the product will be the number of lights. By this rule 1in. pipe will supply 12 lights; 1 1/4in., 28 lights; 1 1/2in., 50 lights; 1 3/4in., 78 lights; 2in., 112 lights; 2 1/4in., 200 lights; 3in., 450 lights. It is poor economy to have your pipes too small.—FLORE ALMOND.

[44711].—Gas-Lighting.—The quantity of gas passing through a pipe depends not only on its diameter, but on its length, and the pressure at which gas is supplied. The quantities given below are calculated from Professor Pole's formula on the motion of fluids in pipes, as passing in one hour at 1 1/2in. (ordinary) pressure:—

	Dia. of pipe in.				
Length in yards.....	10	20	30	50	75
Cubic feet delivered by 1/4"	146.1	103.2	81.3	65.1	53.3
1/2"	492.4	284.0	232.3	179.9	146.5
1"	826.2	581.5	476.5	363.5	301.0
Length in yards.....	25	50	75	100	150
Cubic feet delivered by 1 1/4"	913.3	615.4	527.3	455.6	371.2
1 1/2"	1439.7	1017.5	829.2	719.8	586.2
Length in yards.....	50	75	100	150	200
Cubic feet delivered by 2"	2090	1706	1474	1204	1042
2 1/4"	3653	2978	2582	2109	1823
Length in yards.....	100	150	250	500	750
Cubic feet delivered by 3"	4070	3317	2576	1823	1482

The above calculations are for straight pipes; any contractions or bends in the pipes will diminish the quantity of gas delivered. Ordinary burners consume from 3ft. to 6ft. or 8ft. per hour; it is, therefore, readily found from the above table what diam. of pipe is required to supply any given number of a given size. It is wise to put in pipes rather larger than is absolutely required, especially the main pipe from the meter, as the additional expense is trifling in comparison with that incurred if they are found inadequate when more lights are required, or a gas cooking apparatus put up. Gasfitters ordinarily appear to give themselves very little trouble with calculations, but work very much by rule of thumb; and the complaints made of "bad gas" arise generally from that source.—GAS MANAGER.

[44713].—Curvature of Portrait Lens.—If our valued friend "O. V." will kindly furnish the required information I shall be glad, as my time is very much occupied. Should he, however, not have the requisite time to spare, sooner than disappoint this querist, I will myself attend to the matter.—SUNLIGHT.

[44714].—Size of Suction-Pipe to Pump.—Your argument is correct. Whatever the size of your column may be, the pressure on the piston depends only on the area of the piston and the height of the column. The size of pipe used is usually a question of expense.—FLORE ALMOND.

[44714].—Pump.—Increasing the diameter of

delivery pipe does not increase the pressure on the bucket or handle. Lay a penny on a table and stand a handful of spills or skewers upon and around it. The penny only bears the weight of those that stand upon it. It is the same by a pump bucket. Water of a definite depth gives a definite pressure per square inch, and this is the same whatever the size of the delivery-pipe may be. A good size pipe is best because the friction is less.—W. WYATT.

[44714].—Size of Suction-Pipe to Pump.—“W. W.” is right, of course, but the opinion of the pump-maker is only what one may expect from “the trade” until they discover how ignorant they are of the elementary principles of hydraulics and pneumatics concerned in their daily work, and how commercially advantageous it would be to devote a few dozen hours’ study to them. It is in diffusing knowledge of this kind that the technical schools will be useful. Let us hope they will take the plumbers in hand first, for they sorely need help.—J. BROWN, Belfast.

[44714].—Size of Suction-Pipe to Pump.—The increase or decrease in the size of the delivery or suction-pipes has not much to do with the strain on the handle of the pump. Of course there are limits to the increase or decrease which it is not advisable to go beyond. There are several reasons that will cause the handle to work easy or hard; first take, for instance, any imaginary pump fixed and working, say it’s a suction-pump, and the handle moves up and down with uniform speed, and say it requires a pressure of 40lb. to work the handle; now if we increase or decrease the size of the suction (to certain limits) it will not alter the strain on the handle, and exactly as much water, no more nor less, will be thrown up in the same time; 2nd, Let the pipes be as at first. Alter the size of the working barrel, say increase one-fourth in area larger, then the handle will require 50lb. pressure to work it, and the pump throwing in the same time one-fourth more water; say decrease it one-fourth the area, then one-fourth less strain, one-fourth less water in same time; 3rd, Take the handle, which is only a lever of the first order, its fulcrum being the hole through which the pin goes that fastens it to the pump body; one end of the handle you take in your hand, the other end is fastened to the pump-rod, and the proportion these two ends bear to one another determines the stroke or travel of the bucket. Now first remove the fulcrum nearer your hand, so as to cause the bucket to have one-fourth more travel, it throws one-fourth more water; take one-fourth more strain on handle; 2nd, remove the fulcrum toward the pump-rod end, so as to have one-fourth less travel of bucket—result one-fourth less water, one-fourth less strain. Above remarks apply to delivery-pipes as well. If this is not clear to “W. W.” let him write again.—WORKING TOX.

[44716].—Cast-Iron Lift-Pumps.—The only way of boring these true is to do so in a back-gear lathe, using a regular boring-head. If your lathe is not self-acting with a saddle, your next best thing is to make a traversing boring-head with a star-feed. But unless you have back-gear you will not be able to drive slow enough. Also, you will want a slide-rest to turn up the boring-head and bar. There is no other way of boring a barrel, except a makeshift one, and that I would not recommend.—SUNLIGHT.

[44716].—Cast-Iron Lift-Pumps.—“Practical Plumber” says he has a 7in. lathe, but does not say what sort of lathe it is. It should be back-gear, with a leading-screw for travelling saddle. You would want a boring bar with the cast blocks, for holding the cutters, and a specially-constructed saddle, on which to bolt the pump, too, while boring. We have for years discarded boring-pumps, using instead copper cylinders, which “Practical Plumber” can (if he can braze) make himself, or buy ready-made from any coppersmith. They are easily and quickly fixed into the pump, and, in the end, equally as cheap.—WORKING TOX.

[44717].—Magic-Lantern Photo. Slides.—Is the defect you complain of this—that before you get all necessary density in the picture you get a deposit in the sky which should, of course, be clear glass? If so, that arises from the fact that you have not painted out the sky in the negative, with black varnish. And, further, I have not experienced the difficulty you name on getting density by following the directions supplied. To some extent it depends on the method of printing the transparencies.—SUNLIGHT.

[44717].—Magic-Lantern Photo. Slides.—Have tried several dry processes for above, but none have been to my mind satisfactory. I now get first-class slides from the following wet process taken from this year’s “Journal.” Bath.—Silver nitrate 4oz., water 10oz., nitric acid 3 drops, acetic acid, 12 drops. Developer.—Pyro 30 grains, citric acid 1 drachm, alcohol 2 drachms, nitric acid 7 drops, water 10oz., acetic acid, 2 drachms. Bath to be sunned and filtered before adding the acids; give long exposure and develop

in tray bath, and as they develop slowly density and detail are well under control, and fix in hypo. Be careful in cleaning the glass, or you will have some difficulty with the film slipping off in final washing. Slides done by this process require no toning.—J. R., Dumfries.

[44717].—Magic-Lantern Photographic Slides.—The writer has obtained good results on “Bennett’s instantaneous plates,” by the following method:—Place the negative in a printing-frame and a dry plate on it, as you would use sensitised paper; shut the frame, and expose a very short time to one bat-wing burner (daylight being much too strong; now develop with—(A) Liquor ammoniac (fort.), 1oz.; bromide of ammonium, 1oz.; water, 80oz. (B) Pyro, 6gr.; water, 1oz. Equal parts of A and B to be applied to plate. The image ought to come up slowly, if it flash out, expose another plate for a shorter time. Lift the plate from solution, and hold it up to the light and observe its density; should it be too weak, return to developer, until a little more than enough density is obtained; now soak in alum, and fix, adding some chloride of gold to the fixing solution. Of course, wash the plate well between each stage, also after fixing. Now varnish, and it is finished. Some beautiful results have also been obtained on “Swan’s plates,” using the “ferrous oxalate developer.”—WILLIAM PECK, St. Clair, Hayward’s Heath, Sussex.

[44718].—Pressure of Heated Air.—Presuming that the air is put in at 60° Fahr. and then heated, the pressure would be about 21in. of mercury above that of the atmosphere.—PAUGUL.

[44718].—Pressure of Heated Air.—The average expansion of air is 1-480th part of its bulk for each degree of heat on the Fahr. scale. Therefore it is easy to see what bulk the air would occupy when heated to 300°. But if it is in an inclosed vessel, by the rule that the bulk is inversely as the pressure, the tension of the air thus inclosed is readily found. This is the best I can do for you in the absence of sizes, &c.—SUNLIGHT.

[44718].—Pressure of Heated Air.—The pres. of air increases 1-460th of its original amount at 32° Fahr. for every degree of same scale. If the air in the vessel at 32° Fahr. was at atmospheric pressure (say, 15lb. per square inch), it would have, at 300° Fahr., a pressure of 24lb., since $15 + \frac{15(300 - 32)}{460} = 24$.—J. BROWN, Belfast.

[44719].—Agate-cutting.—In the agate-mills diamond-dust is not now generally used for slicing the stone. Naxos emery is employed as follows: The agate is cemented to the bottom of a wooden box or trough; on the top of this is a swing frame, carrying the iron disc or sheer, duly weighted and driven by a pulley and gut-band; the edge of the slicer is set by a side-screw over the line of the cut. The stone is then covered with emery, and sufficient water poured in to bring the mixture to the consistency of thin paste; consequently, fresh emery is constantly running in during the cutting process. This is rather slow, as emery will scarcely cut some kinds of agate; but, with motive-power, it is entirely self-acting, requiring no attention till the cut is finished, and the machine is a very simple and cheap affair, that can be readily constructed by anyone possessing a very moderate amount of mechanical skill.—F. H. WENHAM.

[44720].—American Lever Clock.—Put in a proper mainspring, repolish your scape and pallet-arbor pivots, and balance staff do., repair holes—i.e., rebush them, replant pallets, and shorten balance-spring to bring to time. As a rule, such clocks are not worth much trouble, being put poor affairs at best.—H. J. G.

[44720].—American Lever Clock.—I think if R. A. Goodman put a stronger mainspring to his clock it would likely make it right. If he has got an 8-day spring into a 48-hour clock it must be a thin, and therefore a weak, one. A stronger mainspring would also make the clock go faster. If the pallet-arbor is bent, the holes were doubtless opened intentionally.—J. A.

[44720].—Lever Clock.—I should say that “R. A. Goodman’s” clock, from his description, must be like the schoolboy’s knife—wants a new blade and a new handle! As these Yankee levers can be bought for 6s. 6d., and go remarkably well (I have four in use, one in the rather trying climate on top of a Hofman kiln), I should recommend no time being wasted on such a quantity of repairs as seems to be needed.—TREADLE.

[44728].—Minerals.—You cannot do better than get Landauer’s little book on “Blowpipe Analysis” (Longmans), and work at it with the aid of such a set of blowpipe apparatus as may be got from Mr. Letcher, St. Day, Cornwall, who supplies also fragments of minerals in small tubes for practice.—No. 810.

[44728].—Minerals, Blowpipe Discrimination of.—If “Science Student” will meet me at Griffin’s, 22, Garrick-street, Covent Garden,

London, W.C., I will put him in the way of learning how to make a rapid, but strictly chemical, analysis of ordinary minerals by means of the mouth blowpipe, and also with a hand-blower. I presume he is, like most Englishmen nowadays, “hard up,” and anxious to secure the greatest possible effects with the least possible outlay?—W. A. ROSS, London, W., 16th Sept.

[44728].—Minerals.—For qualitative analyses of minerals, especially when travelling, the blowpipe and its accessories are incomparably the simplest and best instruments to possess. Facility in using them will depend on practice and natural ability. The amount of information to be derived from their use will depend upon your knowledge of chemistry. “Blowpipe Analysis” is merely a “dry” method of chemistry, in which the reactions are chiefly brought about or facilitated and made apparent by the application of heat. A person who thoroughly understands how to use a blowpipe, and who also knows how to accurately interpret the changes it induces in the substances operated upon, has (for qualitative work) little need for a laboratory full of bottles of solutions. “Science Student’s” elementary knowledge of chemistry will, if sound as far as it goes, be of value; but by all means let him extend it as far as possible, because, as I have before said, “blowpipe analysis” is “a dry method of chemistry.” Among the advantages of this method may be mentioned (1), the fact that, as a rule, almost infinitesimal quantities of substances afford decisive indications of their nature; e.g., a pinch of table-salt is sufficient to give many thousand sodium flame-colourations, and the same quantity of a salt of Cobalt would suffice to intensely colour as many borax-beads. (2) Consequently, the instruments may be small in size, and the reagents small in quantity; and so it comes about that the blowpipe chemist is enabled to carry about in his pocket all the things generally needed for qualitative analysis. Nine-tenths of the blowpipe apparatus manufactured in this country are far too bulky and clumsy. I am writing advisedly, as I have closely followed up the subject of blowpipe apparatus. Recently, however, a pocket-set of instruments and reagents has been brought out, and it has received the warmest commendation of such authorities as Prof. Warrington Smyth, Dr. Le Neve Foster, Prof. Richter, F. W. Rudler, J. H. Collins, and others. The conditions under which communications to this journal are made prohibit my giving the maker’s name; but I may say the set contains a host of things, including oil and spirit-lamps, and supply of oil and spirit; and they all pack into a light metal case for the pocket, size, 6in. by 3in. by 1in. There are several useful books. For blowpipe-work, Sheerer and Blanford’s is very good as a small and moderately-priced manual; but the figures and descriptions of apparatus are behind the times. Still, there is a lot of valuable information in the book. There is a work by Mr. Attwood, recently published, entitled “Practical Blowpipe Assaying.” I have a copy, but have not yet had time to go through it very carefully and verify its statements; judging from a hasty perusal I should say it was a really good book, and in the matter of apparatus, it is certainly more up to date than Sheerer and Blanford’s book. For mineralogy Dana’s is the book; but for cheap manuals, J. H. Collins’s are very good. My answer is already long; but I shall be pleased to give “Science Student” any further information I can. If he would like to communicate privately, the following address will find me.—CUBATOR, Royal Geological Society of Cornwall, Penzance.

[44729].—Eccentric Strap.—Angle B should be a right angle for both Fig. 1 and 4. “F. C.” can readily see for himself by taking a piece of 3in. square iron, and bending.—WORKING TOX.

[44731].—L. and N.W. Engines.—211, Goods. 291, Prince of Wales, 7ft. 6in., single Ramsbottom; 355, Goods; 498, Goods; 752, Glowworm, 6ft. coupled Ramsbottom; 794, Woodlark, 6ft. coupled Ramsbottom; 1515, Milton; 1526, Drake; 1576, The Nile; 1680, Livingstone; are all 6ft. 6in. coupled Ramsbottoms, of which, 1515 and 1680 have been altered to look like Webb engines. I am sorry I cannot oblige “Tittesworth” with the information he asks; but perhaps, “Egeria” will. Where are the lists of N.W. engines he promised? I hope he will continue them.—DIOMED.

[44733].—Steel Die-Sinking.—This is an exceedingly short query, but it would take columns to answer it properly, and then the querist would not have learnt much, for it is one of those trades that an eminent man in the trade told me was never thoroughly learnt. Of course, I refer to a good general die-sinker. The tools used are files, gravers, such as are used by wood and metal engravers, rifflers, which are a sort of bent file; punches, which are pieces of square or octagon steel 4in. long, hardened and tempered, with a device or letter on the end; and chisels of all sizes, from 1-16 of an inch to 3in. square. Besides these, he will need a good grindstone, and two good lathes; one should

be a slide-rest, with gearing and oval chuck fitted to it; the other should be about 3ft. bed, and 6in. entre, with a back-rest, as turning is always done with the right arm over the bed of the lathe. If me is to make much profit he should also have an mill to repair his chisels and turning-tools (which are three-square, and have a splendid cutting edge). The bellows and hearth will be found useful for yardening the dies when they are done. Good clay is used to take the impression from time to time, as the work progresses, on a boxwood circular block, with a flat face. If the querist only refers to dies for the backs of envelopes, he will need several sets of letters, which can be had from any letter-cutter—only, of course, they will be the reverse way to those ordinarily used. There are many branches of this trade, such as lamp-bottoms, coffin-plates and furniture, fire-insurance plates for house-fronts, military-cap plates, buckles and buttons, and the cream of the work—dies for coins and medals. The last part of this query, "How to use the tools"—can only be got by practice; but I will say this (and I have been connected with a firm over nine years) a good file-sinker can do any other sort of mechanical work to perfection; at least, I have never found me that could not, as having to file and turn to a hundredth of an inch, combined with a good artistic knowledge, they are the most handy of men for scientific apparatus.—M.M.I.Sc.S.

[44735].—Turning Shafting.—There is a question you do not deal with. Has the shafting been applied you, and, if so, what are the lengths? Or are you ordering yourself, what lengths are you going to get the shafting in? Much depends on these data. If I were going into such a job I would get the bars in as long lengths as practicable, say, 14 or 15 feet. These will not go between our lathe-centres; but that is no difficulty, as you use a box centre, and this would alone save the centring of the one end of each shaft, if desired. You must, of course, use a back turning lathe. The coupling you should clamp on the face-lathe; or, better still, if you have it on a jaw huck, and bore them to size, then place on a sandril and turn up outside. As to the time a man would take, that depends on the hours he works, and on his judgment as well, so as to get everything ready. Some men would do such a job in a far less time than others, but I should consider at a couple of weeks should be ample.—SUNLIGHT.

[44736].—Mending Broken Branch.—"Adam" can try bringing the parts accurately together, binding securely with list or tape to keep a place, and covering the whole with clay, as a skin to keep out air. But success is very doubtful, specially after a lapse of time. If this course had been pursued at once, before the wound dried, the chance of success would have been much greater.—READER.

[44736].—Mending Broken Branch of Tree.—Procure a lump of guttapercha and a vessel of almost boiling water. Soften the guttapercha in the water, and press it closely around the fracture, then bind it firmly to the trunk of the tree with a soft rope. If thus protected during the winter it may begin to grow again next spring, and the wound will begin to heal.—EDWIN.

[44736].—Mending Broken Branch of Tree.—Support the broken branch with laths, from branch to branch, so as to keep it from moving; then bind the parts well together with strong woolen thread, such as ladies use for coarse knitting. The ligature should extend the whole length of the break, and be wound in the figure of 8 round the stem and branch above the fork. When this is done work some clay into a plastic mass, and cover the broken part thickly with it. Next July, when the tree is growing freely, examine the part, and if the bark is becoming indented carefully remove the ligature, but if the break is not united cut on a new one for a few weeks.—X.

[44738].—Exhibition Photos.—For holding the photos, take a piece of tough white paper, of sufficient length and width to hold your quantity of photos on, paste on the unmounted photos in the order you require them; then mount the roll on two rollers in such a manner that, when you unroll off one roller, the other is rolling up. A white silk ribbon would be better than paper.—WORKING TOM.

[44738].—Exhibiting Photo.—I am strongly of opinion that you have somewhat begun at the wrong end. Before you made your case it would have been well to have ascertained as to the lenses and other details. For the size of the pictures should be uniform; and then the question is, are you proposing to use stereoscopic views, or what? And, further, I would remark that you will most probably require lenses specially ground to give you the magnifying power at the distance you quote—i.e., 9in. Special lenses will cost you a special price. As to your showing them in rotation, if you have stereo. views and the case has depth to it, then you can arrange the idea on the plan of a

magazine stereoscope. What is the vertical height of your case?—SUNLIGHT.

[44740].—Waterproofing Brick Walls.—You will find if you have the brick walls "slap-dashed," as many hundreds of houses are in Devon, it will keep out wet. "Slapdash" is, the walls are, outside, first coated with hair-plaster by the mason, and then he takes clean gravel, such as you find at the mouth of many Devonshire rivers, and throws—or, as it is called locally, "scats" it—with a wooden trowel, with considerable force, so as to bed itself into the soft plaster. You can limewash or colour to your liking, and your walls will not get damp through.—WORKING TOM.

[44742].—Calculating Mill-Gearing.—Assuming that the horse goes round once in a minute, then the speed of pulley will be $\frac{71 \times 61}{11 \times 11}$ or about 36 revs. per minute. Then, as you want a motion about five times as fast as this, your other pulley must be about one-fifth of 18in. or 3½in. diameter. More exactly, for 200 revs. $\frac{18 \times 36}{200} = 3\frac{1}{4}$ in., or $\frac{18 \times 36}{150} = 4\frac{1}{2}$ in. for 150 revolutions. If your horse goes round twice in a minute, twice these sizes will give the same result.—FLORA ALMOND.

[44742].—Calculating Mill-Gearing.—This is easy; if "A. B." will but bear in mind the easy formula—multiply all the drivers and the number of revolutions the first driving-shaft makes, then divide this total by all the driven, and the number of revolutions the last spindle is to make multiplied together, gives the result. Its application to particulars given: say the crown driving-wheel revolves 4 times per minute, then we have—

$$\frac{4 \times 71 \times 61 \times 18\text{in.}}{11 \times 11 \times 150 \text{ revs. last spindle}} = 17\frac{1}{2}\text{in. the size in diam. of pulley required to give 150. Or, } \frac{4 \times 71 \times 61 \times 18\text{in.}}{11 \times 11 \times 200 \text{ revs. last spindle}} = 12\frac{1}{2}\text{in. diam.}$$

of pulley required to give 200 per minute. If it is that "A. B." requires the mill-spindle to travel 150 or 200 revs. to driving-wheel one, then omit 4 in the numerator.—WORKING TOM.

[44744].—L. & N. W. Engines.—In reply to "Tittesworth" the engine, No. 945, "Humphrey Davy" is of exactly the same dimensions as the other "Precedents." Their weight is 32½ tons, cylinders 17in. by 24in. The same brake is being added to the older engines of the same class. It is actuated by a small steam-cylinder under the foot-plate.—W. B. P.

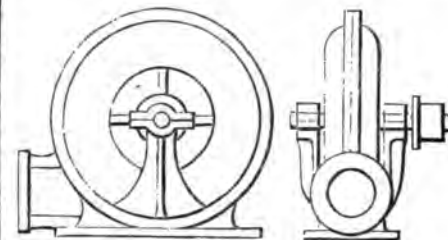
[44746].—Heating Model Boilers.—Very much depends on the class of boiler and the cubic capacity of the firebox. With coke or charcoal, I should not care to try less than 4in. square or circular; but even then I fear you would have but a sluggish fire. With coal it is different; if the draught is good, then it is easy to maintain a good fire on a grate even as small as 3in. diameter. Charcoal would require fully as much area as coke, and would, I think, in so small a furnace, be likely to make but little steam. Tubes are fixed in several ways, according as to how the boiler is constructed. With a vertical, where the tube-ends are get-at-able, I should use a tube-plate thicker than the side-plates and then expand the tubes thoroughly and, subsequently, well sweat them with solder. For model locos. the case is different; it is then best to either screw the tubes into the firebox tube-plate and also staunch with solder, or to slightly cone them, drive in tight from smokebox end and also solder; the smokebox end being over, allows the tubes to be well expanded and soldered. But in this as in many other matters mechanical, it is easier to do the job than describe how it is done.—SUNLIGHT.

[44747].—Violin Matters.—If "War" will take my advice he will not attempt to clean his old violin further than to give it a gentle rub with a little (a very little) olive oil. The back may be rubbed pretty hard, but the rosin seems to work into the varnish on the belly, and to take any of it off will alter the tone for the worse. I know by experience, for I tried to improve my Klotz, and only succeeded in giving it a mangy look and a huskiness of sound which it took a few years of letting alone to recover.—J. A.

[44747].—Cleaning Violin.—By all means clean the instrument. It will improve tone and appearance. For the outside, a strongish solution of washing-soda, applied with piece of flannel. If you find the soda remove the varnish (as it does with some oil-varnishes) use soap-and-water, and then paraffin. When clean, rub with linseed-oil; spirits of wine removes the old rosin at once, but sometimes takes the varnish with it. For the inside, get a handful of rice, steep it in solution of sugar and water five minutes, strain off, and nearly dry the rice till just sticky. Put in at soundholes and shake till tired. This will pick up all dirt, then turn out.—C. P. T.

[44749].—Fan for Smyth.—There are many different forms, but as simplicity is a great thing

when making, I send (to better elucidate) a sketch of one that has proved itself very good in use. The case is cast in two halves with the bracket for the spindle cast on in one piece with the cast, so that there is but one joint. The chief departure is



in the fans, which are curved in a manner not generally employed. There are four of these carried on a casting of such a shape as to assist the indraught of air, and which, besides, form a very strong attachment for the blades, which are oval ones. This form is one I designed for my own use in the first instance, and which I am well satisfied with. The patterns of this or any other form are somewhat difficult and costly to make, as they must be made perfectly true. Would castings off my patterns be of any assistance to "Amateur"?—SUNLIGHT.

[44753].—Painting on Terra-Cotta.—If "Alice" will prepare a varnish composed of 2oz. Canada balsam and with the same bulk (not the same weight) of turpentine mix the ingredients thoroughly and lay it evenly on the terra-cotta, she will find that it will take either oil or water-colours.—OTTER.

[44753].—Painting on Terra-Cotta.—As there are three modes of painting on terra-cotta, it is not very clear which is meant by "Alice." The most elementary mode is with water-colours. Should the querist find the difficulty in this mode of painting, the following instructions may be useful:—Coat the surface over carefully with size, and allow sufficient time to dry properly. Mix the water-colours with Chinese white, and apply and finish as an ordinary painting. Go over the work with a thin coating of gum-water, and when dry, varnish with best copal or mastic. The sizing referred to may be dispensed with on the red or Leuk's (creamy) ware. On Melis, or black ware, rub that part which is to be painted with a finger dipped in a solution of common soda in water until it adheres. Remove the moisture, and paint in the ordinary way, only laying the colours on fairly thick. When dry, varnish with best copal; but do not use gum-water before, nor dry before a fire. Care must be taken in the varnishing to keep it quite smooth, and to make one wash do, if possible. For brilliancy, spirit-varnish is the best, but requires more careful laying-on than the mastic varnish, as it dries very quickly. Should either of the other processes of painting in oil-colours or in china-colours be meant, I shall be happy to answer a repeated query on the subject.—MARGUERITE.

[44755].—Light-Draught Steamers.—When mentioning these boats I should have stated that the speed of 11-25 miles per hour was in still water. They would, therefore, not make such a rate against stream, of course, but would exceed this with it, naturally, and this means when they were driven at full power. These 130ft. boats had a pair of engines, 14in. cylinder and 5ft. stroke, usually cutting off at 1-5th stroke; the stern wheels were 10ft. diam., with feathering floats. Steel was largely employed in combination with special design, that enabled them to be made exceptionally light. The boilers were of ½in. steel, double riveted, and fitted with a blower, as the heating surface was only about 800 square feet.—SUNLIGHT.

[44757].—Coin.—This is a Polish coin of Sigismund III. Sigismund Vasa was the third of the elected kings of Poland, he succeeded Stephen Bathony, in 1587; he was son of John III., of Sweden, but was descended from the old Polish kings of the house of Jagellon, his mother being a daughter of Sigismund I. He succeeded his father as king of Sweden in 1592, but was deposed from the throne of that kingdom in favour of his uncle, Charles IX., in 1604, and was afterwards almost constantly at war both with Charles and his celebrated son Gustavus Adolphus, who succeeded him in 1611. He was very warlike, and took advantage of the internal distraction in Russia consequent on the extinction of the old house of Ruric, in 1598, and the usurpation of Boris, the false Demetrius, and others, to conquer that country, and 1610 succeeded in placing his son, Ladislaus, on the throne, who was, however, deposed in 1613, and replaced by Michael the First, of the house of Romanof. Sigismund was almost constantly at war with Sweden and Russia,

and also sometimes with the Turks, and in the latter part of his reign was very unfortunate; he died in 1632, and was succeeded by his son, Ladislaus. He was grandson of Gustavus Vasa, and first-cousin of Gustavus Adolphus. The leg. on the obv. of "S. G.'s" coin is in full, "Sigismundus III. Dei Gratia Rex Polonie. Magnus Dux (not Lux) Lituanie." (Sigismund III., by the Grace of God, King of Poland, Grand Duke of Lithuania.) There is no doubt whatever about that; the legend on the reverse is not at all so clear to me. Rus., I should say, referred to his conquest of Russia. Prus. is certainly for Prussia. The Duchy of Prussia was formerly held as a fief from the Kings of Poland by the Order of Teutonic Knights, until a Grand Master, Albert, second son of the Elector of Brandenburg, having become a Lutheran, in 1525 secularized it, and seized on it as a hereditary duchy under the suzerainty of Poland. On the death of his son, Albert Frederic, in 1618, without heirs male, he was succeeded by John Sigismund, Elector of Brandenburg, who was his son-in-law, and Prussia and Brandenburg have been ever since united; but in the time of Sigismund III. Prussia was a fief of Poland. "Ma. Sa. Livone" rather puzzles me. Livonia was constantly changing owners between Poland and Russia, and, latterly, Sweden; if the "Sa." had been "Ma." I should have read it "Magnus Magister," and supposed that it gave Sigismund's title as Grand Master of the Old Order of Livonian Knights, which, as King of Poland, I believe he nominally was; but as it is I do not know what to make of it. NO: SV. GO. stand, I should say, for his titles as King of Sweden, and road Norway, Sweden, and Gothland. Though the Kings of Sweden at that time did not possess Norway they claimed it, and retained the title. VA. HK. I really cannot make anything of. Can it be anything else but HR? TR, for instance? Is there any date on the coin? It would most likely be on field of rev., perhaps at sides of arms, or even mixed up with them, and might only consist of the two figures indicating the year of the century without those of the century. On any coins I have seen of Sigismund III., he is represented crowned, with short hair, a peaked beard and large moustache, and large ruff round his neck, and they are dated as I have mentioned. He was allied by marriage with the House of Austria, both the German and Spanish branches, having in 1598 married a sister of Ferdinand of Steria, or Gratz, as he was often called, afterwards the Emp. Ferdinand II., another sister, Margaret, having been married to Philip III. of Spain; he played an important part in the earlier portion of the Thirty Years' War, though by no means so much so as his celebrated cousin and great opponent, Gustavus Adolphus; they both died in the same year—1632. I know nothing of the value of the coin, but should say that there are collectors who would give something more than the value of the gold for it, if in good preservation. "S. G." should put an advertisement, asking for offers, in the "Bric-a-brac" column of the *Exchange and Mart*; he will be likely to get one or more. He should mention the exact weight in pennyweights and grains. I would be obliged if "S. G." would say if the S.A. could be M.A., and the last H.R., T.R., or anything else (what he gives as LVX. is undoubtedly DVX.), also if he can make out any date; on the coins I have seen, all silver, the titles given consisted only of those on obv. of "S. G.'s" coin, and were the same in all succeeding reigns, the rev. leg. consisting of words signifying the value, and that it belonged to the kingdom of Poland.—G. J. H.

[44759.]-**Binocular Microscope.**—It is a very easy matter to set my prism in the binocular microscope. First touch the inner sides of the box with marine glue, and, while warm, slide in the prism, so that its lower edge exactly bisects the axis of the microscope when the prism is thrust in. Some prisms act best when they are thrown backwards a little, so that the lower plane is somewhat out of level. Having got by trial the best position, it remains to be seen if a point in each eyepiece occupies the exact centre. Nearly all microscopes of this form have a fitting that admits a small degree of rotation by slackening certain screws, so that the vision in both eyes can be set exactly central.—F. H. WENHAM.

[44759.]-**Binocular Microscope.**—The binocular prism you mean no doubt is displaced. I can hardly tell you how to readjust it, as it is really a matter somewhat of actual trial. If your prism is altogether loose you will find that it requires to be reset so that the rays from the objective enter the lower surface at a right angle to its plane, whilst they emerge at an angle which, when the prism is rightly adjusted, is such as to project them up the tube, so that the last surface of it forms almost a right angle with the centre line of the second tube. To describe how to reset such is far more difficult than to actually do so; and were you living near me I should put it to rights for you with pleasure. But it is a great question whether or not you would not otherwise do better to send it to, say, our friend Mr. Lancaster, who would,

no doubt, see to it for you, than to risk trying to do so yourself, and thereby risking damage.—SUNLIGHT.

[44763.]-**Altering Tricycle.**—No difficulty, I should think, nor much expense; but a good deal depends on the pattern of machine.—TREADLE.

[44763.]-**Tricycle.**—What class of machine is yours? If an open-front one you could not alter the arrangement without some little cost, as you would have to take off the pillar which carries the steering-handle, and get it brazed on to the other side, whilst the brake-handle would take its place. There is not, to my knowledge, any machine in the market that is made to steer left-handed; but if you were having one made, it could be easily done. A good mechanic should be able to alter one for you at a very moderate cost. At least, it would not cost me much to shift if I wanted it done.—SUNLIGHT.

[44765.]-**Electro-Magnets.**—The one coil would do for what you want: but only having one instead of a horseshoe, you will need a stronger battery. You do not say if you want it to work regularly or only at intervals; so I cannot say what cell would be best. You want the piece that is riveted to the armature to be supported in the middle; then the end farthest from the magnet would strike against the stud, or if you only use a feeble current, put a muffled ball for it to strike against; then you will hear it distinctly. For the second coil you mention, it would not do at all for the vacuum tubes. A powerful induction coil, with Bunsen batteries, produces best results; besides, the coil you have is probably wound with a thin covered wire, so that even if you were to unwind some off to make it do for a primary coil, it would not act at all well; but as it is, if you were to put some good cells to it, and then put a good contact-breaker in the circuit, you would, on account of the length of the coil, get a good spark.—AN ASSOCIATE OF THE SOCIETY OF TELEGRAPH ENGINEERS.

[44765.]-**Electro-Magnet.**—The utility of the coils will depend very much upon the age of the instrument from which they were taken. Thus the coils in the sounder instruments now made for the telegraph department have a resistance of 40 ohms., and the coils in the new single current or direct-writer Morse instruments have 400 ohms.; the older forms, however, frequently amounted to and even exceeded 600 ohms., while those used by some of the cable companies exceed 1,500 ohms. In order to make a sounder with one of the coils, the lever A.B. should be of soft iron and movable in a pivot at C. G and H are limiting screws, and should fit just loosely enough to be turned with the fingers. I is a regulating screw passing through a small piece of metal fixed on to the brass support C.F. The screw (I) regulates the tension of the spiral spring S, which will pull the end B of the lever upwards after the current which drew it down has stopped. D.E. is a piece of brass, and should be made rather heavy to give a firmer tone to the sound. The coil should be fixed to the base and connected by short lengths of wire to the terminals T.T. The best form of battery, in my opinion, is the double liquid bichromate, which consists of a zinc rod or plate immersed in acidulated water and separated by a porous division from a block of carbon immersed in a solution of bichromate of potash with a small quantity of sulphuric acid. This battery is very durable, and is, at the same time, strong. If the resistance of the coil is low, one or two such cells should suffice. The last query is assumed to refer to "vacuum" tubes. I would advise "Wiltshire" to make himself acquainted with the principles and construction of the induction-coil. The wire of the coil he has will probably do for a part at least of the "secondary" coil.—S. G. O.

[44766-7.]-**To "T. G. F."**—The Gault is developed at Folkestone, and the fossils of the corresponding beds would probably be the same in both localities. The bit of quartz, if waterworn, was derived from a distance. Your best plan as to naming would be to get an experienced collector to spend an evening with you, or visit the Museum of Practical Geology, in Jermyn-street, next time you are in town, and, if possible, take the specimens with you and compare them. To anyone inexperienced, identification from plates and descriptions is often unsatisfactory, and quite likely to result in a "hopeless muddle."—T. G. F.

[44768.]-**Hardening Bright Steel.**—By heating in a lead bath, "Steel" himself proposes that which is a partial remedy for his difficulty. Previously to heating small finished-steel articles, I am constantly in the habit of smearing them with a piece of common soap; after quenching, they come out nearly bright, without scale. Watchmakers usually adopt this method, which is almost neglected by other artisans, though it takes scarcely a moment to do. I have not tried it in conjunction with the red-hot lead bath; but I see no reason why it should not answer just as well as in heating by the forge-fire or blowpipe.—F. H. WENHAM.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

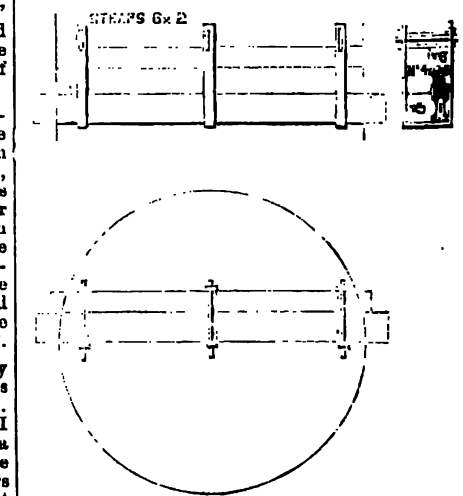
Since our last, J. W. W. has replied to 44354.

- 44191. Meteor, p. 460.
- 44204. Gassiot Star Engine, 461.
- 44208. South Africa, 461.
- 44217. Slide-Rule, 461.
- 44219. Violin, 461.
- 44220. Fancy Doodles, 461.
- 44222. Microscopical, 461.
- 4423. To "Sperans," 461.
- 44369. Solar Engine, p. 557.
- 44401. Carlisle Cathedral, 557.
- 44404. Black Bronze, 557.
- 44411. Violin, 557.
- 44418. Cranes, 557.
- 44419. Dressing Horse Hides, &c., 557.
- 44431. Mending Asphalt, 557.
- 44432. Specifications Wanted, 557.
- 44433. Gas-Engines, 557.
- 44436. Electrical Insulator, 557.
- 44438. Flute Mouthpiece, 557.
- 44450. G. W. H. Engines, 558.
- 44453. Mascuits, 558.
- 44455. Chloride of Zinc Battery, 558.
- 44457. Cutting Diamonds, 558.
- 44461. Water Engine, 558.
- 44463. Annealing Sheet Nickel, 558.
- 44464. Chloride of Zinc Battery, 558.
- 44469. Legal, 558.

QUERIES.

[44771.]-**Catamaran.**—There appeared recently a notice under the "Scientific News" column of a catamaran having made its appearance in New York waters. Would "Sunlight," or any brother-reader, kindly oblige with a few hints how to proceed in getting one up? I was thinking of constructing one out of two rowing-boats of, say, from 15ft. to 20ft. long, if such would do. If not, what kind of boats would I require for the purpose, and to accommodate from 40 to 50 passengers? I would like to know how to fasten the boats together, so as to support, as I suppose, the engine, boiler, and propeller between the two boats. Of course, I am only supposing they are placed between, and the intervening space between the two hulls decked over sufficient for the purpose. The propeller would require to be a paddle with feather floats, as I intend her to run upon a stream with a current of three to four miles an hour. Will such require two engines, or will one be sufficient? If so, what kind, size of cylinder, length of stroke with horizontal boiler, and size of boiler? The mode of getting the upper deck, or what size of boats would I require to accommodate from 40 to 50 passengers without any upper deck, and of very light draught, the river being very shallow in many places. I would like her to steer with wheel at the centre, and rudders at each end so as to dispense with turning. What kind of rudders are best, and how to throw them out of gear and have them firmly fixed when not in use steering, as in the bow going forward, and vice versa, with any other information they may occur as being necessary for the construction and completion of the above, which will be esteemed and oblige.—ONWARD.

[44772.]-**Beams and Girders.**—No. 1 Girder—15ft. 7in. long, 19in. high, 12in. broad, the flange on top and bottom both the same size, 3in. thick, made of ½ plates and webs ½ in. thick. No. 2 Girder—12ft. 7in. long, 16in. high, 14in. broad, the flange on top and bottom are both the same size, 3in. thick, made of ½ plates and webs ½ in. thick. The above two girders are



made of wrought iron. No. 3 Girder—14ft. 6in. long on one side, and 14ft. on the other, 12in. high, and 14in. broad. No. 4 Girder—14ft. 6in. long on one side, and 14ft. on the other, 2ft. 4in. high, and 1ft. 3in. broad. No. 5 Girder—17ft. long, 19in. deep, and 15in. broad. The above girders to be of American oak. The diameter

spirits of salts as flux; but when the work is finished and lacquered, the spirit appears in beads round the joint spoiling the work. I cannot use resin. Will some reader kindly help?—LOWE TOM.

[44811].—Crank-Shaft.—I am about putting new brasses in crank-shaft; how am I to get shaft lifted out of place? Shaft and wheel about 18 tons. There is no beam above for blocks. Hoping someone will assist and oblige.—L. W. B.

[44812].—Claudet's Method.—In what work (or how) can I get a detailed description of Claudet's method of extracting small quantities of gold and silver? I know the principle.—N. E. B.

[44813].—Kindergarten.—Will someone explain the German Kindergarten system for teaching young children by models, &c.?—INDIA.

[44814].—Lathe.—I want to know what size the small wheel on lathe ought to be? The driving-wheel is 2ft. over. And, whether the same velocity will do for wood and stone?—C. RODWELL.

[44815].—Star Antimony.—What are the requisite conditions of casting ingots of antimony to obtain the starred appearance on the surface? I have remelted a cake of antimony without being able to obtain the starred appearance on the surface, which was on the original cake before melting.—IGNORANCE.

[44816].—Electric Gas-Lighting.—There is an electric gas-lighter now sold consisting of a small one-cell battery in tin case (but which does not injure by up-setting), and a spark from that, on making contact, lights the gas. Will someone kindly say what kind of battery is suitable, not to require recharging too frequently?—M. L. KAPLAN.

[44817].—Speed of Pump.—Will "Sunlight," and other correspondents give me their experience as to the highest speed of bucket of lift-pumps, and the height of lift—say for pumps of 3in., 4in., and 5in. bore? Would fifty strokes a minute of a 6in. pump be too great when the stroke was 2ft? Suction and delivery-pipes, 4in. bore. Air-vessel on delivery-pipe. Lift, 50ft.—SALOMIA.

[44818].—Dynamo-Electric Machine.—I have a dynamo-electric machine capable of giving the current of 32 quart Bunsens at a tension of six cells. I wish to alter the machine in such a way as to reduce the current and, at the same time, increase its electro-motive force. I have been told that this can be done by altering the lengths or the sizes of the wires on its magnets or its armatures; but I do not know how to alter them to produce the effects named above. I should, therefore, feel much obliged to Mr. Rankin Kennedy if he will not only tell me how to alter the machine, but give me the reasons or principles to guide me in the proposed alterations. I may add that the machine is fitted with six electro-magnets attached to an iron cylinder, and six soft iron armatures fastened to a short length of shafting.—DYNAMO.

[44819].—Coin.—Wanted to know the probable name and value of a small gold coin issued in the reign of one of the Georges. Weight, 1dw. 5gr. Date, 17—, partly defaced.—ALP.

[44820].—Patent Wrought Nails.—Will some reader kindly describe the process of making patent wrought nails, sharp points?—J. L.

[44821].—Clarifying Temperance Drinks.—I should be glad if someone would give practical instructions how to quickly clarify syrups and temperance drinks in general.—LIGHT AND BRIGHT.

[44822].—Comets.—Will some reader kindly tell me in what work I can find the times of perigee and perihelion of all comets since 1860?—COMET.

[44823].—Inhaler.—To Mr. G. H. WILKINSON.—I made an inhaler from the description you furnished (July 23), for which I thank you. Would you please say how often the camphor-water should be changed?—M. R.

[44824].—Photography.—To "PHOTO."—Could I use anything to gloss some large landscape photos? I have no rolling-press. Could I make any use of an ordinary letter copying-press? Does a half-plate require more exposure than a quarter-plate? I have a quarter plate photo lens, and I take a portrait with dry plates in about five seconds—lens stopped. With same lens and same stop I exposed a half-plate (to get a large head), five seconds, ten seconds, and fifteen seconds. First two plates, no good; last one, figure out, but no details.—LUCIFER.

[44825].—Colouring Water.—Can any of your readers inform me what I am to use to colour water to imitate brandy, rum, and whiskey, so that there will not be any deposit, but always retain their brilliancy?—W. LAW.

[44826].—Transparent Decorations.—Will any of your correspondents kindly give a few directions how to proceed to make a transparent device for decorating the front of a house—say a screen 6ft. by 6ft., to be illuminated from behind by gas? What is the best material, and what colours are used?—G. D.

[44827].—Water-Wheel.—I want the dimensions, &c., of a small water-wheel to be driven by 1½in. diameter pipe, and a fall of 3½ft., to pump water to a height of 6ft., or some other arrangement by which a small quantity could be lifted 6ft. by a fall of 3½ft. Will some of your mechanical correspondents oblige?—G. D.

[44828].—Separating Gluten.—Can any of your readers tell me how to separate the gluten from wheaten flour, in order to make bread for diabetic diet?—DIABETIC.

[44829].—Hydraulic Cylinders (Cast Iron).—Will some reader kindly supply formula, with examples, for calculating strength and thickness of above? Also, the power of pumps for hydraulic purposes.—W. TURNER.

[44830].—L. and N. W. R. Engines.—Will some correspondent kindly give lists of engines (with classes) stationed at Camden (1), Shrewsbury (30), and Carlisle (29)?—MISSISSIPPI.

ANSWERS TO CORRESPONDENTS.

* * All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 31, Tavistock-street, Covent Garden, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

* * Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

A NEW VOLUME.

NUMBER 859 was the first of Volume XXXIV. Readers willing to oblige us by recommending "ours" to new subscribers should do so now, when a new volume has just commenced. The index to Vol. XXXIII. is published in this number, and cases and bound volumes will be on sale shortly. Readers desirous of making up their sets for binding the last volume are recommended to do so at once, as the back numbers soon run out of print.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 21, and unacknowledged elsewhere:—

B. C. Z.—W. T. R.—C. E. Stretton.—E. R. Dale.—Bonj. Jenkins.—Blue Danube.—Tyneside.—B. A. Scott.—C. Townley.—A. J. S.—T. Harris.—C. P. E. S.—J. E. F.—Melon.—L'Abbe Guibet.—Amateur Organ Grinder.—Walden.—Delta.—Arrowroot.—F. Morrell.—An Old Sufferer.—L'clair.—Amateur.—Centaur.—Amoeba.—R. M. Tuttle.—Mineral Oil.—Titterworth.—T. Wiesendanger.

INEXHAUSTIBLE. (Indigestion has nothing to do with it. It appears to be something in the blood, constitutional, and, if real cancer, is, so far as modern medicine or surgery is concerned, incurable. 2. You had better apply to a medical man. The tape-worm is made up of many "joints," and what you describe may be pieces. You will not be relieved until the head is expelled. Several remedies have been given in back volumes, but you had better consult a medical man, showing him some of the "worms.")—SPARKS, Bristol. (If you can get no reply from the Secretary, better take the advice of a solicitor. 2. You will find what you want on p. 462, No. 590; but any tricycle-maker or blacksmith would rig up a velocipede to be worked by the hands.)—J. DOWNING. (A similar query inserted last week. See p. 196, Vol. XXXIII., for the soda.)—SCIO, Cork. (We are not aware that any prizes of the kind are offered.)—GEO. WILSON. (See p. 72, 74, Vol. XXXI., and many other places in back volumes. Use soft-iron rod and silk-covered wire. The Bunsen, Daniell, Bunsen, or the bi-chromate will do.)—M. Birkenhead. (See p. 79, Vol. XXVIII., and get the "Book of Hall Marks," by Albert Lutchnaig, manager of the Liverpool Assay Office, price 6s.)—MUZZUT GUNOS. (See the indices of back volumes, under head Bronchitis. You could try an inhaler, for which see index published herewith.)—AMSTERDAM. (Such a battery would be of no use for the purpose. You want 30 quart Bunsens to get any light worth mentioning.)—PUZZLED (Spencer says "press less," and it is obvious that that is impossible, for the weight is the same, whether the foot is put down gently or not.)—W. A. S. (Many remedies have been suggested in back volumes. Try powdered borax strewn thickly near their haunts, or the Persian insect powder in heaps, or paint all about their haunts with tar.)—G. LYCH. (Certainly. Against the tide the blade is travelling in the same direction as the water, and a quicker motion is instinctively adopted. Easier with the tide.)—H. W. BEAD. (See p. 565, last volume, No. 855.)—ZARKS. (Why not put it to the practical test? At any rate, we have no room to spare for further discussion.)—JOHN THOMSON. (Will you kindly say what instrument you mean. The name you use is that of a well-known steam-pump.)—MUSSTRA. (Not that we know; scarcely likely.)—INDIA. (You were answered at the time in this column. Can you send us any particulars of the solar engine? It appears to be Mouchot's, which we illustrated in No. 564, and which has given good results in Algiers.)—H. HAMILTON. (Inquire of the musical-instrument-dealers.)—G. R. (Rough polished with sand, and finished with crocus.)—SI JE PUIS. (Full particulars on pp. 464, 487, 509, Vol. XII., but the respective secretaries are always ready to give information.)—J. WRIGHT. (See the index published with this number.)—CHARLES NORMAN. (We cannot repeat a sketch. Why not point out the inaccuracies in words?)—JACK. (The phenomenon has been several times explained in back volumes. It arises from the fact that the glass mirror has two reflecting surfaces. See Ganot's "Physics.")—ERNEST. (The articles in Vol. XII. have been issued in book form by Mr. Hughes, of 151, Hoxton-street, N. They contain "all particulars.")—W. J. C. (Very few experiments are possible without expensive and troublesome apparatus. To show the composition even, you would need a battery.)—PAMPAKOS. (They are the units respectively of quantity or current, of electro motive force and tension, and of resistance. Explained in any textbook on the subject, and many times in back volumes.)—ALFRED SPENDING. (See the indices to the last two volumes. As to the fret-saw, we could not say until we had the description before us.)—FLAT. (See the indices of the last two volumes.)—X. Y. Z. (Water in freezing expands, and so the pipes burst

unless they are strong enough to resist the pressure. The fracture takes place just after the water assumes the solid form.)—THOS. SKINNER. (We do not know of such a work.)—G. F. FISHER. (You must stir the mixture in the pot, so as to bring all the contents into contact with the cold metal.)—A. FERRIS CORBY. (We do not understand you now; but perhaps an illustration in No. 629 may help you. No. 573 contains a diagram showing the parts.)—E. A. (I planned in nearly every back volume.)—AN LA MECHANIC. (Purely a case of personal examination. It is something constitutional.)—INQUIRY. (A similar query inserted.)—HARD-WARE MERCHANT. (Try some of the large tool-makers.)—PRELEX. (Consult respectable medical man.)—A. C. D. (See index published with this number.)—W. L. THOMSON. (The idea of compressing air might be worked on a fall-gate, as it would act as a brake, but it would be complicated to be of any real value.)—AN INQUIRY. (Instructions for making an American organ were published in Vol. XXVI.)—DYSPEPTIC. (See pp. 30, 43, 190, Vol. XXXII. It is not easily cured. Try vegetable charcoal and peppermint.)—A. CONSTANT READER. See port. (See pp. 181, 451, Vol. XXIX.)—CLAPHAM. (Keen's cement. It was probably put on with a plaster of Paris and a solution of alum.)—B. (Three instruments named are quite distinct. 2. I can see the microscope you mean at any good optician.)—F. FRANK, JUN. (You simply want an engine which any firm of pump-makers will supply.)—W. LIAM. (The difference is 8, the value of which will be seen on the dial, whether tenths or hundredths. Set up an accurate sketch of the dial, and we will tell you.)—H. (Try Messrs. Lancaster, or use Bonite.)—J. W. LEACH. (A sauce containing oil is a good one. 2. He was the greatest master of the French school, studied and lived chiefly at Rome. You might obtain such a book of Mr. Bateford, High Holborn.)—E. ASHRO. (Christie's shilling book, published by the Society for Promoting Christian Knowledge.)—MAN ENGINEER. (Only through the "service," we believe.)—A. M. CHIFFREAU. (Such a book is published Sampson Low and Co., Fleet-street, W.C.)—GAMMA. (We do not.)—SUCCAT. (None, practically.)—2. No. The ordinary pigments worked up with printer's "wash."—J. W. GOUR. (We do not understand how any one can reply without some definite idea of what is the matter. Is it rheumatism or gout?)—LRI. (One stone will last for a very long time if carefully treated. You will not be able to make a press cheaply as you can buy. Get the "Grammar of Lithography," published by Wyman and Son, Great Queen-street, W.C.)—REX. (You can use it if you like; it is diuretic and aperient, and will not improve the flavour of roast beef.)—A. COUNTRY WHEELWORK. (They cannot be shortened; they are usually sprung the larger. Make the wheels larger or get smaller tires.)—W. GOUR. (The moon on Sept. 8 was the "harvest moon.")—EGG. (See the indices of the last three volumes.)—ENO ALPHA. (You want a medical coil, or a magnet machine.)—J. S. BALL, C.E. (Sketch invalid).

The Gilchrist Engineering Scholarship.

The regulations connected with the Gilchrist Engineering Scholarships, given by the Gilchrist Trustees, first offered for competition in 1880, are as follows:—A. Entrance Scholarships.—1. An entrance scholarship of the value of £35 per annum tenable for two years, will, during the pleasure of the Gilchrist Trustees, be annually offered for competition, subject to the following regulations:—The competition is limited to those who have previously been students of the college. 3. Candidates must show, to the satisfaction of the committee, that they were not more than 18 years of age on 1st of October immediately succeeding the examination. 4. Candidates must, on or before the 23 of September in each year, send to the secretary written notice of their intention to compete, stating whether they intend to present themselves for examination in French or German, together with certificates of age and good conduct. 5. The examination will take place in September at the college. 6. Every candidate must declare in writing his bona fide intention of taking at least the two first years of one of the engineering courses, as set forth in the prospectus, and the payment for the second year will be contingent on his entering, at the commencement of that session, the classes comprised in the course, and also upon his having presented himself at the class examinations of the preceding session, and obtained not less than three certificates in these examinations. 7. The subjects of the entrance examinations will be as follows:—(1) Mathematics, (2) mechanics, (3) mechanical drawing, (4) essay on one of three given subjects connected with mechanics or engineering, (5) French or German, (6) the use of tools, either carpenter's tools, or the lathe (wood or metal), or the file. 1. Senior Scholarships.—1. A senior scholarship of the value of £80 (half payable at the time of award and half in the succeeding June), will, during the pleasure of the Gilchrist Trustees, be awarded at the close of each session from 1881-82 inclusive. 2. Candidates for this scholarship must, to the satisfaction of the Faculty of Science, have attended during the whole of the session immediately preceding the award college classes in the following subjects:—Applied mathematics, practical physics, junior engineering, engineering drawing, geology. The scholarship will be awarded on the results of the ordinary class examinations in these subjects. The above entrance and senior scholarships will be awarded by the council upon the report of the Faculty of Science.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, SEPTEMBER 30, 1881

THE CONTINUOUS BRAKES' RETURN.

THE Continuous Brakes' Return for the half-year ending June 30 last presents some features which are not readily understood by the cursory reader, however well acquainted he may be with the construction and action of the brakes reported on. It may be remembered that besides making a return of the number of engines and coaches fitted with continuous brakes, the companies are required to record the "failures" of the brakes, and the consequent delay to trains, if any, distinguishing whether the failure was due to the neglect of servants or to defects in machinery or material. The instances of failure are returned under three heads—viz., failure to act when required in case of accident, or of a collision being imminent; failure to act in ordinary circumstances; and the duration and cause of delay if any. The return of rolling-stock fitted has already formed the subject of a letter by Mr. Stretton (p. 43), and we purpose now to call attention to the "failures" reported, and their causes. The brakes may be divided into two classes—the automatic and the non-automatic, the total mileage run by trains fitted with the better-known brakes being respectively 7,589,033 for the automatic, and 16,915,003 for the non-automatic. The former class comprises the Westinghouse, which has run over 5,339,097 miles, and had 425 failures reported; the Sanders and Bolitho, which has run over 2,200,664 miles, with 78 failures; and the Vacuum Automatic, which has run over 49,272 miles, with four failures. These figures give respectively one fault in 12,562 miles, one in 28,213 miles, and one in 12,318 miles. In the non-automatic class are the Clark and Webb, with a mileage of 8,855,092, and 35 failures, the Smith Vacuum with a mileage of 7,588,988, and 95 failures, and the Westinghouse non-automatic with a mileage of 470,923, and no failure. These figures give one fault in 253,002 miles for the Clark and Webb, and one fault in 79,884 miles for the Vacuum,—results which at first sight compare favourably with the automatic brakes. The non-automatic brakes, however, do not comply with one of the most important conditions of a really efficient brake, and are therefore not fairly comparable with the automatic brakes; but the apparent value of the results shown by the figures vanishes when we come to examine them more closely. As is well known, the Clark and Webb brake is used only on emergencies on the London and North-Western line, and we accordingly find the large mileage of 7,424,374 as having been accomplished with only 21 failures, while the same brake on the Great Eastern, where it is used for all stops, had 5 failures in 146,184 miles. The emergency brake is supposed to be tried at the first stop in order to ascertain that it is in working condition, and the remainder of the stops on the journey are then made by the ordinary hand-brakes. Although the brake has been "carried" for the number of miles recorded to its name, it can scarcely be said to have run the distance. Of the 21 failures reported, seven were due to some defect or other, but four only of these

can be described as failures to act when wanted. Of the 14 instances of delay, the brakes either went on, or could not be released after being applied. Of the five instances of failure recorded by the Great Eastern Company, only one was a failure when required to act, the others being delays through the brake not releasing itself. We have directed attention to these facts because it is not unlikely that an attempt will be made to show that whereas the non-automatic brakes failed once in 130,115 miles, the automatics failed once in 14,968 miles—the apparently good result shown in the former case being mainly due to the facts that the chain-brake is used only on emergencies, and that the Metropolitan District does not report any failures with the Westinghouse non-automatic brake. Turning now to the records of the three brakes which comply with the Board of Trade conditions, it will be seen that the Automatic Vacuum had one failure in 12,318 miles, the Westinghouse one in 12,562 miles, and Sanders and Bolitho's one in 28,213 miles; but on examining into the details, we find the following extraordinary returns, which at present we fail to understand. The London and Brighton Company has used the Westinghouse automatic brake for running over 1,789,158 miles, and reports 106 failures; the North-Eastern has used it over 1,213,880 miles, with only 34 failures; the North British has worked 1,022,896 miles with it, and reports 66 failures; but the Midland, which has worked it over only 377,944 miles, reports exactly the same number of failures as the Brighton Company does for five times the mileage. Here it is obvious one of two conclusions only can be arrived at: either the Brighton Company do not report as failures the trivial incidents which happen in everyday working, or the brake must be badly fitted or carelessly treated on the Midland. Of the 106 failures recorded by the Brighton Company none are made under the first or second heads above mentioned, but all are put down as "delays"; while of the 106 recorded by the Midland, nine are put down under the second head—viz., failure to act when required to make an ordinary stop, the remainder being classed under the head of "delays" caused by some temporary defect in the apparatus or by neglect of the company's servants. The delays on the Brighton line were due mainly to bursting of the pipes and connections, and to defective washers, causing leakage, the loss of time ranging from one minute to fifteen, but rarely exceeding five minutes. In the cold weather of last January some of the delays were caused by the exhaust parts of the triple-valve freezing over; but it is worthy of notice that in the long list of failures returned by the Brighton Company, in no single instance did the brake fail when it was required to act—in other words, it always gave notice that something was not right beforehand. Of the nine failures when the brake was required, reported by the Midland Company, one was due to the triple valve freezing on the tender, the train overrunning the platform by five coaches; but the rest appear to have been caused by the neglect of servants to properly connect the brakes. The delays returned by the Midland are, some of them, serious, both in their duration and in their cause. On Jan. 13, for instance, a train was delayed eighteen minutes by the bursting of a hose-pipe, and the freezing of the taps; and, on Jan. 29, a train was delayed sixty-one minutes by the breaking of a coupling and side chain of some fish-trucks when the driver applied the brake. The trucks were G. and S. W. stock, and, as the drawbar shackle of another also broke on the same journey, it is probable the couplings, &c., were not of sufficient strength. A delay of thirteen minutes is reported on Feb. 4 in the following terms: "Brake stuck

on tender No. 810. It ultimately released from tender, and applied itself on the carriages and would not release." The phrase "would not release" occurs several times in the Midland returns, and although in some cases the "delay" is put down at only one minute, we suspect that the longer "delays" are not altogether due to the difficulty in releasing the brake-blocks. Many of the failures on the Midland are put down squarely to the "fault of the servants," and in some cases it is distinctly stated that the "guard did not understand the working." The causes of the 34 failures and delays on the North-Eastern are set forth very fully; but only three of the instances come under the second head—viz., failure to act when wanted, and one of these was due to the fact that the brake-connection between engine and train had not been made, while in another case, although the train had been properly coupled to engine, the valve in the tender coupling was found closed or left unopened. The delays were caused mainly by the brakes going on owing to some defect in the connections, especially when other stock was picked up; but in no case was the delay greater than five minutes. The 66 failures recorded by the North British are all under the head of delays, the brake in no single instance being found wanting when required. In these returns a brief statement of the cause of delay is given, followed, in the majority of instances, by the words, "failure of material." It will be seen, then, from the returns of the Brighton and the North British lines, that the Westinghouse brake has been worked during the past half-year over nearly 3,000,000 miles without a single failure when required to act; and if we add its mileage on the Great Eastern and the North-Eastern, we have a gross return of four and a half million miles with only four failures, two of them being due to the neglect of servants in not properly coupling the train to the engine. Referring now to the Sanders and Bolitho automatic vacuum brake, we find that it ran 618,812 miles on the Great Western with 31 failures, and 1,581,852 on the Midland with 47 failures. Of these only three were failures to act when required, the remainder being delays caused by defects similar to those which delayed trains fitted with the Westinghouse. We notice, however, that some of the delays were caused by "applying the brake fully instead of slightly," and though time to the extent of a minute or two was lost, it seems rather beyond the question to enter such a fact in the returns—especially when we remember that in the summary such events count as failures in adding up the total numbers. The automatic vacuum brake has been used on three lines, and on a mileage of only 49,272 the number of failures returned is four, two of which were instances under the second head—failure when required to stop in ordinary circumstances. In one case the pipes on the engine were frozen, and in the other air had found its way into the vacuum cylinder. It goes without saying that the results in every case would have been the same if the brake had been required to prevent a collision, and the figures we have above quoted in connection with the Westinghouse automatic serve to prove that it is the best brake at present available. The results recorded by the London and Brighton Company alone are sufficient testimony to its value, for on that line the brake did not once fail when required to stop the train during the whole of the six months. If we compare that result with the returns given by the Great Northern in connection with Smith's vacuum—a non-automatic brake—which really worked over the three million and more miles credited to it, we find that of the total number of failures (44) no fewer than 33

were failures to act when required, and in the majority of cases the platform or the signal was overshot. On the South Eastern, too, with a mileage for Smith's Vacuum of 937,541, eight failures are returned, seven being cases of overrunning the platform. On the North London the chain brake has been used over 824,550 miles with only two failures—mere cases of delay for a minute or two; and in 20 out of 43 trains the brake has now the automatic action fitted. It is a curious fact that while in one part of the Returns it is stated, under the head of the London and North-Western, that Clark and Webb's chain-brake "cannot creep on when not required to do so, all danger on that score being consequently avoided," in another part, where the list of delays is given, out of 14 instances six were cases of the blocks going on to the wheels without being required to do so. The reporter naïvely remarks in some of these instances that "the cause of this irregularity cannot be ascertained." In three of the six cases there was just that amount of danger which a delay of fifteen minutes means. To those interested in the brake question a little careful inspection of these Returns will be found profitable reading; but probably the digest we have attempted above will help to explain the apparently extraordinary results given by a simple summary of the figures.

DUCTILISING AND BURNISHING STEEL.

IN the course of some investigations which Mr. Jacob Reese, of Pittsburgh, Pennsylvania, made while inventing a machine for burnishing steel, he came across a few facts which are of interest to students of molecular physics. He discovered not only that steel bars could be burnished by the action of a machine, but that the metal, during the process, may have its ductility increased from 30 to 90 per cent, at temperatures ranging from 60° to 250° Fahr. In the known and practised methods of treating iron and steel by rolling, &c., the elastic limit of the material is invariably elevated, whereas in that discovered by Mr. Reese it is slightly reduced; and his process occupying, as it does, the minimum of time, may possibly be found of considerable value in the case of all constructions in which steel is largely employed. The machine consists, in principle, of a pair, or several pairs, of discs, with flat conoidal-shaped faces, which are caused to revolve in contrary directions opposite one another, in such a manner that a bar of steel passed between them is not only rubbed by the pressure brought to bear, but is caused to revolve so as to bring all parts of its periphery under the influence of the burnishing discs. The faces of the discs are described as slightly conical, with the centres turned concave, so that the working face of each disc may be considered to be a zone extending from the outer edge of the disc to that of the concavity. It will be easily understood that a bar of steel or other metal can thus be passed between the faces of two opposing discs, provided they are suitably placed, and that any desired amount of pressure can be brought to bear in burnishing the bar, which revolves because the discs each tend to turn it in a contrary direction. The number of discs operating at one time may be six or more, according to the size of the machine or the length of bar to be operated on, but it is necessary that they should rotate uniformly and that the working faces should be true and highly polished. That is accomplished by sprinkling the faces of the discs with oil and emery, and passing a piece of squared hard wood between them. The wood is drawn forward by the motion of the discs, which are polished by the friction, and are

then ready to receive the metal bars when properly adjusted for the purpose—a point which will need considerable care and skill on the part of the operator. Suitable rests form a part of the machine which Mr. Reese has devised, and when their position has been determined, the feeding of the bars will be uniform and constant, and the effect will be determined by the pressure put upon the revolving discs between which the bars pass. The greater the friction the greater will be the tractive force which tends to film or draw the surface of the metal, and the ability of the latter to withstand the drawing force must depend on the cohesion of its particles. That naturally varies with different metals, and with them, also, at different temperatures, being least at the highest temperature; but in the case of iron and steel it depends mainly upon the amount of carbon in combination with the metal. As temperature in the case in question will depend on the frictional action of the discs, it is obvious that the greatest pressure must be put on the first pair of discs between which the metal passes; for when the bar is put into the machine its temperature will be gradually raised by the frictional action at each pair of discs, and it will therefore become less able to resist the tractive force, and will become liable to draw or scab. The object is to compress the inequalities, and to develop enough frictional or tractive force to overcome the attraction of cohesion of the particles composing the scale, but not enough to overcome the force of cohesion of the particles which will then form the surface of the metal itself. It is sufficiently obvious that great care will be required to effect this object, and the pressure required to be put on can only be ascertained by practical trials of each sample of metal. The metal bars should also be rolled to a uniform gauge, so that the machine when once set can be fed without alteration; but it is impossible to state any definite pressure for a given size of bar, because where the scale is not tenacious a much lighter pressure will suffice than in the case of metal which, soft in itself, has a very tenacious scale. The machine having been set and tested by means of a trial bar, is in a condition to receive the others, which one after the other are rotated rapidly between the discs and drawn forward at a speed which may vary from one to sixty feet per minute, being delivered perfectly straight, truly cylindrical, and highly burnished. Mr. Reese says that when burnishing cold bars he places some narrow pans containing petroleum beneath the second and third pair of discs, in such a position that the lower portions of the working faces of the discs are immersed in the oil as they revolve, thus preventing scratching and tearing of the metal bars. If it is required to burnish the metal as it comes hot from the rolls, it should be allowed to cool to at least a dull red heat, and plenty of water should be allowed to flow upon the first set of discs, and upon the bar, to assist in loosening the scale by the contraction of the metal. A blast of some kind should be used to carry away the scale, and the second set of discs will then readily remove any remaining scale, and at the same time heat the surface of the bar by their frictional action. The oil covering the faces of the discs in this part of the train is partially vaporised, and the bar consequently becomes covered with a film of carbonaceous matter that is apparently forced into the pores of the metal by the action of the other discs. Whether that is the rationale of the process or not, Mr. Reese says that bars so burnished have a finer appearance than those treated without oil, and what is more, they resist oxidation to a greater degree. The discs opposite one another travel at different rates of surface-speed,

and the steel bars are consequently rubbed as well as rolled between them; the rests which support the bars in their proper position also help to burnish the surfaces, and there is also the forward motion of the bars themselves. Thus, suppose the discs to have a rubbing-surface of 113 and 138 square inches respectively, the total area will be 251 square inches slipping or rubbing over the revolving bar, which rotates, say, eight times to each revolution of the discs. The rests have a working-surface of, say, 5 in. in length, and as the forward movement is about two inches for each revolution of the discs, it will be seen that the rest acts very much as a burnishing-tool in the lathe. So much for the burnishing operation, which is not the most remarkable effect produced by the action of the machine. The heat developed by the friction is found to gradually expand the metal, and unless the screws regulating the pressure of the last two pairs of discs are slackened, the metal will be liable to scab; but, if that is avoided, and the bar be compelled to just retain its original diameter, the elastic limit and ductility, as well as the tensile strength, remain the same as in the original state. If the screws are adjusted so as to allow the bar to keep its increased diameter, there is a slight decrease of tensile strength and elastic limit, with a great increase in the ductility of the metal. Such a result is remarkable, and is worth experiment in order to see how far Mr. Reese's statements can be borne out by trial in this country. The operation is conducted, he says, in such a manner that the temperature does not generally exceed 250° Fahrenheit, which would be quite insufficient to ductilise or anneal heavy bars of cold steel, however long continued. When steel is required for structural purposes where concussion, vibration, and deflection have to be resisted, it is the usual practice to secure the required ductility by making it low in carbon, which, consequently, reduces the tensile strength. The steel is annealed after manufacture to remove the effects of rolling, hammering, and drawing; but as carried out it is a slow operation, and leaves the metal covered with scale. The process devised by Mr. Reese not only burnishes the surface, but greatly increases the ductility of the metal, without materially reducing the tensile strength. It is specially applicable to the production of steel shafting, piston-rods, and similar work, large or small; but it is peculiarly valuable in the case of constructive works of steel, in which it is of the highest importance that due warning should be given of an approaching rupture. The cause of the increased ductility produced by the friction of the discs is a problem which invites the attention of students of the laws of molecular physics; and for the purposes of experiment it is obvious that the machine can be constructed on any scale, as what is found true for a knitting-needle will probably hold good even up to a screw-shaft.

THE PARIS ELECTRICAL EXHIBITION.—VI.

WHEN water is decomposed in a voltameter, hydrogen is given off at the negative and oxygen at the positive pole. If we now take away the battery with which we have been decomposing the water, and connect the platinum plates of the voltameter with a galvanometer, we shall observe a current flowing in the opposite direction of the current of our primary battery. Thus we obtain a short secondary current, during which the gases in the voltameter recombine. On this principle Grove made a gas battery consisting of fifty tubes, alternately filled with hydrogen and oxygen and standing over acidulated water. Each tube contained a plate of platinised silver, and those being connected formed a very efficient gas battery.

This, however, does not constitute a secondary battery, for Grove did not obtain his gases by electrolysis.

In 1858, M. Gaston Planté brought out his secondary battery, which merely consists of two plates of lead dipped in acidulated water. The two plates of lead are rolled up together, with a layer of cloth between them, in order that they may not touch each other. This secondary battery or accumulator is charged by connecting the plates with a battery; the water is decomposed, the hydrogen going to the negative and the oxygen to the positive pole. After some time the battery is taken off and the accumulator may be discharged. It gives an intense current of short duration. With a large number of his accumulators, M. Planté has made a very interesting series of experiments and researches on high tension currents. It was soon found that the accumulators improved as they got older, and this was seen to be due to a deposit of oxide of lead which formed on the plates. M. Faure, in his accumulator, does not wait until a deposit of oxide forms on the plates, but coats them with minium, and thus deposits in a few minutes a layer which would take two or three years to form by itself. Faure's accumulators are exhibited by the "Force et Lumière" Society. The small cylindrical model weighs 16lb., and is 14cm. in diameter, 26cm. high, and can give out one kilogramme-mètre during eight hours. The large size accumulators consist of wooden troughs, each containing twelve flat plates of lead painted with minium, and separated by felt. The positive plates are 2mm. thick, and the negative 1mm. The total weight is 44lb.; electromotive force, 2 volts; quantity of electricity when saturated, 150 Webers; internal resistance, 0.006 ohm; total mechanical work, 30 kilogramme-metres, which may be spent in a short or long time varying with resistance of circuit. At the Exhibition the accumulators are charged by three Siemens machines requiring 3 horse-power each, the two small exciting machines 2 horse-power each.

Each Siemens machine charges 40 accumulators in five hours to saturation. In the daytime the accumulators may be seen working sewing-machines, saws, pumps, &c. In the evening they light up part of Swan's incandescent lamps thus distributed:—

Room.	Swan lamps.	Accumulators.
No. 4, Vestibule ..	23	.. 56
„ Kitchen ..	4	.. 56
„ Bathroom ..	2	.. 29
No. 7, Telephone-room ..	17	.. 29
„ „ ..	18	.. 29
„ „ „ „ „ „	34	.. 56
Total ..	98	170

I am indebted for the above information to M. Lieppmann, who kindly performed many interesting experiments with the accumulators before me. A copper-wire, 4mm. diameter, and 2m. 50 long, was brought to a bright red heat in a very short time. Short pieces of copper were immediately melted. It will be remembered that in the beginning Faure's accumulators were to be charged by batteries, but, of course, dynamo-machines are preferable, and altogether eclipse any kind of battery.

C. Detaille.

ASTRONOMICAL NOTES FOR OCTOBER, 1881.

The Sun.

Day of Month.	At Greenwich Mean Noon.			
	Souths.	Right Ascension.	Declination.	Sidereal Time.
	h. m. s. a.m.	h. m. s.	° ' "	h. m. s.
1	11 49 35.08	12 31 0	3 20 56	12 41 25.39
6	11 48 3.84	12 49 12	5 16 48	13 1 8.15
11	11 46 42.39	13 7 33	7 11 1	13 20 50.92
16	11 45 33.61	13 26 7	9 2 48	13 40 33.68
21	11 44 39.79	13 44 56	10 51 23	14 0 16.45
26	11 44 2.77	14 4 2	12 35 55	14 19 53.21
31	11 43 43.87	14 23 26	14 15 33	14 39 41.99

Spots, faculae, and other indications of activity continue to appear on the Sun's disc. The Zodiacal light may still be looked for before sunrise in the east. The method of determining the Sidereal Time at Mean Noon for any other station will be found on p. 388 of Vol. XXXII.

The Moon

Is full at 1h. 59.0m. on the afternoon of October 7th, and enters her Last Quarter at 2h. 26.0m. in the early morning of the 15th. She will be new at 2h. 31.1m. a.m. on the 23rd, and enter her Last Quarter at 4h. 47.1m. a.m., on the 30th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	8.0	6 42.5 p.m.
6	13.0	11 16.0 „
11	18.0	2 42.7 a.m.
16	23.0	6 49.1 „
21	28.0	10 23.6 „
26	3.4	2 42.7 p.m.
31	8.4	7 19.3 „

The Moon will be in conjunction with Saturn at 2 p.m. on October 9th, with Jupiter at the same hour in the afternoon of the next day; with Mars at midnight on the 13th; with Venus at 8 p.m. on the 20th; and with Mercury at 9 p.m. on the 24th.

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappear-ance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappear-ance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
2	13 Capricorni	6	10 13 p.m.	Dark	76	99	11 4 p.m.	Bright.	333	3
2	14 Capricorni	5	11 15 „	Dark	69	100	11 59 „	Bright.	338	12
5	B.A.C. 8152	6½	† 10 15 „	S.S.E.	30	29				
5	κ Piscium	4	12 9 „	Dark	123	144	1 16 a.m.	Bright.	293	322
5	9 Piscium	6	12 14 „	Dark	90	110	1 13 „	Bright.	326	355
9	ρ Arietis	6	6 9 „	Bright.	81	46	6 55 p.m.	Dark	311	272
9	ρ Arietis	6	6 12 „	Bright.	162	126	6 40 „	Dark	229	192
9	54 Arietis	6½	11 52 „	Bright.	49	21	12 30 „	Dark	346	326
12	ε Tauri	5	† 1 42 a.m.	S.	5	337				
12	105 Tauri	6	4 15 „	Bright.	40	52	5 8 a.m.	Dark	517	342
15	f Geminorum	6	1 3 „	Bright.	119	78	1 58 „	Dark	223	183
16	29 Cancri	6	2 44 „	Bright.	54	15	2 50 „	Dark	278	240
18	14 Sextantis	6	6 1 „	Bright.	53	27	7 19 „	Dark	252	241

† Near approaches.

Mercury

Is an evening star during the whole of October, but is very indifferently placed for the observer, from his increased and rapidly increasing South Declination. His angular diameter varies from 5.4" at the beginning of the month to 9" by the end of it. He attains his greatest elongation East (24.33°) at 7 a.m. on the 16th.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ' "	h. m.
1	13 47.8	12 41.1	1 6.2 p.m.
6	14 13.0	15 32.2	1 11.7 „
11	14 36.8	17 59.6	1 15.8 „
16	14 58.2	19 57.4	1 17.4 „
21	15 15.3	21 16.8	1 14.8 „
26	15 24.9	21 42.8	1 4.7 „
31	15 22.4	20 52.1	0 42.6 „

Hence, it will be seen that Mercury will travel from Virgo into Libra; without, however, approaching any conspicuous Star in either Constellation.

Venus

Is a morning star during the entire month, and is a conspicuous object in the East before sunrise. She is well placed for the observer during the first fortnight, but is just now an uninteresting object in the telescope, as she is merely gibbous, and her diameter on the 1st subtends an angle of only 13", which diminishes to one of 11.4" by the end of October.

Venus.

Day of Month.	Right Ascension.	Declination	Souths.
	h. m.	° ' "	h. m.
1	10 27.0	10 41.1 N.	9 45.9 a.m.
6	10 50.0	8 37.1 „	9 49.2 „
11	11 12.9	6 26.3 „	9 52.4 „
16	11 35.7	4 10.1 „	9 55.5 „
21	11 58.4	1 49.9 „	9 58.5 „
26	12 21.1	0 32.8 S.	10 1.5 „
31	12 43.9	2 56.4 „	10 4.5 „

The path indicated by the above Ephemeris begins close to the 4th magnitude Star ρ Leonis, and traversing the rest of the constellation Leo terminates in Virgo. The planet will be just south of χ Leonis on the morning of the 7th, the two presenting an interesting spectacle in the telescope. She will be less than ½° north of γ Virginis, on the 24th, but will not approach very near to any other conspicuous star in the region which she will traverse.

Mars

Is a morning star throughout October, as far as his Southing is concerned; but he rises about a quarter past 9 at night at the beginning of the month, and about 8 p.m. at the end of it. He is excellently placed for the observer, his North Declination being very great; but he is still a comparatively insignificant object of markedly gibbous figure, his diameter subtending an angle

which increases from 11.2" at the beginning of October to 13.8" by the end of it.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ' "	h. m.
1	6 14.2	23 31.2	5 33.9 a.m.
6	6 23.8	23 35.3	5 23.7 „
11	6 32.6	23 38.2	5 12.9 „
16	6 40.7	23 40.7	5 1.3 „
21	6 48.0	23 43.2	4 48.9 „
26	6 54.3	23 46.3	4 35.6 „
31	6 59.6	23 50.8	4 21.2 „

Mars thus starts from a point about 1° to the N. and W. of the 3rd magnitude Star, μ Geminorum, and travels through a portion of the constellation Gemini, somewhat barren of conspicuous stars.

Of the Minor Planets,

Vesta

Is the only one visible. She is coming into an excellent position for the observer, being in opposition to the Sun on the 30th. About this time she may be seen with the naked eye by any one who knows exactly where to look for her.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ' "	h. m.
9	2 56.5	5 41.7	1 45.3 a.m.
18	2 48.5	4 56.6	12 58.1 p.m.
28	2 38.9	4 15.2	12 9.0 „

On the night of the 1st she will be in that barren region of the sky N.N.E. of α Ceti, and will travel in a retrograde path through that constellation until, at the end of the month, she will be found between 1° and 2° N. of γ Ceti.

Jupiter

Is now practically visible all night long, and is a splendid object in the telescope. His angular diameter, which, on the 1st is $43.4''$, increases by the 30th to $45.8''$. His considerable North Declination is very favourable to his observation when near the meridian, and, as will be seen by the table annexed, the phenomena of his satellites are numerous and interesting.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	°	h. m.
1	3 35.0	18 2.5	2 55.1 a.m.
6	3 33.8	17 57.6	2 34.2 "
11	3 32.2	17 51.8	2 13.0 "
16	3 30.4	17 44.9	1 51.5 "
21	3 28.3	17 37.2	1 29.7 "
26	3 25.9	17 28.7	1 7.7 "
31	3 22.9	17 17.6	12 41.1 p.m.

Jupiter will describe the short retrograde path thus indicated through that blank region in Taurus to the south and west of the Pleiades.

Saturn,

Like Jupiter, is now visible all night long, and is remarkably well placed for the observer. His ring is more open this month than it has hitherto been, or will be again, during the present year. His angular diameter increases imperceptibly from $18''$ on October 1st to $18.2''$ during the second week, at which it remains for the remainder of the month.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	°	h. m.
1	2 38.6	12 41.7	1 58.9 a.m.
6	2 37.4	12 36.3	1 38.0 "
11	2 36.1	12 28.5	1 17.0 "
16	2 34.4	12 19.9	12 51.7 p.m.
21	2 32.9	12 12.6	12 30.6 "
26	2 31.4	12 5.1	12 9.4 "
31	2 29.8	11 57.5	11 48.2 "

This short retrograde path starts at a point some 3° North of the 4th magnitude Star μ Ceti, and lies wholly in the uninteresting region where Aries and Cetus are contemporaneous.

Uranus

Is too close to the Sun to be visible.

Neptune,

Especially towards the end of October, is in an excellent position for observation, and is at a good height above the horizon during all the working hours of the night.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	°	h. m.
1	2 55.8	14 55.5	2 17.0 a.m.
6	2 55.4	14 55.5	1 50.0 "
11	2 55.0	14 51.3	1 36.7 "
16	2 54.4	14 40.1	1 19.6 "
21	2 54.0	14 40.8	12 52.5 p.m.
26	2 53.8	14 43.0	12 32.2 "
31	2 53.7	14 41.4	12 12.0 "

Notice it will be seen that Neptune describes a very short arc in an utterly blank part of the southern boundary of Aries.

Mars's Position

Is now station in the prominence of Mars's right shoulder between 11 and 12 p.m. It may be found from the 1st to the 31st of the month, 1891.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	I	Oc R	7	12	P.M.	13	III	Sh I	11	4	P.M.	23	I	Sh I	7	4	"
2	II	Sh I	3	45	A.M.	13	III	Sh E	12	53	"	23	I	Tr I	7	36	"
2	II	Tr I	5	46	"	14	I	Ec D	1	23	0 A.M.	23	I	Sh E	9	16	"
3	III	Ec D	4	57	32.33	14	III	Tr I	2	27	"	23	I	Tr E	9	47	"
3	II	Ec D	10	55	7 P.M.	14	III	Tr E	3	36	"	24	III	Ec R	6	33	18.11
4	II	Oc R	3	22	A.M.	14	I	Oc R	4	18	"	24	I	Oc R	6	55	"
5	I	Ec D	5	0	2.33	14	II	Oc R	6	49	P.M.	24	III	Oc D	7	15	"
5	II	Tr I	6	56	P.M.	14	I	Sh I	10	42	"	24	III	Oc R	8	25	"
5	II	Sh E	7	41	"	14	I	Tr I	11	26	"	25	II	Ec D	6	41	19.12
5	II	Tr E	9	29	"	14	I	Sh E	12	54	"	26	II	Sh I	12	53	P.M.
6	I	Sh I	2	18	A.M.	15	I	Tr E	1	37	A.M.	27	II	Tr I	1	53	A.M.
6	I	Tr I	3	14	"	15	I	Ec D	7	51	33.34	27	II	Sh E	3	30	"
6	I	Sh E	4	30	A.M.	15	I	Oc R	10	44	"	27	II	Tr E	4	22	A.M.
6	I	Tr E	5	25	"	16	I	Sh E	7	22	"	28	I	Ec D	5	12	3.11
6	III	Sh I	7	3	P.M.	16	I	Tr E	8	3	"	28	II	Ec D	7	59	0 P.M.
6	III	Sh E	8	53	"	18	II	Ec D	4	5	58.33	28	II	Oc R	11	19	"
6	III	Tr I	11	1	"	19	II	Sh I	10	17	P.M.	29	I	Sh I	2	30	A.M.
6	I	Ec D	11	28	40.33	19	II	Tr I	11	33	"	29	I	Tr I	2	54	"
6	III	Tr E	12	12	"	19	II	Sh E	12	54	"	29	I	Sh E	4	42	"
7	I	Oc R	2	32	A.M.	20	II	Tr E	2	6	A.M.	29	I	Tr E	5	5	"
7	I	Sh I	8	47	P.M.	20	I	Sh I	6	7	"	29	I	Ec D	11	40	41.33
7	I	Tr I	9	40	"	21	III	Sh I	3	5	"	30	I	Oc R	2	13	A.M.
7	I	Sh E	10	59	"	21	I	Ec D	3	17	27.33	30	II	Tr E	5	29	P.M.
7	I	Tr E	11	51	"	21	III	Sh E	4	54	"	30	I	Sh I	8	58	"
8	I	Oc R	8	58	P.M.	21	III	Tr I	5	48	A.M.	30	I	Tr I	9	20	"
11	II	Ec D	1	30	35.33	21	I	Oc R	6	2	"	30	I	Sh E	11	11	"
11	II	Oc R	5	40	"	21	II	Oc R	9	5	P.M.	30	I	Tr E	11	31	"
12	II	Sh I	7	40	P.M.	21	I	Sh I	12	36	"	31	I	Ec D	6	9	24.33
12	II	Tr I	9	15	"	22	I	Tr I	1	10	A.M.	31	I	Oc R	8	39	"
12	II	Sh E	10	17	"	22	I	Sh E	2	48	"	31	III	Ec D	9	0	48.33
12	II	Tr E	11	48	"	22	I	Tr E	3	21	"	31	III	Oc R	11	43	"
13	I	Sh I	4	13	A.M.	22	I	Ec D	9	46	3 P.M.						
13	I	Tr I	4	59	"	22	I	Oc R	12	29	"						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon.

Ephemeris is for Berlin Mean Midnight = 11h. 6m. 25s. G.M.T.

Day of Month.	Right Ascension.	Declination North.
	h. m.	°
1	8 0.0	42 5.3
6	9 2.0	39 2.4
11	10 2.4	33 34.5
16	10 55.7	26 19.4
21	11 40.0	18 23.9
26	12 16.5	10 42.0

Hence the Comet will travel from the uninteresting Constellation Lynx across Leo Minor and Leo into Virgo.

Shooting Stars

May be watched for during the nights from the 1st to the 6th, and again (more particularly) between the 18th and 21st.

Greenwich Mean Time of Southing of Thirteen of the Principal Fixed Stars on the night of October 1st, 1891.

Star	Souths.
	h. m. s.
δ Aquilæ	6 37 2.65 p.m.
Altair	7 2 27.32 "
α Capricorni	7 28 51.93 "
α Cygni	7 54 42.26 "
α Cephei	8 32 58.08 "
α Aquarii	9 16 47.68 "
Fomalhaut	10 8 3.74 "
Markab	10 15 47.84 "
γ Cephei	10 51 24.51 "
α Andromedæ	11 19 2.12 "
α Canadelpæ	11 50 29.61 "
β Octi	11 54 18.62 "
Polaris	12 33 0.73 "

The Method of finding the Greenwich Mean Time of Southing of either of the Stars in the above List, for any other night in October, is also that of determining the instant of its Local Transit at any other station, will be found on p. 860 of Vol. XXXII. The rules there given,

though, are not rigidly accurate when applied to Polaris and other circumpolar stars, although they are sufficiently so for all ordinary purposes.

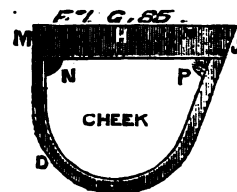
PRACTICAL NOTES ON PLUMBING.

XIV.*

By P. J. DAVIES, H.M.A.S.P., &c.

Making up C-Traps (Fig. 85).

IN the last chapter I have described the planning and cutting of good, reliable,

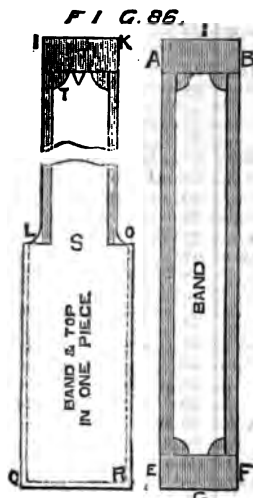


self-cleansing C-traps; the following is a brief description of making them up:—

Having cut out the cheeks and band to the proper size, take the dresser and flatten the lead quite smooth; then place the cheeks and rasp the rounded edges true on to the other in order to have them the same size and square to each other, next soil them all over inside and outside as shown at MDHJN, Fig. 85; the soiling at H should be $2\frac{1}{2}$ in., and at D from $\frac{1}{2}$ in. to $\frac{3}{4}$ in., with the angles NP rounded. Next take a gauge-hook and shave round the inside lin. from M to D and from D to J, touch the shaving over, and do the other cheek. Now take the band, Fig. 86: this is the exact length round the cheek, and the width of a 4 in. dip-pipe drawn to $2\frac{1}{2}$ in. scale. First plane up the edges AEBF to the desired width and parallel. Soil all over the inside, then the outside, as marked out, then take the gauge and shave the inside of the band to the same width as you did the inside of the cheek, but on both sides. You now want

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a "trap-block," which is a piece of 3in. deal, say 18in. long by 1 1/2 in. wide, planed up smooth. It must, moreover, have something to keep it from warping. A good plan is to put two pieces of iron barrel through the centre of the stuff, and near to each end. Next lay the cheek inside upper-



most upon this block, and, with two small clout nails, fix it there by driving the nails through just where the shaving will come when soldering on the top, as at the dots near H, Fig. 85. Take the prepared band and place the end (which, of course, should be square to the sides) to the heel of the cheek at M, and with a 2in. wrought-iron clasp or clout nail just driven nearly upright into the block, say, 1/2 in., to hold it in position; that is to say, the edge of the band up to the heel of the cheek. Now bend the band truly up round to the edge of the cheek, and fix it there by driving a few more nails into the block. Place a piece of board across the top of the band, and a small weight to keep it there, and then solder up the trap, which is done as follows:—First splash on the solder round the joint, and then, with an iron (or if you are quick at soldering you can do without the iron), warm it up by working the point or ball into the solder from heel to out-go of the trap-cheek, then take a small "branch cloth," say, 2 1/2 in. by 2 in. (see cloth table, Chap. 2), and wipe from right to left or left to right, as you choose, but do it at one quick sweep. Some plumbers wipe from about the centre or bottom of the cheek, and do it at twice. So may you; but the former is the quicker, and, as quickness is the principal part in wiping, it must be the best. Having one cheek soldered on, do the other in a similar manner.

Be careful that the heel of the trap is square with the band, and quite true or level; next, shave all round the outside of the top or body at H, Fig. 85, or L, 79, say, 1/4 in. wide, and bore a small hole, 1/4 in. of an inch, as an air-hole, at just about J, or where the out-go will be; this is to allow the air to get into the trap. When it is cooling down after soldering up, this small hole is important, or the sides would be pressed in with the extra pressure of the atmosphere, owing to the interior air condensing as it cools. Now, having the body of the trap all ready for soldering to the top, prepare the top as follows. Take a piece of lead well flattened out, soil over the inside part and edges, also about three-quarters of an inch round the under-side of the edges, which, when soldered on the body, will be the top side. This prevents the solder uniting to this part of the lead while being soldered on. Place the body of the trap on the top, taking care that it is properly fitted, and, with the compasses, scribe all round the top, and 1/4 of an inch farther out, for the solder, as at K M, Fig. 87. Then remove the body, and shave this ready for soldering on. First look after the air-hole, then place the top on the block (which is all the better for being warmed), and splash on the solder. If you are quick you can splash on all round, and get up a good heat and wipe without an iron; but if you cannot do all at once, splash all round and warm up with the iron, and wipe off from right to left, commencing at the out-go corner. If you cannot manage to wipe it quickly enough this way,

splash half at a time and wipe, but leave sufficient solder unwiped to begin again with when replashing, and keep this point in a fluid state; then warm up again with the iron, and finish, taking care to well warm up the solder where you commenced to wipe, so that it will not look rough at this point. Having wiped all round, trim the spare lead off the top, which would be all the better if you have an inch or so; but at any rate, trim it off square and true, or plane it off.

Next is the dip-pipe; this can be put in in one piece, or if you prefer it, in two pieces, by flanging the part that enters the trap, so that it will rest on the top, and make the other to go into this; in fact, make a flange-joint of it, as shown in section at E, Fig. 34. When soldering it in this way, it is necessary to paste some brown paper over the solder below, to keep it from falling off.

Plumber's Paste.

The proper way to make plumber's paste is by mixing a spoonful of flour in cold water, and boiling it in a clean ladle until it is thick; cut the paper in long strips about two inches wide, and soak it before pasting.

Putting the Dip in C-Trap before Soldering on the Top.

This method of soldering on the dip first is far the best plan, if you have a proper trap-block for the purpose, which is nothing more than having a hole cut in it to allow the dip-pipe to drop through; and if you arrange it properly for one trap, you can make the block the correct height for gauging the right depth of the dip that is to say, for 9in. traps, the top of the block should be 5 1/2 in. high—here you may put in the dip-pipe in one piece, or, if you like, you can solder on the dip-pipe from the underside of your top, which will allow the boards to go down with equal thickness over joists, but the evil attached to it is that this solder comes in the way when soldering on the top, and does not look so well.

Badly Constructed C-Traps.

Fig. 87 shows the C-trap not properly made for self-cleansing purposes. You will observe that the dip-pipe is away from the side, and consequently gives room for the fur to collect.



The bottom of the dip at F is also furred over; the principal cause of this is the urine. Even with the best-made traps this is likely to take place. I have an O-trap quite full of this matter; but when plenty of water can be used, and the trap properly constructed, this formation of fur is greatly retarded.

(To be continued.)

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.*

By JOHN WATSON WARMAN,
Associate of the College of Organists, London.

W. FOR Examples actually executed see in the Descriptions;—at 54, m; 57, l; 59, d; and 59, i. Other existing Instances may be studied at the Cathedrals of Amiens and Chartres; and in the Churches at Clamecy, Honblieux of Picardy, Moret, Perpignan, St. Bertrand des Commignes, and Solles Villes (all

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the eight in France); and also at a Church in Nordlingen (Germany).

X. Thickness.—This will never be less than 1/4 in.—pricked for the Frames: the Panels may be allowed thinner.

*** VIEW OF CONDUCTOR or OF MINISTER.

XX. See first what is said under the Head of SCREEN (ref. 83, f).

Y. It will be noted that in the foregoing Descriptions and Treatments of the several portions, &c., of the Case, no mention has been made of a choice of *Clavier Posit* with reference to the Player's obtaining a view of the Conductor or other Official person.

Z. The reason for this is simply that the question is one better left to be fully discussed in the Department of CLAVIERS: for it will be obvious that the consideration of the best Location of the Player must first be settled, and afterwards the proper Treatment of the Organ-Case and its accessories be determined and designed in accordance with such settlement.

ZZ. Other information concerning the View of Conductor, &c., will be given in the Department of ENTIRE ORGAN.

**** CLAVIERS;

Inc. their ATTACHMENT, LOCATION, ORDER, and POSITION. Inc. DUPLICAS, ENHARMONIC and other SPECIAL Forms, and Consideration of INCOMPLETE and SHORT OCTAVES. For the remainder of latter see chiefly in Department of COMPASS.

(Inc. also Involved KEY-ACTION.)

[86, a.] In this Department are included all Forms of the Organ Key-board, whether operated by the Hands or by the Feet, excepting where such Key-board, or any part of it, is employed for actuating some Non Sounding portion of the Instrument,—such as the Bellows, the Stop-Action, or the Swell-Shutters. For such exceptional use of any Clavier see the Departments of BELLOWES, BLOWING-ACTION, STOP-ACTION, SWELL-ACTION, and SWELL-BOX. For COMPASS see c next.

*** ACCESSORY CLAVIERS.

See with DUPLICAS (comm. 114, k).

*** APPLICATION.

See with DESCRIPTION (comm. 95, e).

*** ATTACHMENT.

See with DESCRIPTION (comm. f, next).

*** AUGMENTATION BY CLAVIER.

b. This is a Contrivance for adding at pleasure the Common or other *Chord* to any Key put down by the Player. It is difficult to imagine how any reasoning being could ever have seriously imagined that such an expedient could be of practical utility. The Device has been Patented, and the Description can therefore be obtained from the Specifications, which are:—F. Guichéné, A.D. 1855, No. 1545; and A.D. 1856, No. 22: also A. Deban, A.D. 1860, No. 2,540.

*** BASIS.

See own Department (comm. 3, u).

*** CLAVIER-WARMERS.

c. This, as its name indicates, is a Treatment for Warming the Key-board, so that the Organist shall not have his Extremities chilled when playing in an Apartment or Building which is not itself warmed. The Clavier-Warmer, which may be applied to the Pedal-board as well as to the Manual, consists simply of a suitable Reservoir, placed as near to the Playing portion of the Key-board as is practicable, and having Steam, or Hot-Air or Water contained in or passing through it. This idea has also been Patented,—by G. Price, A.D. 1868, No. 1615.

*** COMPASS.

cc. To this a separate Department (comm. 119, s) has been devoted: some additional matter will, however, be furnished in the present one, under distinct Heads of Manual (see p next), and Pedals (see 95, u).

*** DESCRIPTION AND CHIEF ADMEASUREMENTS.

d. Here will be given sufficient of general *Description and Dimensions* for conveying to the workman a clear idea of the Models enjoined,—leaving the more minute Treatment—that is to say, the exact Working Directions—for the future *SUB-PART DETAILED*. It will, however, be found that even in the present *Department* the matter given is fuller and more particular than is the case in several other parts of the present Treatise; and the reason for this lies in the very great importance of all *Clavier* portions of the Instrument. (See here more fully under Head of *PEDAL-BOARD*, at 94, q.)

** MANUALS.

e. The Descriptions here given of the *Manual Clavier* will be rather slight, because its Types usually vary so little, except in small matters, and their forms are so very well known. And it should be always remembered that the present Key-board is positively simple in its nature, compared with that of the *Pedal-board*,—with its Scale, Model, Radial-Length, &c., so much and so constantly varying.

ee. It must also be borne in mind that the Construction of *Coupling-Actions* is involved in the Designing of the Manual, in respect (1) of the Wedge on the Key for Coupling by Sliding Sticker or other part of Action, (2) of the Shifting or Moving of an entire Key-board, and (3) of virtual extension of the Clavier Width for the obtaining of Keys for the working of the Stop-Action. The last named is a Device not naturally often employed. See further on all these matters in the *Departments of COUPLING-ACTION and STOP-ACTION*.

* ATTACHMENT.

f. There are Four distinct Treatments of Attaching or Fitting the Manuale to the main Body or Case of the Organ. These four are by *Folding or Dropping*, by *Fixing*, by *Sliding*, and by *Hanging or Hooking*.

ff. A *Folding Manual* is one which is so Hinged or Pivoted, at its corners farthest from Player, that it admits, when not required for use, of being Turned and Folded upward and backward, so as to remain perpendicular, and either form a portion of the visible Case-Front, or admit of being Closed in by a suitable Door, in the usual way (see 74, b). An *Example* of the Folding Manual, with the last-named method of Closing, occurs in the small Organ built by Henry Pilcher for Mr. E. Stone, of Canterbury, and still (1881) in the possession of the latter gentleman.

g. A *Fixed Manual* is, as its name implies, merely one which is permanently fixed in its position,—the Closing up of its Keys therefore requiring to be done by means of some separate piece of Construction. *Examples* of such Manuals are too numerous to call for any particularisation under present Head; the reader may if he pleases here look at what was furnished in *Depart. of CASE* (comm. at 72, r.)

h. A *Sliding Manual* is one which is so constructed and fitted as to admit of Sliding back, when not in use, into the Body of the Instrument: the Opening through which the Key-Frame passed being then Closed by a Door or Flap, generally Hinged, and of the same kind as may be employed with the Folding Manual (see again 74, b), the appearance of the Case becomes restored, and the Clavier is at the same time secured from interference.

i. *Examples* of the Sliding Manual were formerly common in small Organs; one of the largest possessing such, so far as present writer has seen, being the Instrument standing some years ago (and perhaps remaining to the present time) in the New Congregational Church at Margate, Kent. There is I have reason for believing, a specimen of a *Two Manual Organ* having its Manuals Sliding, in the possession of Dr. Wm. Huggins, of Upper Tulse-Hill, London: but it needs hardly to be observed that such a Treatment is never to be recommended.

j. The *Hooking Manual* is a Device of the present writer's. Its object is to avoid the taking up of the room still demanded by the *Projecting Fixed Manual* when no longer in use, and at the same time to dispense with the necessity for leaving any space inside the Organ for the Keys to Slide back into. The Treatment consists simply in making and fitting the Manual to

Hang or Hook on, at its exact proper point, to the Front or other desired portion of the Organ-Case,—the *Key-Tails*, and sometimes the *Key-Frame* also, entering such Case for a short distance. On the removal of the Manual the Opening thereby left must of course be Closed up in the usual or some other suitable way.

jj. No *Example* of the *Hooking Manual* yet exists, so far as the author is aware.

k. *Selection of Method of Attachment*.—The *Folding Treatment* may be dismissed at once: while occupying as much space inside the Case—or nearly so—as is demanded with the *Sliding Arrangement*, the *Folding* is the more inconvenient of the two, because the provision of the necessary space for it will generally involve a curtailing of the Width of the *Soundboard*.

l. The *Fixed Manual* gives the best arrangement under all *Normal* circumstances, and it should therefore always be adopted by preference: it should, in fact, never be departed from except where room is really and unavoidably confined; and even then the treatment must still be adhered to if the Organ do possess more than one Manual (see i ante). The actual determination of the question of whether the Manual shall be a *Fixed* or a *Movable* one will thus be decided by the requirements and conditions as respects the room or space available in each particular instance,—always bearing in mind that with sufficient care and proper construction the *Movable Manual* presents a quite *practicable* and *safe Treatment*, as is proved by dozens of existing Specimens.

m. The *Sliding Manual* has the advantage of being, so soon as it is pushed in, safe out of harm's way; and it is also quite easy to place into action,—the simple drawing forward being all that is required: but the space it demands within the Organ-Case is a serious drawback. For a Form of *Cheek-Finish* suitable to the *Sliding Manual* see with *Description* (at t, next).

n. The *Hooking Manual* of course avoids the disadvantage last named; but is, on the other hand, somewhat liable to be damaged, unless put into some secure place, while separated from the Body of the Instrument. There exists also a certain amount of both risk and trouble in either Attaching or Detaching a Clavier of this kind.

o. When, through Confinement in Space, it becomes necessary to resort to one of these last two forms of Attachment, it may be considered that the *Hooking* is the Treatment to be preferred, if such Confinement be in the direction of *Height*; but that where the clear Pitch of the Apartment is as much as, say, 9ft. (the Confinement being in the matter of *Area*), the *Sliding Method* has the fewer disadvantages.

oo. See further concerning Selection of Manual Attachment, in *Pro-Department ENTIRE ORGAN*, under Heads of *Treatment of Chamber Instruments*.

* CENTRING.

See with KEYS (at 88, h); and DESIGN PRECISE (at 89, h).

* COMPASS.

p. This has already been stated to be chiefly given in its own *Department* (comm. at 119, a). It will be presently seen that G³ is to be advocated as the top note of the Manuale under all normal circumstances. The question of the best bottom note for both Manuale and Pedale is especially gone into in the said *Department*.

(To be continued.)

ON A NEW SYSTEM OF BLOWPIPE ANALYSIS.*

By LIEUT.-COLONEL W. A. ROSS (late R.A.)

(1) The Use of Aluminium Plate for Volatilising Substances.

VOLATILE metals and sulphur compounds, &c., are, in the old system, treated before the blowpipe, as is well known, upon the support of a parallelopiped of charcoal held horizontally in the direction of the blast from the blowpipe, the disadvantages of which are: (a) that black sublimes as those now known to be obtainable from arsenic, antimony, lead, &c., are undistinguishable on the

black charcoal. (b) The greater part of the sublimate from most volatile metals is blown away by the blast—a serious objection when, as is often the case, there is only a trifling proportion of such metals present in a mineral or compound. (c) When the charcoal becomes incandescent, the most interesting portion of the sublimate (that next the assay) is often thus resublimed and lost. (d) The white charcoal ash is so mixed up with sublimes as often to conceal them, and, in cases of minute quantities, to mislead the operator into supposing there is a sublimate at all. (e) In the treatment of a compound containing two or more volatile metals, sulphides, or oxides, the sublimes obtained therefrom are mechanically, and perhaps sometimes chemically, combined, and then cannot be separated so as to be distinguished from each other, by means of the blowpipe or in any other way at the time, on the spot. (f) It is impossible to obtain a blowpipe sublimate from charcoal free from the silica, &c., of the ash, by scraping it off for supplementary examination. (g) Most charcoals, after blowpipe treatment for any length of time, split up into cracks and deep fissures, into which the sublimate or the assay falls and is lost.

Here are several objections to the use of charcoal as a blowpipe support; most of them serious, some fatal to a thorough pyrological examination of volatile substances; and yet it has obtained ever since Von Swab invented the chemical employment of the blowpipe in 1738 (in which year he thus treated an ore of zinc at Dalarne in Sweden), and is still used at Freiberg.

In 1869 Napoleon III. had offered, or I understood him to have offered, a premium of £1,000 to any one who could discover an efficient solder for aluminium, and being then on sick-leave in India, I thought of employing my leisure in attempting this discovery.*

After investigation, I imagined (from burning my fingers so often) that the reason an aluminium solder could not be made was the enormous heat-conducting powers of the metal, which transferred the heat from a blowpipe-flame so quickly away over the entire substance of a fragment of given bulk, that no one part of it could be raised to the fusing-point, so that, although small portions of almost every other metal or alloy could be readily fused upon it, even the most fusible, such as antimony, bismuth, &c., could not be made to combine with the aluminium.

As I had then studied blowpipe analysis on the Freiberg system for ten years, it was obvious to me that, although I had no chance of obtaining the £1,000, the facts thus ascertained might be utilised so as to make aluminium plate or foil remedy in part, at all events, the disadvantages above described of charcoal as a blowpipe support.

I found that arsenic, antimony, bismuth, &c., the fusion of the smallest particle of which upon platinum is so fatal to it, could be treated without the slightest danger before the blowpipe upon aluminium, which metal also, probably from the reason above given, withstood heat concentrated upon any point, in direct proportion to the bulk of the fragment used as a support.

I found that some volatile metals, as, e.g., antimony, would not yield a sublimate when treated before the blowpipe upon the bare aluminium plate, but readily did so when a small slip or lozenge of charcoal was placed between the assay and the aluminium. Here, then, was a rapid and effectual means of separating the pyroxides or sublimes obtainable from a compound, for instance, of antimony and arsenic; the latter subliming readily upon the bare aluminium plate; the former only after treatment upon a charcoal slip.

The horizontal charcoal support was, of course, changed into a perpendicular one, in direct opposition to the blast from the blowpipe, so as to catch all sublimes of every kind; the grey-coloured, shining aluminium betrayed at once the faintest sublimes, whether black or white; these, again, could be readily treated by the oxidising or reducing flame of the blowpipe on the aluminium, where they thus afforded, in most cases, new and characteristic reactions; the perpendicular aluminium could be graduated by a scale showing the different specific gravities of sublimes by their mean ascension on the plate, unacted upon by the blast as in the case of charcoal; and finally, any portion of a sublimate could be easily and cleanly scraped off with a penknife, so as to be afterwards examined in any way desired.

Another advantage I found, referrible, I presume, to the same cause (of superior heat-conduction in the support) is that the alkaline carbonates, so often used in blowpipe analysis, as in the detection of manganese, for instance, assume, when treated before the blowpipe on aluminium, a globular

[* After the paper was read, Professor — asked Col. Ross if he had discovered a solder, and he answered on the spur of the moment that he had not; but we are informed by him that on one occasion last year (1880) he actually did succeed in soldering two small pieces of aluminium together, and that he has a description of the process in his notes.—Ed.]

* Paper read before section B, at the recent meeting of the British Association at York.

shape, and that the resulting bead or ball of sodium or potassium carbonate, can be readily picked, when cool, off the plate with forceps, instead of lying in a kind of pool and sticking to the metal as they do in the case of platinum foil.

To other uses of aluminium plates, as in flattening blowpipe beads and their contents for microscopical purposes, I have not time to allude.

2) A New Air-Reservoir Mouth Blowpipe (Called by me a "Pyrocone.")

A member of the Royal Geological Survey of England told me in Jermyn-street, that he believed many geologists and mineralogists were deterred from using this important little instrument by the trouble if not difficulty of blowing, and for a long time I tried to discover some means of obviating this difficulty in vain. At last, one day, in the Zoological Gardens of London, looking reflectively at the antics of some anthropoid types of our ancestors there, I could not help feeling a kind of regret that the process of "Natural Selection" should have eventually deprived my race of the pouch under the jaw, no doubt at one time possessed by them, which would have served so admirably as an air-reservoir in using the blowpipe, and it suddenly struck me that I could partially remedy the defects of specific development in this matter, by applying an elastic air-reservoir of indiarubber to the ordinary mouth-blowpipe.

Here is the result. I have made it of a simple tube-like form, instead of the usual tapering one, as seen in Black's blowpipe, because I had to adapt it to be packed in a cigar-case like this, the only way of effecting which was to have it in a telescopic arrangement, opening and shutting thus: and this arrangement had another advantage, that, namely, of adapting the length of the instrument to the differing optical focus of differing vision.

For the jet I took Wollaston's ingenious idea of passing the stem of the blowpipe through the arm of the jet; only instead of doing that, it suited my purpose better to pass the jet through the stem of the blowpipe thus. Of course, in either case, the inserted tube must fit air-tight—an easy matter to effect. Over the throat of the mouthpiece is tied a piece of oiled silk which acts as a valve, preventing the return of the breath into the cheeks. In this manner all difficulty in blowing is entirely removed, and even a child can use this blowpipe, because all he has to do is to blow through the valve till the air-bag is filled; then he can stop until the pressure of the blast begins to slacken, when a few more breathings will refill the bag. The blast pressure from the bag may also be increased by the operator placing it between himself and the table, and gently pressing the bag with his body, which he can easily do while using this apparatus.

I have only to add that, as you observe, the jet and air-bag fit for packing into the tube of the blowpipe itself, for which purpose there is no necessity, as in the one I have here, to make the end screw off, as all one has to do is to draw the telescopic arrangement out altogether, and, slipping in the jet and bag, to shut it up again; this, of course, would make the article cheaper. Griffin makes them (with the screw end) for, I believe, half a crown, but, of course, any ordinary mechanic could make such a blowpipe for himself for a few pence.

(3) The Pyrological Candle.

I begin a brief description of this fuel with the remark that it is practically impossible for the traveller to use gas of any kind—not even petroleum gas—as fuel, on account of the difficulties of carriage. The same remark applies, but in another way, to oil of any description. A bottle of this is no doubt easily carried, but is very apt to leak at the cork, and so to spoil any or most articles near it in a box.

Considerations of this kind led me, in 1871, to look to the modern composite candle as a substitute for the Berzelius blowpipe lamp, supplied with Plattner's Freiberg apparatus, which I had used for twelve years. The candles then used for blowpipe operations were, indeed, in no respect different from those used for illuminating purposes. How Von Engeström, Bergmann, and the more modern pyrologists who are said to still use common candles for blowpipe work, contrived to do anything useful with them, I fail to understand. With even a small wick in the centre of the candle, which, of course, must be turned on one side to prevent it from stopping the blast, the heat radiation from the blowpipe-pyrocone melts the tallow or wax from that side more rapidly than the remainder of the circumference melts, so that a deep channel is soon formed, down which the fluid fuel runs, leaving the wick "high and dry." The consequence is that the pyrocone becomes "thready," from the burning of dry carbonaceous particles eliminated from the wick, and when it is cut down a mass of unconsumed tallow almost covers it at one side.

I therefore adopted the plan of having the candle made with a thick, and even double, wick, placed at one side instead of in the middle of the

fuel, and in order to supply more of the latter, I had my candles made a prismatic instead of a round shape. I placed a thick collar of a good conducting metal, such as zinc, round the edge of the candle, just under the wick, in order to conduct away and diffuse through itself the vibrations of heat. At first I had a series of these metallic collars, and proposed to remove them as the candle burned down; but I afterwards found that one or two good thick zinc collars would be sufficient.

Here is a candle from my cigar-blowpipe case which I am at present using, and another unused one, as made for me by Price and Co. of Battersea.

(4) Candle Scissors.

In Plattner's apparatus, scissors are supplied for cutting the lamp-wick, which of course can also be used for other purposes, and also a pair of pliers for squeezing the wick together, and pressing it in any direction; these latter cannot be used, from the dirty state into which they get, for anything else. I use these two articles combined into one—i.e., a pair of ordinary scissors with knobs at the end. This also goes into my cigar-blowpipe-case.

(5) Ordinary Watchmaker's Pliers

with a piece of wire-strapping round them, to enable them to act as holders of platinum wire supports, and they also act as the best cleaners of the wire by drawing the latter from between the pressed flat sides.

(6) Two Agate Slabs for Grinding Powders.

I have here got instead, a small Freiberg agate mortar, with a pestle made from an agate pen, as I had no slabs small enough to pack away in this cigar-case.

(7) Reagents. Boric Acid.

It has always seemed to me as though blowpipe-workers, or, as I call them, "Pyrologists," could no more profess to begin analytical operations by using a salt as reagent, than the analytical chemist could say he intended to begin his solution-work by using sodium nitrate instead of nitric acid. By employing boric acid instead of borax, therefore, in 1869, I at once obtained a series of new, very pretty, and important reactions, especially in the case of the alkaline earths, which formerly used to be the weakest part of blowpipe analysis; now, they are one of the easiest. Space and time do not allow me to describe these reactions here; and, unfortunately, I have brought no boric acid with me here in order to illustrate them; but here is a little German-silver cigar-light box in which the acid is kept, as it does not thus deteriorate. This also goes into the cigar-case.

Phosphoric Acid is another of my new reagents (when I say "new," I mean that they are now 12 years old, but new in the sense that they have not been as yet generally adopted.) I use it instead of the old reagent "microcosmic salt." It affords, with several oxides before the blowpipe, new and interesting colours, as in the case of cobalt oxide, which imparts to it a very fine and pure violet instead of the ordinary blue. Of course, when a sufficient quantity of soda to form metaphosphate of sodium, or microcosmic salt after the ammonia has been driven off, has been added, the bead becomes blue, and this fact enables it to be used as an alkaliometer. It is the only reagent which requires to be kept in a stoppered bottle; and is such a powerful acid before the blowpipe that gold leaf is rapidly dissolved in it, yielding a brilliant purple bead. It affords, with iron oxide, a bead the colour of watery blood. This ends the list of things packed in the cigar-case.

(8) A Compass in which the Needle points E. and W.

This is made by bending an ordinary magnetised needle in the centre until the points are opposite, like a lady's hairpin. It is, in fact, an ordinary horseshoe-magnet suspended, and such a magnet suspended swings E. and W. for a very obvious reason. It might prove useful in Arctic voyages, as such a needle would probably possess little or no "dip." If you bend an ordinary magnetised needle at a right or any other angle, and suspend it from or on its centre of gravity, a line bisecting the angle will point E. and W., and it was such a needle I first made in order to find a very delicate test for traces of iron in ores. The more open or obtuse the angle, the more delicate this test is. I call it the "Equatorial Needle." With a right-angled equatorial needle, you can detect the mere trace of iron in the ore *Molybdenite*.

(9) An Alloy-Button of Gold and Silver in which these Metals have been partly Separated by the Blowpipe alone.

Many years ago I found that, if you heat an alloy of two or more metals very gently with the blowpipe, so as not to promote fusion, in which case the ball spins round, and all the component metals are mixed again—that one nearly pure metal invariably

leaves the others, and approaches the source of heat. This is a case of gold and silver alloy, in which the silver has approached the source of heat, but the process can be admirably illustrated in the case of a common bronze pin, in which the tin approaches the source of heat, while the copper remains in the background. Such a process might obviously be found useful in metallurgy on the large scale.

A SIMPLIFIED READING MICROSCOPE FOR HORIZONTAL AND VERTICAL CIRCLES.*

By M. HENSOLDT, Optician, Wetzlar, Germany.

THE application of the compound microscope, in combination with a micrometrical screw for correct readings of divisions, is an excellent means for obtaining accurate measurements. Not alone its far greater power in comparison to the ordinary magnifying glasses in use for reading off verniers, confirms its superiority, but also through the fact of the verniers with their errors, and their frequently-occurring parallax (which latter is an especial source of errors) becoming unnecessary, a far greater accuracy is effected.

In the case of larger, especially astronomical, instruments, the microscope, therefore, has been almost universally adopted. But for instruments of medium size, such as theodolites of from 12 to 20 centimetres (5 to 8 in.) limb diameter, they are partly too expensive, partly rather inconvenient, as regards transport, especially on account of the projecting micrometrical screws, and the often considerable length of the microscopes.

For a long time I, therefore, sought for a means of making the microscopic reading in a simplified manner, likewise applicable for transportable instruments of medium size. To effect this, it became first of all necessary to reduce the length of the microscope as much as possible, and to do away with the micrometrical screw. My first idea was to place, instead of the latter, a vernier, direct into the microscope—viz., to divide a glass micrometer as a vernier. Could the field of the microscope be extended to such a degree as to comprise, say, from 20 to 25 millimetres ($\frac{1}{2}$ to 1 in.), the transmission of the vernier into the microscope would be practicable; however, such is not the case. Only a few degrees of the division are visible at a time, and the fewer the stronger the magnification. It would, therefore, become necessary to have a very minute subdivision of the circle; for instance, in the case of 15 cent. (5 in.) limb diameter, in 1-6th degrees. Of these, it would be well possible to divide nine intervals ($1\frac{1}{2}$ deg.) into ten, by means of the micrometer, and thus to obtain readings of up to one minute, and by mental subdivision, perhaps, even to thirty seconds. Such a detailed subdivision would, however, be quite out of proportion with the result obtained. Besides, the microscope would still only be able to bear a very low power to permit a complete survey of the vernier.

I, therefore, came upon the idea to divide only one interval of the primary or circle division (which, in this case, does not want to be so detailed), by means of the micrometer, into a number of equal divisions, and to divide each of these secondary intervals mentally into ten parts.

This would by no means presuppose any very special skill in estimating with the eye on the part of the observer; but anyone who does not possess it already, could easily acquire this ability after a little practice, as it is also useful and necessary for numerous other purposes. In a very short time the observer would be sure not to misjudge one-tenth; he would not be in doubt whether to take, for instance, 0.3 or 0.4, and would not put 0.7 for 0.6, or 0.8. Soon he would even be in a position to judge whether an interval, taken as 0.3, would be too small, and as 0.4 too large, and would more accurately put 0.35, 0.34, 0.36, of which I have sufficiently convinced myself by my own experience, as well as that of other observers. But I will here merely take it for granted that it is not possible to misjudge one-tenth, and will draw attention to the fact that, at present, all telescope-levels, range-finders, &c., are constructed for direct reading, and that the tenths of the intervals are likewise obtained by mental subdivision with almost absolute accuracy.

I would particularly wish to point out that, especially in the simplicity of my method, and in the small number of gradations in the micrometer a chief advantage consists, as it permits an easy, rapid, and accurate reading, which does not occupy so much time as in the case of verniers, and that I consider a further direct subdivision of the micrometer impractical and only confusing.

Now, if a circle is divided *f.i.* in 1-6th deg., or from 10 to 10 minutes, and the micrometer is made to consist of ten equal gradations, which

* Translated from "Zeitschrift für Vermessungswesen," Vol. VIII., Heft. 10, Stuttgart, 1879 (the organ of the Society of German Surveyors, edited by Prof. Jordan).

...with a means of controlling the perform-
...with the utmost exactness,
...revealed by the micro-
...account in the calcu-

...the index arrangement above-
...superfluous, the firm
...every single degree of
...small figures, so that
...the angles can be di-
...which is exceedingly convenient

...I need scarcely remark that my
...in the same manner, applic-
...method.

WILHELM KUNZ, 1877

M. HENSOLDT.

...the author of this article, I
...method of reading
...position of the
...by two observers,
...table of ten such
...degrees and one-
...be read off
...is inessential, and
...are expressed in units of the
...old di-

Observation	Difference.	σ .
1	0.0	0.00
2	0.1	0.01
3	0.0	0.00
4	0.1	0.01
5	0.1	0.01
6	0.1	0.01
7	0.1	0.01
8	0.1	0.01
9	0.1	0.01
10	0.1	0.01

$$\text{Mean error of the reading} = \sqrt{\frac{0.07}{20}} = \dots$$

...and as one part of scale =
...we have: mean error of reading
...division.

...of the trials it is to be
...constant errors of this value
...are neglected.

WILHELM KUNZ, 1877

JORDAN.

...to the above, we give, in the follow-
...of two other measurements taken
...of this construction.

OBSERVERS: PROF. DR. HELMERT, OF AACHEN
(AT-LE-CHAPELLE).

Measurement of the angle between the two ver-
...with readings on differ-
...in the divided circle.

(The degrees are omitted.)

1	2.1	0.01
2	2.1	0.01
3	2.15	0.04
4	2.0	0.11
5	2.15	0.04
6	2.1	0.01
7	2.1	0.01
8	2.15	0.04

Mean = 2.100.

The mean error is thus = 0.05', which amounts
...for one angle measurement.

...the right-error out of consideration,
...accuracy of a microscopic reading is hereby
...expressed. Namely, the mean error of a
...reading is also = 3.0, or 0.025 double
...—that is, 1-40th of one micrometer inter-

OBSERVERS, MESSES KLUTMANN AND PIETRS.

Subject is the angle Lochner-Jacobi on six por-
...of the divided circle. In each two measure-
...with right and left-hand lines.

4.95	0.02
4.95	0.02
4.9	0.07
4.9	0.03
4.9	0.04
4.95	0.02
4.95	0.01
4.9	0.08
4.95	0.03
4.9	0.02
4.95	0.07
4.9	0.07

4.955

The mean error for a measurement of angle, or a
...reading, is = 0.054' = 3.2'.

The maximum error is, in the first case 5', and
...in the second also 5'.

...of medium size.

MECHANICAL DRAWING.—VII.*

By PROF. JOHN E. SWEET.

(Continued from p. 53.)

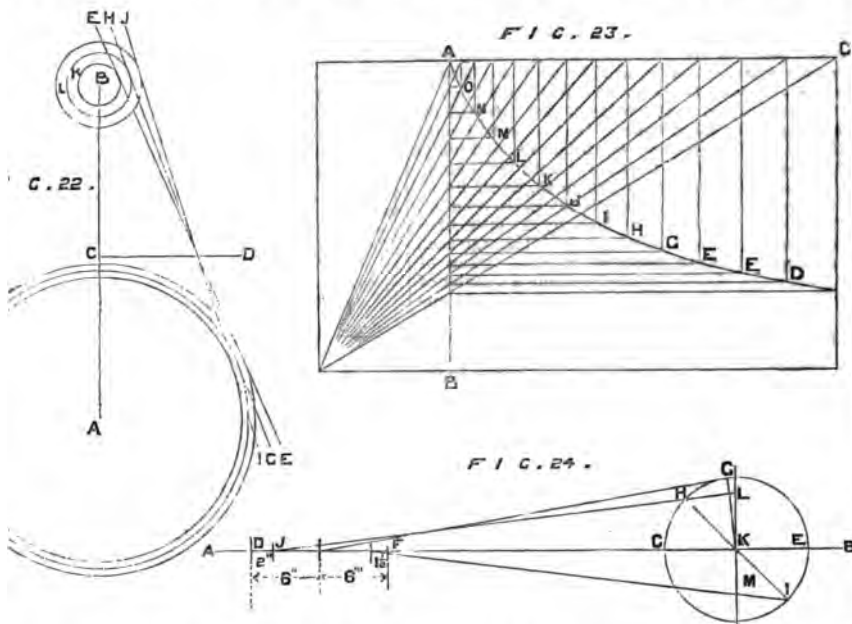
Pulleys, Expansion Curve, Effect of Connecting Rod on Crank.

consideration of the subject of the proportioning of cone pulleys, left incomplete in article, it was assumed that the counter-weights were several feet from the lathes, and that the were of nearly the same size. When the on one shaft are quite large, and those on r small, and where the shafts are not far s is the case in a foot-lathe, then another

pin would be at D, and when at E the cross-head pin would be at F. When the cross-head has moved half way from B to F, the crank would be at G only. With a crank moving at a uniform rate, it will be seen that the cross-head must travel faster at the end farthest from the crank, for when it has moved one-eighth of a revolution from G to H, the cross-head will have moved 2in., whereas where it has moved one-eighth of a revolution, from E to I, the cross-head will have moved but 1½in. only

If the same power be applied to the cross-head in each case, there would not be the same tendency to rotate the crank when at I as when at H. To determine what that difference is by the aid of the

the way, and is ready for use at a moment's notice, besides, it does not occupy unnecessary room, and is also handy in setting the tool to run a finishing cut over several pieces of work to be of equal diameters. Referring to the illustration, A represents the carriage of a lathe, E the screw for adjusting the tool, being operated by the handle upon the end. The device referred to consists simply of a brass or iron collar, C, neatly fitted upon the thimble, B, upon the end of the screw. A single line is cut upon the collar to coincide with a similar one upon the carriage at D. In cutting screws the tool is set and a cut run over the work, and while this is being done the workman rolls the collar, so that the mark upon it stands a little behind the mark at D, corresponding to the distance the screw must be advanced to take the required cut, as shown in the cut. After the tool has passed over the work, the carriage is to be run back and the screw turned, so that the marks coincide when the second cut is taken. This operation is to be repeated until the thread is cut to the required depth. By putting a single mark upon the thimble upon the screw, and graduating the edge of the collar C next the handle, this device is made even more useful. These advantages will readily suggest themselves to the lathe-hand. I used one of these devices upon a lathe a number of years ago, and at present have one upon my foot-lathe. I like it very much, and would not part with it. Such is the statement of all those with whom I am acquainted, who have used them.



the angle of the belt, enters into the proportion in this case, as will be seen by reference to the step, or amount one pulley is larger than the other is greater in the upper cone than in the lower one. This is necessary in order that the belt be equally tight in all positions. Fig. 22 shows a graphic method of determining the sizes re-

ould advise my apprentice friends or students about for an old foot-lathe wheel, or small wheel, to run with it. In Fig. 22 it is shown that the size of the different lifts of the wheel are known and represented by the circles below, and that the distance between the centres of the shafts is known. Draw the line A B, and set off the centres of the two wheels the proper distance apart, either full size, or scale. Strike the circles of a size to correspond to the wheel or pulley that is already made. Lay a line between the centres of the two shafts, and draw a horizontal line C D. Determine the size of the steps of the wheel or pulley desired, and draw a line to represent the belt E F. Strike vertical lines, G H and I J, so as to just strike the two circles and to cross the line C D at the same point. Circles K L, drawn so as to strike these lines, will give the size of the pulleys required. This method is not entirely correct, but the error is so slight as not to be noticeable in using the ordinary leather

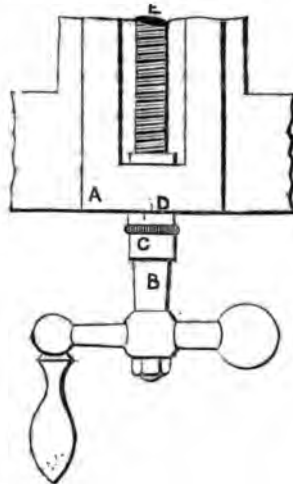
23 shows a method of drawing a very useful diagram. First, draw the four lines bounding the figure of any size or proportion. Then draw the vertical line A B near one end. Divide the line A to C into a number of parts of equal size. From these points, strike vertical lines, and diagonal lines to the lower opposite corner. Where the diagonal lines cross the line A B, strike a series of horizontal lines. Through the points where the vertical and horizontal lines join, strike vertical lines, and so forth, strike the curves. This diagram is good practice; its use can be learned and understood when the use of the engine indicator is mastered.

24 illustrates some of the peculiarities of the connecting rod, pitman, or shackle bar of a steam engine. Strike the circle to represent the crank, which we may assume to be 12in. in diameter, drawn full size or to any scale. The line B, passing through the centre, gives the motion of the travel of the centre of the cross-head. When the crank is at C the cross-head

diagram, is a very simple matter. Continue the line J H through to the vertical, and as much greater as the distance from K to L is greater than from K to M, so much greater is the rotative effect when the crank is at H than at I. And, too, this is a simple way of determining the amount. One hundred pounds applied to the crank, when at H, will have the same effect as if applied to a crank at L. For the last two of these diagrams, I am indebted to Jesse Warrington, formerly of the Buckeye Engine Works, whom I believe to have been the originator of them.

SIMPLE SCREW-CUTTING DEVICE.

The accompanying diagram illustrates a very simple adjunct to a screw-cutting lathe,



which is used to a very limited extent in only a few shops in this country, says Mr. L. F. Lyne, in the American Machinist. The gauge screws, as applied to lathes for indicating the depths to which a thread tool should be set, and also the other devices used for the same purpose, each have their particular advantages. But all of them require more or less adjustment before they are ready for use, besides being more or less in the way in doing general lathe-work. The device here shown is entirely out of

THE SCIENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING.—VII.*

By Professor W. GRYLLS, ADAMS, F.R.S.

(Continued from p. 58.)

Subdivision of the Electric Current—Incandescent Lamps—Luminous Effects of Electric Currents in a Vacuum, and in Various Gases.

Crompton Lamp.

THE carbons are brought together by means of the weight of the upper carbon holder, as in the Serrin lamps. The carbons are controlled by means of an electro-magnet, of which the principal armature separates the carbons, and a light secondary armature is arranged on the back of the large one, and does the more delicate work of bringing the carbons together. The large armature supports the negative or lower carbon; and when the small armature has brought the carbons together, so that a current passes, the large armature separates them to the proper distance apart for a good light. When the arc is broken, the armature, supported by a spring, is raised, and brings the carbons into contact, and relights the lamp. The small variations in the strength of current react on the second armature, which is held at some distance above the large armature by a light spiral spring. The small armature carries an arm, which is applied as a brake to a brake-wheel, which is the last wheel of a train of wheels, set in motion by the weight of the positive carbon-rod.

Regulator in Brush System.

A very pretty arrangement for shunting the current past a lamp (when it is not in use), so that one lamp may be put out without affecting the other lamps in the circuit, is adopted on the Brush system.

The current passes through a solenoid coil, wound with thick wire, and then passes to the upper carbon, through the arc to the lower carbon, and then by the frame to the next lamp. The solenoid holds up a rod of iron, which tilts a ring on one side, through which the carbon passes, and so locks it. To the end of a thick wire of the solenoid is attached a thin wire (150 ohms), which is also wound on the solenoid, and which forms a shunt or by-pass to the arc, taking more and more of the current as the resistance of the arc increases. This thin wire is wound the opposite way, and the current in it relaxes the hold on the carbon, so that it falls slowly, and then takes more of the current. As soon as it does so, it is again held fast. To prevent the carbon from falling too rapidly, it is passed through a vessel containing glycerine, and slides downwards very slowly. The current through the thin wire also passes through another solenoid, which forms a shunt or by-pass to the whole lamp, so as to take all the current past the lamp if it should get out of order. When a considerable current flows by this path, i.e., if the arc becomes an inch long, so that its resistance is greatly increased—the second solenoid draws up a piece of iron which lets all the current pass, and the lamp is thrown out of the circuit.

In the Brush lamp, which is designed to burn 16 hours, there are two pairs of carbons, with the rings on the upper carbons, which hold them by

* From the American Machinist.

* A series of "Cantor Lectures" delivered this year before the Society of Arts.

friction, so adjusted that one is held about one-fourth of an inch above the other, and, therefore, the second carbon will not come into action until the first falls or is burnt out.

All the electric candles, such as the Jablochkoff candle, the Jamin candle, the Wilde candle, and the De Meritens candle, consisting of three carbons, are fed by means of alternate current machines, because it is essential that the two carbons should burn away equally. In the Jamin and the Wilde candle the carbons are at first in contact, but when the current passes, one of the carbons is separated from the other, because its holder is set on a hinge, so as to be acted upon by a small electro-magnet through which the current passes.

M. Joubert has found that it is necessary, in order to keep the arc steady with the Jablochkoff candle, that the alternate current in the circuit should have a mean value of eight or nine webers, and that below five webers the arc cannot be kept alight; between the bases of the two carbons forming the candle there is an electromotive force of 40 or 50 volts. The Jablochkoff candle uses up about 66 kilogrammetres of work, of which 33 kilogrammetres, or 4.6 h.p., is converted into heat and light.

When the arc is produced in a magnetic field, either by disturbing it by an electro-magnet, or by placing a frame around it, as in the Jamin candle, it is necessary to have a current half as large again as when the electro-magnet is not in action. One-third of the energy of the current is in such a case spent in producing a strong magnetic field around the electric arc, and is, therefore, so much wasted energy, as far as the electric light is concerned.

When gas was first introduced extensively for lighting purposes, many objections were raised to its use, and among them was one which was recorded by Clement Desormes, in 1819, which is summed up in the following quotation:—

"The light is of a disagreeable yellow colour, entirely different from that red and warm gleam of oil-lamps; it is of a dazzling brightness, its distribution will be impossible and irregular, and it will be much dearer than oil lighting, and even if it should be improved, it will still remain much dearer than those lights which we already possess."

Just as Desormes had become accustomed to the red gleam of oil-lamps, and objected to the coldness of the yellow gaslight, so, a year or two ago, a similar objection was raised against the electric light, that it was entirely different from the yellow and warm gleam of gaslight; that it is of a dazzling brightness; that its distribution would be impossible and irregular, and that our streets would be left in darkness.

These objections do not seem to be so strongly taken up by the public as they were two years ago, for they have seen several trials of the electric light; and although there are many difficulties in the way, yet the fact that the electric light has all the colours more uniformly blended, and is, therefore, a whiter light than gas, and enables objects to be seen in their true colours, can hardly be urged any longer as an argument against its use. The same argument might be used for the same reason against bright moonlight, or against the light of day, and in favour of a yellow London fog. The Kyrle Society, in its search after truth and beauty, must surely be strong supporters of the spread of the electric light.

If we turn to the Report of the House of Commons, we find the following statement:—

"A remarkable feature of the electric light is that it produces a transformation of energy in a singularly complete manner. Thus the energy of 1 horse-power may be converted into gaslight, and yield a luminosity equal to 12-candle power. But the same amount of energy transformed into electric light produces 1,600 candle power."

The experiments of Mr. Sawwender, of Dr. Hopkinson, and of others have shown that, both with the Jamin machine and with the Gramme machine, 99 per cent. of the total work expended is converted into electrical energy. Theory has established that, if the external resistance of the circuit is equal to the internal resistance of the battery or magneto-machine, the available work in the external circuit is a maximum.

Suppose, then, that we have 40 Grove's cells, each of 25 ohm resistance, and of an electromotive force of two volts, the external resistance being 10 ohms

$$\text{Then } Q = \frac{E}{R + r} = \frac{10}{10 + 10} = 0.5 \text{ webers,}$$

$$\text{And } I = \frac{E}{R + r} = \frac{10}{10 + 10} = 320.$$

The work done in the external circuit is 0.5×2

10 kilogrammetres per second nearly, or about 1.3 h.p.

A small Gramme machine of the A type, having an internal resistance of 4.53 ohms, and with an external resistance of 4 ohms, gives

an electric current of 17.5 webers, and an electromotive force of 158.5 volts, giving an amount of work equivalent to 2 h.p., $EQ = 160 \times 17$ nearly = 8 times the energy of 40 cells of Grove.

If we wished to replace such a machine by Grove's cells, we should have to arrange about 80 cells to get the same electromotive force, and to make each cell about four times as large, or to arrange 320 cells in four sets of 80 in each set, to get the same amount of external work done as by the Gramme machine. This will show how impossible it is to do the work by voltaic batteries which can be done by magneto-electric machines.

The equation work = EQ , may be satisfied in two ways—either by making Q large and E small, i.e., making what is called a quantity machine, which will only do effective work when the external resistance is small; or we may make Q small and E large—i.e., what is called a tension machine, which requires an external resistance large enough to prevent the machine from being overheated, and to satisfy the relation for the greatest amount of external effective work.

COMPARISON OF TWO GRAMME MACHINES.

	Quantity	Tension.
Number of turns per minute ..	797	967
Internal resistance	1.2	4.58
External resistance	1.14	4.00
Current in webers	29.67	17.51
Electromotive force in volts ..	81.58	158.50
Work spent to produce current	243	277

Thus we see that the total amount of energy is nearly the same in the two cases, but in one case it is spent in driving a large current through a small resistance, and in the other a smaller current is sent through nearly four times the resistance, and to do this a higher electromotive force is required. This higher electromotive force is obtained by increasing the number of turns of wire in the bobbin and in the magnet, so strengthening the magnetic field, and also by increasing the number of turns of the machine.

We arrive, then, at the conclusion that, to overcome higher resistances more effectively, higher electromotive force, and therefore higher speed, is required. Now our resistances may be so high that an ordinary current of electricity, even from a dynamo-machine, will not pass through it, in which case we have to resort to another method of producing electricity of still higher electromotive force; but the quantity produced is then considerably diminished. We have then to take an induction coil, consisting of two coils, in one of which a current of electricity from a battery is passing, and by suddenly breaking and making this current, to obtain great changes of the magnetic field, and hence great electromotive forces, and so get very powerful alternating currents. We know the effect of checking suddenly the flow of water in a pipe. Sometimes the increase of pressure so produced may be sufficient to burst the pipe, and this is one transformation of the energy of motion of the water. This is analogous to the development of the energy of the induction current by the sudden checking of the electric current in the primary circuit. Water may be raised to a high level by a series of sudden impulses, as in the hydraulic ram. A flow of a considerable quantity of water being suddenly stopped, there is at once a sudden increase of pressure, which is sufficient to lift a valve, and allow a small quantity of water to pass into the reservoir or air-chamber. This air-chamber regulates the action of the flow of water up the pipe from the reservoir, just as the resistance and capacity of the secondary circuit regulate the secondary induction current when the primary current is broken. The action of the induction coil is very well illustrated by the action of the hydraulic ram, the level to which water is raised corresponding to the electromotive force of the secondary circuit. Just as in the hydraulic ram, the quantity of water raised by the machine is at the best only about 66 per cent. of the quantity used, so in making use of the induction current to do work or to produce the electric light, it is impossible to convert more than a fraction of the energy of the original current into useful work.

In the two systems of electric lighting to which I wish to draw special attention this evening, we have instances of the two opposite methods of accomplishing the same end—viz., the lighting of moderate-sized rooms by a steady and pleasant light.

(To be continued.)

The apertures of the wall letter-boxes in the neighbourhood of Cambridge have been encircled with luminous paint, so that they may be seen in the dark.

SCIENTIFIC NEWS.

ACCORDING to telegrams received, Mr. E. E. Barnard, of Nashville, Tennessee, has discovered another comet; but the news, as transmitted, is rather contradictory, and even the *Dun Echt Circular* makes no attempt to explain. The first telegram from the Smithsonian Institution was dated Sept. 21, 11 a.m., and stated that "E. E. Barnard, Nashville, Tennessee, announces bright comet seven forty-six Ascension thirteen twenty-eight north. Daily motion three degrees north-east." The second, also from the Smithsonian Institution, Sept. 21, 3 p.m., says:—"Comet in thirteen twenty-eight north three forty-seven. Daily motion three degrees north-east." A Reuter's telegram, dated Rochester, N.Y., Sept. 22, says:—"The director of the University here has received intelligence from Nashville, Tennessee, stating that on the night of the 19th inst. a new telescopic comet was discovered there, its situation being three degrees north of Zeta Virginis. The Professor of the University on the morning of the 20th inst. caught sight of the long-expected Encke's comet near Beta Aurigæ."

Although the meetings of the Electrical Congress are not open to reporters, the results of the deliberations generally leak out, as they do in similar cases. We are at a loss to know why the sittings are held, as it were, in camera; but we give the following results of the discussion on electrical units for what they may be worth. They are, in all probability, correct, but no official intimation has been received. The ohm and the volt will retain their present definitions raised to the ninth power for the ohm and to the eighth for the volt—"henceforth and for ever," as Sir W. Thomson says. The unit of resistance (the ohm) will be represented by a column of mercury of a square millimetre section at the temperature of freezing water, zero centigrade. An international commission will be appointed to determine by new experiments for actual practice the length of the column of mercury of a square millimetre section at zero temperature centigrade which will represent the value of the ohm. The current produced by a volt in an ohm will be called an ampère. The name coulomb will be given to the quantity of electricity which is defined by the condition that an ampère gives a coulomb per second. The name farad will be given to the capacity defined by the condition that a coulomb in a farad gives a volt.

The Iron and Steel Institute will meet at the Institution of Civil Engineers in London on October 11—14, Sir Henry Bessemer, president. The list of papers to be read is long, and the subjects are of sufficient importance to attract a large number of members, and probably a considerable contingent of foreign visitors. Sir H. Bessemer has been appointed president of an influential committee formed for the reception and entertainment of the members and visitors.

We have received the syllabus of Anderson's College, Glasgow, which, with the syllabus of the College of Science and Arts, mentioned last week, shows that at all events the great Scotch city is well provided with the means of instructing the rising manhood of the nation. Popular evening classes are the great attraction for workers, and we are pleased to learn that for a fee of half a crown each course, the workman or the student can attend 25 lectures on either Natural Philosophy, by Prof. Blyth; Anatomy and Physiology, by Prof. A. M. Buchanan, Music, by Mr. Colin Brown; and Chemistry, by Prof. Dittmar. The lectures are delivered on Tuesday, Wednesday, Thursday, and Friday evenings, so that the searcher after knowledge can obtain a good deal at a very moderate outlay, especially as the half-crown fee includes the use of the library, which has some 8,000 volumes of works on science and general literature.

The annual fungus forays will be made next week, the Epping Forest and County of Essex Naturalists' Field Club holding theirs on the 1st of October, when Dr. M. C. Cooke, Dr. H. T. Wharton, and Messrs. Worthington Smith, and Jas. English will assist as referees and conductors. The Yorkshire Naturalists' Union will make their foray on Friday and Saturday in the neighbourhood of Harrogate.

A new electric revolving light, to be placed

on South Head, Macquarie Harbour, Sydney, was recently exhibited by the makers, Messrs. Chance Brothers, of Birmingham. It is a first-order, dioptric, revolving light, with electric arc, and will, when erected in its house, form the most powerful lighthouse in the world—the emerging beam from the apparatus being calculated to exceed in luminous intensity twelve million candles. The electric arc, which is supplied by a De Meritens machine, has a power of 12,000 candles, the machine being worked by an Otto engine of 8 h.p.

Dr. C. W. Siemens and Mr. Boothby, of Kirkcaldy, have obtained a patent for an electrical method of working railway-brakes (696, 1881). The brakes are worked by means of a current from a dynamo on the engine, which is conveyed to other machines affixed to each carriage. A powerful spring is used to put the brakes on, but the "grip" can be increased by means of the current. The action of the brake is automatic, but the force applied to the blocks in the event of a break will be that only of the spring.

Commander King, R.N., writes from Scarborough, under date Sept. 26:—"While waiting off Scarborough, in steamship *Flamboro' Queen*, I witnessed a very large meteor, nearly as large as the moon. It shot from north to south, and left a tail of yellow fire behind it, and burst with a loud report; it was seen at Whitby, also at Filey."

M. Pasteur has resolved to continue his researches into the means of preventing diseases by destroying or nullifying the virulence of the germs, and is about to visit the Bordeaux lazaretto, with a view of studying yellow fever, which he hopes to conquer by means of inoculation.

The Observatory of the Pic du Midi is now placed on the top of the mountain, the old buildings being retained as a shelter for travellers. The altitude of the site of the new building is not much less than 9,000ft., and occasionally the storms are so heavy that it has been deemed necessary to erect no fewer than six lightning conductors. General Nansouty, the director, is taking the precaution to provision it for more than six months, as it is probable that the paths leading to it will be blocked for quite that time by masses of snow.

It is stated that Prof. Guthrie has succeeded in producing a blue-black protective skin or coating on polished steel by dipping it in fused nitrate of potash. The "bloom" improves the appearance of the metal, and the coating is said to wear well.

It is intended to hold in Manchester, early in the ensuing month, a preliminary meeting for the purpose of forming a committee representing the interests of all concerned in the present state of the Patent Laws. The promoters propose, among other objects, to hold public meetings with the view of adopting resolutions and sending out petitions setting forth the necessity for a new law which would be alike satisfactory to capitalists, inventors, patentees, and patent agents. It is desired that the question of Patent Law should be discussed in full, so that Lancashire may be enlightened as to the proposals of the draft bill of the Society of Arts, which apparently is intended to be forced upon the attention of Parliament, whatever course Government may take in the matter.

It has been found by M. de Lacerda that permanganate of potash is very efficacious as an antidote to the poison of snakes. He experimented on dogs, injecting a one per cent. solution of the substance into the cellular tissue or into the veins, after the poison, and the usual effects of the latter were strikingly obviated. In one series of experiments the poison was allowed time to take some effect before the permanganate solution was injected, the dogs showing dilatation of the pupil, respiratory and cardiac derangements, muscular contractions, &c. Two or three minutes after the antidote was given these troubles disappeared, and after 15 to 25 minutes of some measure of prostration, the animal would be able to walk and even run about, and recover its normal aspect. The same dose of poison, not counteracted, caused death, more or less rapidly.

There now exist, in several towns, notably in Amsterdam, and in Memphis, in America, special systems of exhaustion pipes for removal

of sewage. M. Berlier, director of the Lyons Sewage and Manure Company, has been authorised to try such a system in Paris. The receiving vessels and pumps it is proposed to place in the sand-removing works of Levallois-Perret. An iron pipe 0.15in. in diameter will enter Paris from this by the galleries of the great collecting sewers as far as the Place de la Madeleine. Thence a number of secondary pipes will radiate in the sewers of the Rue de Naples, &c., and will be connected with the waterclosets of the houses included in the experiment. This connection of closets at different levels is one of the most delicate parts of the problem. M. Berlier is required to apply the system to a population of 3,000 inhabitants, and the proprietors' assent must, of course, be gained. A "société d'essai" has been formed for these first operations, and to study the possibility of applying the system in Paris on a large scale.

A French naval doctor, M. Crevaux, has lately made important explorations in the northern parts of South America, more especially in the valley of the Orinoco and its affluents. Among other facts of observation, he states that the Guaranos, at the delta of that river, take refuge in the trees when the delta is inundated. There they make a sort of dwelling with branches and clay. The women light, on a small piece of floor, the fire needed for cooking, and the traveller on the river by night often sees with surprise long rows of flames at a considerable height in the air. The Guaranos dispose of their dead by hanging them in hammocks in the tops of trees. Dr. Crevaux, in the course of his travels, met with geophagous, or earth-eating tribes. The clay, which often serves for their food whole months, seems to be a mixture of oxide of iron and some organic substances. They have recourse to it more especially in times of scarcity; but, strange to say, there are eager gourmands for the substance, individuals in whom the depraved taste becomes so pronounced, that they may be seen tearing pieces of ferruginous clay from huts made of it, and putting them in their mouths.

A new electrical journal, which has lately appeared in Paris, *Le Moniteur Officiel de l'Electricité*, makes the fifth on that subject now published in France, the others being, in order of date, *L'Electricité*, *La Lumière Electrique*, *Le Gaz et l'Electricité*, and *l'Electricien*.

A method of determining the density of steel in fusion, devised by M. Petrouchewski (of the Russian Physico-chemical Society) consists in pushing the orifice of a porcelain tube into the metal to a known depth, and compressing the air till it begins to rise in bubbles to the surface. At this moment the excess (measured with a manometer) of the air-pressure in the tube over atmospheric pressure, balances the column of melted metal equal to the length of tube immersed. The experiment was made at a cannon-manufactory at Perm. The density obtained was about 8.05, which is notably greater than that of solid steel.

Dr. François-Franck describes, in the *Journal de Physique*, several rapid and inexpensive methods of getting transparent designs suitable for projections. One (already known) is to trace the design with a pencil on ground-glass and fix with turpentine varnish. A second consists in tracing on a thin gelatine plate with a fine-pointed needle, the drawing previously traced on paper, the lines being afterwards made opaque by passing a dry black or red powder over the surface. Any colours must be applied in very fine layers. The gelatine plate is afterwards inclosed between two plates of thin glass. A third method consists in drawing on a glass-plate smoked with a candle-flame, and fixing the lamp-black with ordinary photographic varnish diluted with spirit.

Instead of the crude method, still common in Sicily, of roasting sulphur ore in stacks, or *calcaroni*, to extract the sulphur, MM. de la Tour du Breuil have lately adopted the practice of treating the ore with water which has its boiling-point raised by presence of a salt—viz., chloride of calcium (66 per cent.). There are two rectangular boilers, heated alternately. While liquation is going on in one (during two hours) the other is charged afresh, and the work thus proceeds without interruption. The expense of extraction is much reduced, the extraction is very complete, the sulphur produced is nearly pure, and the work may be carried on all the

year round, whereas at present Italian law allows of the process with *calcaroni* only from the end of June till the 15th of February, on account of sulphurous acid given off.

Experiments have been lately made by M. Gaiffe, with a view to find the best way of producing magnets of cobalt and nickel. Very hard pieces of these metals were obtained by the electrochemical method, and equal-sized bars were magnetised, some in the hard state, others after annealing, others after annealing and forging. The deflections of the magnetometer, observed at once, and also 36 and 72 hours after magnetising, are tabulated (*Comptes Rendus*), and show how these metals, and especially cobalt, may acquire a comparatively great coercive force, where pure iron, got by the same means, and similarly treated, gives inappreciable deflections. The order of increasing deflections is that of different treatment above given, the annealed and forged bars deflecting most. One of these bars (cobalt) produced a deflection of 14.45° immediately after magnetising, and after 72 hours, the deflection was 13.30°.

To render the action of shock on wooden wheels of carriages less injurious, Herr Nordmann, of Dresden, bends the spokes, giving them a certain elasticity. These wheels are made of the best ashwood. The spokes, after cutting, are steamed and bent in iron presses, then dried at a moderate temperature. The curvature is made different, according to the carriage and load; it is least in the middle. Special modes of connection with felloe and tire are adopted, giving great strength and durability, and allowing of old or damaged spokes being removed, and good ones substituted. The system is patented in Germany.

The section for Wood-Industry of the Technological Gewerbe Museum, in Vienna, proposes an international competition, from Dec. 1, 1881, to April 1, 1882, in technical novelties in production of *seat-furniture*. Applications may be made up to Nov. 1. All objects sent for competition will be exhibited in the museum. Drawings and models are excluded. For reward of meritorious work, the Lower Austrian Gewerbeverein provides ten silver and twenty bronze medals.

According to a recent official document, there are at present, distributed over the globe, nearly four thousand manufactories of paper, in which are treated rags, straw, wood, jute, &c. Besides these papers, the product of European civilisation, there are those made of rice, of which China and Japan are the great producers. All these works together produce a quantity of paper estimated at nearly a milliard kilogrammes a year. This figure represents a surface of forty milliards of square metres, nearly that of Switzerland or Denmark. Books and journals take about one-half of this quantity. The paper used for journals alone represents a surface exactly double that of Paris, within its present limits. Next come, as large consumers of paper, governments, schools, commerce, and industry. An anthropologist, it is known, has proposed to call the present age of paper, as we speak of the past ages of polished stone, brass, iron, &c.

The manufacture of beer in France appears to be increasing considerably. Thus, while in the ten years 1830-40, the average production was 3,477,708 hectolitres, or 10.54 litres per head of the population; the average for the period 1870-80 is 7,244,857h., or 22.28 litres per head. Last year the amount was over eight million hectolitres. The exportation is trifling; the average for 1870-80 was 28,659 hectolitres. On the other hand, importation, which in 1830-40 was only 1,771 hectolitres (annual average) has been, in the last decade, 248,201 hectolitres.

Fletcher's Argand Bunsen.—Mr. Fletcher, of Museum-street, Warrington, has just brought out a simple and cheap Argand Bunsen, which is well adapted for general laboratory work, and will be found handy in many a shop. The flame is shorter and higher in temperature than the ordinary form of corresponding size, and is free from smell. The air-supply is self-adjusting, on the principle of the solid-flame burners, but the Argand Bunsen is readily converted into the ordinary form by stopping up the centre air-way. The new burner is made in two forms, with and without a tripod, at corresponding differences in price; but either is cheap, and both will be found very useful.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

* In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physics; a view from whence great inconveniences derive their origin."

—Montaigne's Essays.

ORDER OF BRIGHTNESS OF STARS.

[19249.]—I THANK "F.R.A.S." (letter 19051, p. 546) for his courtesy. I think, however, that he has not exactly apprehended the nature of my request: I did not mean photometric observations of the different stars in the Plough so much as determinations of their order of brightness. I need hardly remind one so able and learned that two stars may be of the same magnitude, and yet one be brighter than the other.

The following are the principal determinations I am, at present, able to find:—

Herschel.	Heis.	Groombridge.	Yarnall.
ϵ V	η	ϵ V	α
α V	ϵ	α	η
η V	α	η	β
ζ	ζ	γ	δ
γ	β	δ	ϵ
β	δ	ϵ	ζ

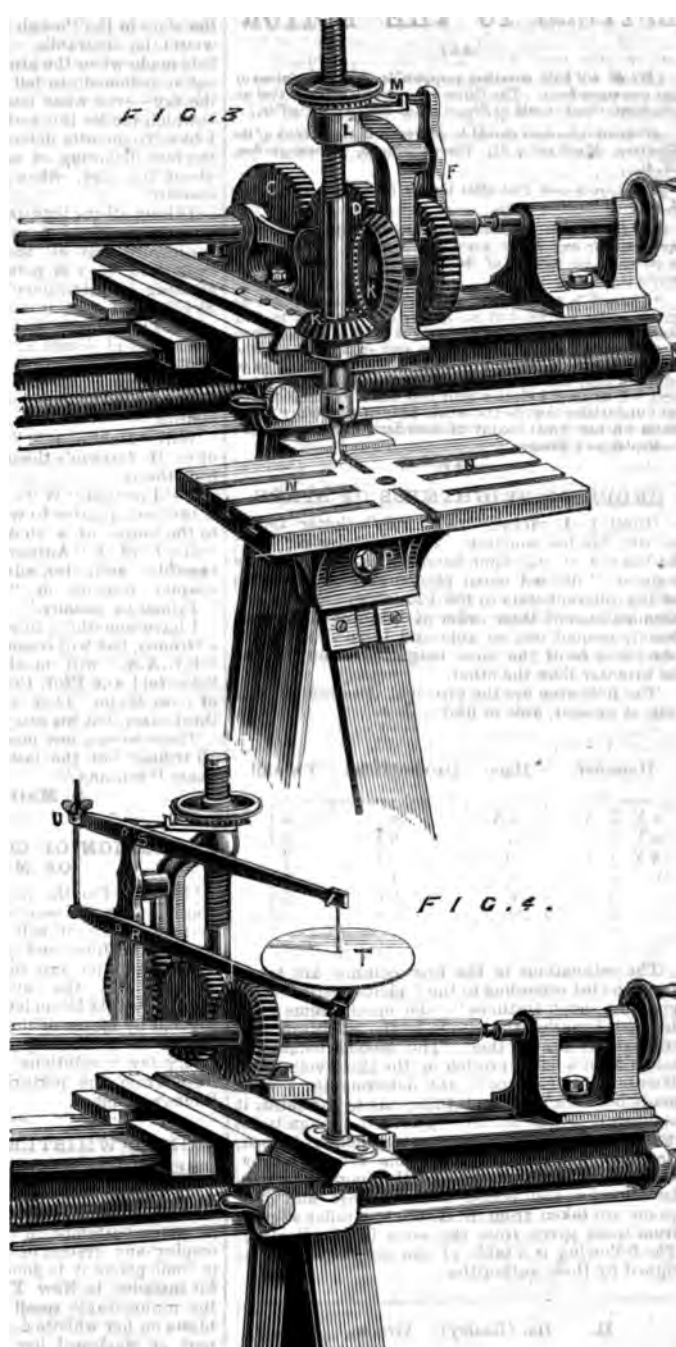
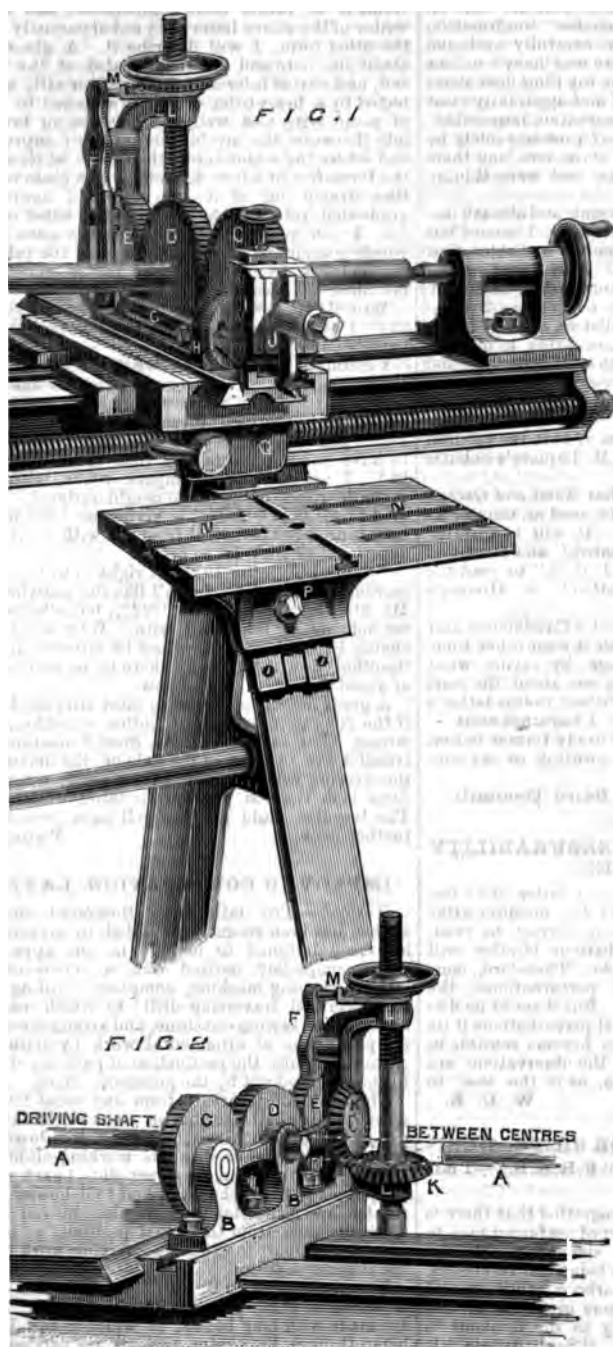
The estimations in the first column are taken from the list according to the "photometric" scale given in the "Outlines"; the epoch seems 1837. In 1850, Herschel stated η to be the brightest: the subdivision shows this. The second column is taken from a letter printed in the third volume of Humboldt's "Cosmos": the determinations were made between 1842 and 1850. As to the third, it is difficult to tell to what period the magnitudes given in Groombridge refer (or whether, indeed, they are not Flamsteed's); the fourth labours under a similar disadvantage—the magnitudes may be true for any period between 1845 and 1861 (some are taken from B. A. C., but differ slightly from those given from the same by Mr. Bazley). The following is a table of the magnitudes as assigned by these authorities:—

	H.	Ha. (Bazley).	Groom.	Yarnall.
η	2.18	2	2	2
ϵ	1.95	2	3	—
α	1.96	2	1.2	2
ζ	2.43	2	3	4
β	2.77	2.3	2	4
γ	2.71	2.3	2.3	2.2
δ	—	4.3	3	3.8

I cannot find ϵ in Yarnall. Argelander gives 3.4 as magnitude of δ . Sufficient has been stated to indicate the confusion which exists; another matter may be added. Sir J. Herschel enters, in the table of variable stars in "Outlines," α and δ as variables, and assigns limits of variability in the case of α 1.5–2, of η 1.5–2, and of δ 2–2.5; in the latter—and also by omitting ϵ —he contradicts his table at the end.

The following table is a selection from my own lists: it gives "successions" only; weak sight and want of appliances have hitherto prevented my doing much in the way of individual estimations.

1873.	1874.	1875.		1878.		1879.					1880.					1881.							
15-8	12-1	27-8	30-9	16-8	9-9	9-8	14-8	18-9	10-10	30-11	18-3	24-3	6-5	28-5	16-6	11-7	29-3	3-5	25-5	2-6	11-8	14-8	15-8
ϵ	ϵ	ϵ	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η
η	η	η	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
ζ	ζ	ζ	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α
α	α	α	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β
β	β	β	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
γ	γ	γ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ
δ	δ	δ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
ϵ	ϵ	ϵ	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η
η	η	η	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
ζ	ζ	ζ	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α
α	α	α	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β
β	β	β	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
γ	γ	γ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ
δ	δ	δ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
ϵ	ϵ	ϵ	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η
η	η	η	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
ζ	ζ	ζ	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α
α	α	α	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β
β	β	β	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
γ	γ	γ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ
δ	δ	δ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
ϵ	ϵ	ϵ	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η
η	η	η	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
ζ	ζ	ζ	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α
α	α	α	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β
β	β	β	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
γ	γ	γ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ
δ	δ	δ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
ϵ	ϵ	ϵ	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η
η	η	η	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
ζ	ζ	ζ	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α
α	α	α	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β
β	β	β	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
γ	γ	γ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ
δ	δ	δ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
ϵ	ϵ	ϵ	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η
η	η	η	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
ζ	ζ	ζ	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α
α	α	α	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β
β	β	β	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
γ	γ	γ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ
δ	δ	δ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
ϵ	ϵ	ϵ	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η
η	η	η	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
ζ	ζ	ζ	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α
α	α	α	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β
β	β	β	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
γ	γ	γ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ
δ	δ	δ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
ϵ	ϵ	ϵ	η	η	η	η	η	η	η	$\$													



l on the mandril with requisite speeding, by range-wheels. A circular feed can also be used from the hand traversing-action Q, which acts on the leading screw, as shown in 5. g. 4 shows an arrangement for fret-sawing; lower arm R is fixed to the rocking-bar, the upper arm S may be adjusted to stretch the saw thumb-screw U; a tilting work-table T is used on the slide-rest. It will be observed that quick and slow gear of the lathe-head stock been utilised in all these combinations. my next letter I shall describe some simplifications, and also additions for ornamental work, suitable to the wants of amateurs.

J. A. Armstrong.
Westcombe-park, Blackheath, Sept. 11.

THE PURIFICATION OF COAL-GAS.

3253.]—THE subject of gas-purification is still a matter of great interest, both to the gas-maker to the gas-consumer—to the former because he is in many cases already compelled to effect a certain degree of purity, or is expecting to be so called, and to the latter because he has a natural instinct which has been educated, perhaps, by the fact that impure gas is neither good for health nor comfort. In many large districts the gas, as supplied, is certainly of a high degree of purity compared to what it was ten years ago, or to what it now is in many other parts where the most recent sulphur legislation has not yet extended.

There is a great practical difference between gas

containing 40 to 50 grains of sulphur per 100 cubic feet, and gas containing only 6 to 10 grains in the same volume; for there can be little doubt that gas containing 40, or even 30, grains of sulphur when burned in badly-ventilated apartments, is perceptible to the senses, whereas it is highly doubtful whether the most sensitive person can detect the sulphur in gas containing even 16 grains, by taste or smell.

It is a pity that architects and those concerned in the construction of dwellings have not taken more means to free apartments from the exhalations of the human body and lighting agents; but it is satisfactory to note that the revival of the regenerative system in gas-lighting (first used by Bowditch) has in the hands of F. Siemens shown how the products of combustion can be utilised, and afterwards removed to a point where they can no longer be unpleasant.

The sulphur which has caused the most solicitude is in the form of carbon disulphide, and is ordinarily termed sulphur, other than sulphuretted hydrogen, which latter impurity has been prohibited from an early period in gas-making, and is practically absent from the gas of all countries.

Seven to ten grains per 100 cubic feet of sulphur, other than sulphuretted hydrogen, may be taken as the type of the best purified gas, though there are some cases where a slightly lower amount is obtained.

There are three impurities which are the subject of modern legislation:—

- (1) Sulphuretted hydrogen, which must be entirely absent.
- (2) Ammonia, which must be below a certain

maximum, averaging about four to five grains per 100 cubic feet.

(3) Sulphur other than sulphuretted hydrogen which must be kept below a certain maximum (15 to 30 grains S per 100 cubic feet). This form of sulphur is practically carbon disulphide, for though there is a small amount of sulphur in coal-gas in unknown forms, ranging from 4 to 10 grains, there are no generally-known means of reaching these obscure forms of sulphur by any purificatory process, and as there is a perfectly-definite and well-understood process for removing carbon disulphide, the legislation for forms of sulphur other than sulphuretted hydrogen clearly aims at the carbon disulphide; though at the time when the agitation first arose in respect of sulphur, there was no scientific evidence as to the manner in which this sulphur was combined.

There is another impurity which is only of direct importance to the gas-maker—viz., carbonic acid. His interest in this body is due to either one or both of two circumstances.

1st. As a simple matter of economy, where the gain in illuminating power exceeds the cost of removing the carbonic acid.

2nd. As a matter of necessity, where the extraction of carbon disulphide is desired, the removal of the carbonic acid must be first effected.

ON THE INFLUENCE OF CARBONISING ON THE IMPURITIES OF COAL-GAS.

There can be little doubt that the degree of temperature employed in the carbonisation of coal has a great influence on the amount of the carbon disulphide. Coal which at the temperature usually

employed in iron retorts yields a gas containing from 15 to 20 grains of sulphur other than sulphuretted hydrogen will, when carbonised at the temperature used with clay retorts, contain as much as 40 to 50 grains; but the retort-house being a very important point in the economy of a gasworks, the trifling expense attached to the removal of the carbon disulphide has no weight in considerations as to what temperature shall be employed for carbonisation.

It is very necessary that no air should be drawn up the ascension pipes, or through the holes or cracks in the sides of the retorts, by excessive vacuum, for oxygen has a most disturbing influence on those purifiers used for abstraction of carbon disulphide, and consequently it is most important that it should be absent.

THE INFLUENCE OF THE QUALITY OF COAL ON THE IMPURITIES OF COAL-GAS.

The nature of the coal used has, it is almost needless to say, a close connection with the extent of the impurities in the gas it yields. Some coals contain a large quantity of sulphur, and, what is worse, a considerable percentage of hygroscopic moisture which reaches, in some cases coming within the author's experience, an amount equal to 11 per cent. at 212° F. Such coals are generally the driest in appearance, and it very often happens that coal, to all appearance very wet, loses less than 5 per cent. of water at 212°. Appearance is no guide in this matter of hygroscopic moisture, for nothing short of a chemical determination is of value as to the amount of moisture in a sample of coal.

As an instance of the bearing of hygroscopic moisture upon the impurities of coal-gas, the following cases may be cited:—

Ordinary Newcastle coal yields a gas containing 12 grains of carbonic acid and 10 grains of sulphuretted hydrogen per cubic foot, the hygroscopic moisture not, perhaps, exceeding 2 per cent. at 212°.

A sample of coal with 10·3 per cent. moisture at 212° gave a gas containing 30·2 grains carbonic acid and 12·5 grains sulphuretted hydrogen per cubic foot.

Another coal containing 6·0 per cent. moisture at 212°, gave a gas with 18·5 grains carbonic acid, and 12·5 grains sulphuretted hydrogen per cubic foot.

When it is understood that plant, which may be sufficient for gas containing 12 grains carbonic acid, would be altogether inadequate for gas containing 30 grains, the importance of this subject of moisture in coal will be appreciated.

There are many cases where proximity to certain kinds of coal outweighs all considerations of quality; but when possible, the impurities in the gas yielded by a coal should be a factor in its selection.

Beckton, London, E. Lewis T. Wright.

(To be continued).

TRICYCLES.

[19254].—ANY person about to purchase a tricycle must be in a glorious state of indecision if he is inclined to be guided by the diverse opinions of "Sunlight," "T. F.," and myself.

"T. F." advocates large wheels; "Sunlight" favours small ones speeded up; I have recommended medium-sized ones geared level.

The fact of the matter is each kind is best under certain conditions. A large wheel gets over inequalities smoother, takes longer cranks to propel it if geared level, and is a poor hill-climber. A small wheel feels inequalities more (though this ought not count if the machine is well constructed and seat properly hung); it should be a good hill-climber, and it takes a shorter crank if geared level. Now speed the large wheel down and the small one up until the leverage in both is equal to that of a medium wheel geared level. The three machines should travel at about the same speed for the same number of foot-strokes, but the large wheel speeded down is a bad hill-climber, because it is propelled with the leverage of a smaller size, but it should travel well over a rough but level road. The small wheel speeded up is a good hill-climber, as it works with longer leverage; but it feels a rough road more. The medium-wheel geared level is better than either of the others for general purposes, but worse for special ones.

The foregoing remarks were penned before receipt of "E. M." containing "Sunlight's" last letter (19228). In reply to his query as to my height, I am 5ft. 8in. in my boots.

In the long run "Sunlight" will find his and my opinions draw nearer and nearer to perfect agreement. I am obliged to him for reminding me of an omission in my last letter. There is no branch of this subject that I have a stronger opinion on than that one-sized machine will not suit everybody. At the present time tricycles appear to be made with driving-wheels of every imaginable size, and a rider is compelled to adapt himself to some one of them, the only adjustment being a raising or lowering of the seat, while the

crank-throw is nearly of uniform length in all. Now I hold that the standard to start from should be each individual's most convenient length of stroke. This determines the throw of cranks. The throw regulates (according to build of machine) either the actual size of driving-wheel if geared level, or if speeded up or down, the size the wheel should be speeded to run as. In fact, a tricycle should fit its rider as accurately as his bicycle or his boots. A uniform throw will not suit all legs. It is the throw that regulates the leverage. This important point decided for each individual, he can then exercise his own discretion as to whether to have his wheel geared level or a larger size reduced, or a smaller one multiplied according to the class of roads over which he expects to do most riding.

I am glad to notice a discussion on seats started. I am one of those heterodox persons who disbelieves in the usual seat arrangement, and consider it altogether wrong in principle. I have had in use for two years a seat fixing that permits no side joggling, and which contributes most important aid in hill-climbing. If "Sunlight" will be so kind as to communicate with me privately, it will give me much pleasure to send him sketches of my seat, which I believe to be unapproached for comfort and efficiency. I, at least, have never sat upon, nor seen figured, its equal.

W. H. Staurope Westropp, M.R.I.A.
Lisdoonvarna, Ennis, Sept. 24.

SAFETY BLOWPIPE-LAMP.

[19255].—THE idea of your correspondent's safety blowpipe-lamp (19198), though doubtless a good one, is, I fear, scarcely practicable with the majority of those who have to use these lamps. The greater number are used by painters for burning off old paint, and by plumbers; and where the apparatus is in every-day use with these, unless care is taken, it soon becomes clogged with a sticky dirt that would prevent the boiler from rising freely, and as Mr. Crichton points out, "In making this contrivance it is essential that the boiler should rest on its seat without in any way hitching—that is, it must be perfectly free to rise by the sole action of the safety spring."

In the hands of Mr. Crichton it would probably answer its purpose, as he would be careful to keep the apparatus clean; but the majority of painters, &c., are quite indifferent to the cleanliness and appearance of the lamp so long as it will act at all. Besides which, where one lamp bursts through the boiler becoming nearly empty, a dozen burst through the non-action of the safety-valve. A number of these lamps pass through my hands, and I have nearly always found the explosion due to the dirt sticking to the valve, which in some cases covers the whole of the upper part of the boiler.

In a great measure this is due to the workman using "finish" instead of methylated spirit, or through the spirit having been put into a dirty can that has previously contained polish or varnish, the consequence being both valve and blowpipe gets clogged with gum, so that an explosion becomes almost inevitable. Many different forms of valves have been tried, but without success. I have, however, a suggestion to offer which will, I think, prove successful. It is to make a small hole in the upper part of the boiler, say about 1·16in. in diam., and stop it with the following fusible alloy, viz.:—Lead, 3 parts; tin, 2 parts, bismuth, 5 parts. This composition melts at about 190° F., and methylated spirit at that temperature exerts a pressure of about 30lb. per inch, which is as much as one of these boilers will bear. With this arrangement it would be immaterial how dirty the boiler was, and the alloy if melted could be replaced with very little trouble and expense. Fusible plugs have, I believe, been tried on steam-boilers, though I cannot say with what success.

Something is certainly wanted to make the lamp a safer article than it is in its present state, as serious accidents are, I know, constantly happening through these explosions.

F. Morrell.

N. E. ENGINES.

[19256].—IN last week's issue of the "E. M." I noticed a drawing of one of the new North-Eastern goods engines. The drawing is similar to some of their classes, but it is certainly not one of their new goods engines. Your readers will notice that the engine drawn is double-framed, but the N. E. Co. have not built any double-framed engines since 1872—the 755-780 class of goods engines built by Hawthorn and Co. being the last of this class. The new goods engines (both Gateshead and Darlington classes) are single-framed engines. The diam. of driving-wheels of Gateshead class is 5ft., that of the Darlington class is 5ft. 6in. I do not know the size of the cylinders. Can Mr. Lawrence inform me? Both classes are powerful engines. The Darlington class are commonly known as "Quakers" from their short thick chimneys and high domes; indeed, they are not the prettiest of engines to look at. Mr. Lawrence's

drawing is very like one of the engines, but in this class there are apparently none stamped in the splashers, and the "A" glass tube the framing. I agree with Mr. Lawrence—he upper that I should like to see more said of the engines of the different companies, as they are quite worthy of notice. I also hope to see the lists of L.N.W. engines which "Egeria" promised. If it be not too much trouble, could he oblige us by giving the dates, as a great number of readers are interested in them.

I notice that Mr. Lawrence wants to know about G.N. 8-footers at Leeds. There are no 8-footers stationed at Leeds, all the express engines there being 6ft. 6in. coupled. I think their Nos. are 72, 261, 285, 290, 299, and 540. The 10 a.m. express is taken out by one of the Doncaster 8-footers, which comes up early in the morning; a Peterborough 7-foot single comes in the afternoon. These are the only G.N. singles going to Leeds.

Meteor.

THE HEATON-NORRIS ACCIDENT AND THE CHAIN BRAKE.

[19257].—ON the 3rd of August an accident took place at Heaton-Norris Station, on the North Western Railway, in consequence of a point-rod failing to move a pair of facing-points, and thus caused the up Normanton mail to be wrongly turned into a goods line 320 yards long.

Upon coming to the end of the line the engine cleared away the buffer-stops, ran on to the platform, knocking down three brick piers which support the roof. The driver, fireman, signalman, and post-office clerk were injured.

The mail train consisted of engine and tender, No. 1141, and six vehicles. The engine and two of the vehicles had no brakes, the tender had a hand-brake only, and the other four vehicles at the rear of the train were fitted with Clark and Webb's chain brake, applicable by the driver by means of a cord, and also under the control of the guard.

The speed of the train was 20 miles an hour. When about 200 yards from the buffer-stops the driver found out that his train was running upon the goods line. He at once pulled the brake-cord, reversed the engine, and opened the sand-boxes, at the same time the fireman applied the tender hand-brake. The guard of the train states that when the driver pulled the cord the continuous brake was not applied.

General Hutchinson (in his report just issued) remarks:

"This only furnishes another instance of how little the action of this brake, when required to be used on an emergency, is to be depended on. In a distance of 200 yards, with a speed much in excess of what was stated to have been the case on this occasion, the train, if supplied with a quickly-acting continuous brake, would have been stopped without difficulty."

I quite agree with Mr. J. T. Lawrence (page 67), that it is much to be regretted that the London and North Western Company does not fit its trains with an efficient continuous brake, more especially after it has become convinced that the chain brake is a very "inadequate appliance."

An article which appeared in the *Times* of September 17th, upon the subject of accidents, has caused considerable commotion in the railway world in consequence of the truth of the statements made, and the very concise form in which they are expressed.

The *Times* informs its readers "that the companies themselves cannot be trusted to provide adequately for the safety of the public"; and "that it is cheaper to pay for an accident now and then than to render its occurrence well-nigh impossible." If the manager of a railway, therefore, thinks he can get what he would consider reasonable safety at a cheap rate, he is tempted to advise his board not to spend money in expensive appliances; and, then, some day, an accident will occur, and he will do his best to describe it as "unavoidable," or to attach the blame for it to any quarter but the right one."

This statement has been considered by "managers" to be "rather severe," but, still, it is an admitted fact that it is perfectly correct.

The article in question concludes with the remark:—

"If something be not done it would be just as well to abolish the railway department of the Board of Trade, and to save the salaries of the officials, and the cost of printing their reports."

With this latter opinion I entirely disagree, because railway officials themselves state that even the present safety of railway-travelling has been obtained through the constant pressure of Parliament, the Board of Trade, and public opinion; and that if accidents are to be further reduced in number in the future, it will be in consequence of the adoption of the safety appliances and modes of working recommended by the railway inspectors of the Board of Trade, and insisted upon by public opinion.

Clement E. St. John
Saxe Coburg-street, Leicester, Sept. 1881.

GIDDINESS.

pendence in your experience of my own. As that was rather at times when walking or falling. At bath daily, allowing in the usual manner. Giddiness was due to tar shock, or aggravated of proceeding, by fall on my back and is easily done by backwards, and on giddiness left me, and I. Ever since I have are of the head to cold. Onal experiments which which attributes this "glow" which follows er to any part of the ther muscular machine, bably take cold showers ; but where the brain point anything promot- ily in that direction is igerous, as tending to Mattieu Williams. aden.

IT STEAMERS.

to the correction on the steamers, as your readers my first letter, I simply the exception that from red, the fact of the dis- was a point on which I sation was one in which ly asked for, in replying, uestion at all, as far as e partial error which our ll, however, look up the sition; but I do not, even leal out, as the hulls were so the engines. But I ay that unless the matter ed exact reply for actual pected to wade through tions that would be re- query as this; as there an assumption, if it were any bad result, as in a , before any person went and particulars would be, into. Sunlight.

VERING PROCESS.

of the "E.M." has tried rrors, detailed in No. 794, d be glad to know what t with. Mr. Braahear tain results and a hard illiancy. I have followed y as I can, and can only owderly film of silvering, by warming the solutions unge ought to take place ion? Mine remain clear, ange, until heated, when our, but far more of the thrown down as a sort of to the film on the glass. l quantities of solution of otash. Is this right? I h in excess, and, after r, I find a good deal of edissolve the precipitate always a small residue of des. I have also tried in Mr. Calver's "Hints," dd like the chemistry of plained so as to know ammonia, and what the

"Hints," gives 32 grains d with 3oz. sugar-candy, he gives the proportion as -candy. Which of these it indifferent which pro-

se solutions turn instantly ue be wrong somewhere, w no sign of turning at med, when they do turn t good. How long ought ring at a temperature of ld the film be in ferma- Edwin Holmes.

S — TRANSPARENTICING — FAURE'S TERY.

glass, I can recommend following formulae, given his notes, and which I

have frequently and successfully employed:—Dis- solve 154gr. of nitrate of silver in 17 fluid ounces of distilled (or soft) water, and add caustic ammonia until the precipitate at first produced is nearly redissolved. Filter and make up to 34oz. Call this solution A. For solution B, 31gr. of silver nitrate are dissolved in 34oz. of distilled water, the liquid raised to boiling in a clean porce- lain dish, and then 23gr. of Rochelle salt, dissolved in a little water, added, and the solution boiled until the precipitate becomes grey. Filter and allow to cool. To silver the glass, it must be per- fectly clean. It is first rubbed with strong nitric acid, then washed, and caustic potash used, washed again, and alcohol used, and finally washed with distilled water, and placed, while still wet, in a flat dish, with the side to be silvered uppermost. Equal quantities of solutions A and B are then mixed and poured on, and the silvering is complete in from two to four hours. The surface may then be varnished, or, if thick enough, polished with rouge and cotton-wool. The great point is to see that the glass is quite clean. The operation does best in the cold, or if very slightly warmed.

I am glad to see that the subject of photographic transparencies has been started (44717). Would Mr. Peck kindly say how long the "very short time" for exposure is—one or two seconds? Would he also give formulae for the "ferrous oxalate developer" with Swan's plates?

With regard to agate slicing (44719), the method as carried on at Idar, in the Palatinate, where large quantities of the stones are cut, is with diamond-dust and petroleum. The diamond is simply crushed in a small mortar by one or two blows of the hammer, and carefully placed on the edge of the iron disc, which just dips in a little petroleum. With this arrangement, stones several inches thick are cut through in a few minutes. The same method is employed for cutting pebbles at Aberystwyth, and, I believe, other places in England.

I have made several experiments with Faure's secondary battery (44773), but have failed to get good results.

I took six trays of thin sheet-lead (about 1 square foot) bent up at the corners. On the first was a layer of red-lead, then a piece of thick flannel, another layer of red-lead and the second plate, and so on. The trays were then filled with dilute sulphuric acid, and the plates prevented from touching by thin strips of wood soaked in paraffin. On charging this with six Grove's cells, which gave a deflection of 70° in a tangent galvanometer, a current of about 35° passed through the battery, which gradually fell in about twenty minutes to 10°, at which it remained constant. But on connect- ing the secondary battery with the galvan- ometer alone, I only obtained a deflection of about 2° or 3°, instead of getting one of about 80°. Can anyone tell me what was the fault? I believe there was no local action, as there was when the strips of wood were omitted. I need not remark that there was contact between the red-lead and sheets of lead throughout. The subject is one of general interest, and a few practical details would no doubt be of value to many readers. B. Sc.

GRINDING, POLISHING, AND TESTING GLASS SPECULA.

[12262.]—I must venture to differ from H. L. Baldwin, p. 38, in the advice he gives to amateurs, not to make a machine for the above purpose. Considering that a 9in. speculum, if well figured, is worth from £10 to £20, no amateur should grudge the cost (from 10s. to 40s.) or trouble of making one.

"H. L. B." cannot look upon his handwork with much satisfaction, if about an inch of the edge is imperfect, thereby seriously detracting from the value of the speculum, and reducing its effective area from 80 to 50.

"H. L. B.'s" failure with the Foucault test is, most probably, from want of experience.

I have tested specula with a small sperm-candle and cardboard cylinder round it, obtaining good results, but not equal to those from a 10-candle power lamp, and a minute hole in thin metal foil made by the point of the very finest steel needle I could buy. The shadow test beats the eyepiece test hollow, if carried out as above, in a dark room, free from all vibration and in still air, but a most essential point is the position of the cutting-off screen, which had better be a straight strip of thin metal or wood put in a small block of wood rather than the curved blade of a razor.

This position is well described by Mr. Bell on page 625, No. 780, but if "H. L. B." cannot grasp it, I am sure he has only to make the want known, and there will be plenty to the rescue. I believe the reason why "H. L. B." detects irregularities with the eyepiece test and fails with the shadow test is, that in working the latter he has used too large an illuminated hole, and his cutting-off screen has been placed too near the mirror, so as to be too much in advance of that point where the bulk of the illuminated rays cross in coming from the mirror.

I believe nothing can equal the delicacy and trust- worthiness of the Foucault shadow test, if carried out properly, except testing on a star, but the eye- piece test is useful as a check upon the other.

I have been greatly pleased with H. A. Wassell's letters, but I really think he might do without his triangular supports if he adopt this plan. I centre the speculum on table, and at three equi- distant points round the edge, about 3in. from it, I put in a stout brass screw, with the usual cross-cut head.

Now a soft-wood wedge, 3in. wide, for each screw, and the disc laid upon a double thickness of wetted house-flannel, will keep it firmly in its place, and the disc is gripped at its lower half only.

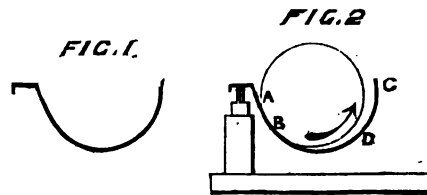
The speculum table is of wood quite flat, and covered with a single of white-painted oilcloth to keep it dry; and being thick and heavy, it runs upon six small wheels placed underneath. On one occasion, wishing to obtain two mirrors of similar focus, I cemented each disc to a square of 3in. plank with pitch.

Each piece of wood was slotted at two places to allow it to slip under screw-heads, and then made fast by a thumb-screw. Each disc came to a good spherical curve.

This was done to save the trouble of centring each disc when alternately fine-grinding with flour emery; but I offer it now as a suggestion to prevent flexure. J. C. L.

[12263.]—For the benefit of amateurs I describe the way I edge discs for specula. "A. N. H." seems to have had some trouble, and consumed an unnecessary amount of time. I take from 2½ to 4 hours, according to size and amount it is out of truth. To begin with, chuck the disc in the lathe; after the back has been flattened, chuck the face of mirror to lathe. Get a strip of stout sheet-tin, one inch wider than disc, long enough to go half round and bend in as Fig. 1, so as to hook on T-rest, as shown in Fig. 2. Let it have a slight spring against mirror and touch only from A to B, Fig. 2; bend the remainder from B to C, so as nearly to follow form of mirror but not to touch; supply emery and water at A. When the rough is off the edge you can drive as fast as you like, and when the edge is becoming true, let the tin touch but not spring against A and B, and finish with fine emery. No flour necessary. Always keep a chamfer on the edge in front of the grinding, which may be done by drawing a sandstone (at about 45° with face of glass) across the edge. Draw the stone from centre of disc outwards. If you keep the stone stationary you groove it. Press the tin occasionally against disc at D, so as to draw up the refuse between B and D, and help the rough grinding. Four hours is the longest I have ever been, the largest edge being 9in. diam. and 1½in. thick; 6½ mirrors I have done in 2½ hours. Mark centre before taking disc off lathe. Harry L. Baldwin is lucky to do a 9in. in 46 hours. I should want 25 hours to figure it if I had no mishap; 1½ hour for polishing seems very little. I cannot understand why he cannot use small pinhole. Mine is stopped up that it must be less than 1-200; it was only that originally. You must be careful to have the small hole in the axis of the light.

The eyepiece test alone is not satisfactory, as it will not always determine the erring zone, and will not always lead you right unless you have a good knowledge of the in-and-out focus appearance of parabola at centre of curvature. But, using the eyepiece and "Foucault" together, you get a good



idea of the surface. Using too much light with "Foucault" will hide the delicate variations.

Rings and zones are irregularities that are very common and tedious to remove. 120-power is not high enough to test good figuring; try from 300 to 450. I am inclined to think that the zones you see are due rather to diffraction, than actually on the mirror. Your ten-candle power lamp is quite enough. I can endorse your remarks that Braah- ear's silver process is very good, having lately used it. I use harder pitch than the late Mr. Las- sell recommended. John S. B. Bell, C.E. Newcastle-on-Tyne.

[12264.]—I do not think it will be out of place, at this stage of the process, to give a few hints about cell, and mode of mounting; more especially to assist, if I can, H. A. Wassell, who certainly deserves the thanks of his brother-amateurs for the pains he is taking to assist them, and give us

alent focal lengths. Does any one he values are ascertained in the case of

latter, there are two methods (1) by formula, which I have before quoted as $f = \frac{nl}{(1+n)^2}$, where n is the

age to object as formed by the o.g. ination, and l is the distance between ctically this observation is made by is field-glass of an eyepiece to which a yepiece of known value is adapted, and ow many of its divisions are contained of .01, or .001 inch in a stage micro- uring the distance between the two . And (2) by using the microscope yepiece to an astronomical telescope of focal length, determining the magni- r (by a double-image dynameter, if and dividing the power so obtained by cal length of the telescope o.g. scope o.g. I find these two methods to perfectly, the results agreeing to the f decimals; not so, however, with eye- course it is absurd to use an eyepiece— yghenian, Ramsden, or Kellner—as an and they necessarily give a very in- age; still, it has been stated that the od is applicable to all combinations of hich an image can be produced. But of fact, No. 1 of these methods gives order focal length for an eyepiece than difference varying from about 10 to 20 Antares.

PLIES TO QUERIES.

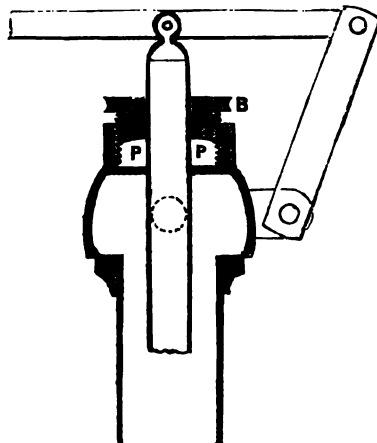
their answers, Correspondents are requested to mention, in each instance, number of the query asked.

Voss Induction Machine (U.Q.).—M." will refer to the illustration of the ine given in the last volume, which is quite accurate, and is, I believe, ale, he will see that the brushes on the is on each side of the machine are in munication with the paper shields on and with the tinfoil discs on the front, plate; when the discs on the revolving in contact with these brushes, both a fixed plate and the front of the plate are in metallic contact. If 'will now refer to the description given el's "Natural Philosophy," of the e replenisher of Sir William Thomson's lectrometer, and remember that the omb's of the Voss machine are insulated other, and that the two vertical combs allic contact, I think he will see the he Voss machine. I have a Voss e with a 10in. revolving-plate; it is pible to damp, but otherwise it works ves a very strong stream of electricity. S.

ad 44701.]—Strength of Tubes.—ng my paper on the bursting pressure ight to have added that the same argu- s when the pressure is applied exter- hen the tube fails by the crushing of the regret that when I wrote the paper I s of reference at hand, nor had I seen "Boiler Inspector," which contained applicable to the case in which a tube rt of "caving in" of the material, and ertainly do when the tube is below a mess. Omitting decimals, the formula

ng-in process is $P = C \frac{t^2}{l^2}$ where C is a e other symbols being variable at will. npiric formula, and is only true to a ut. For instance, if we make t the in- ariable and P the dependent variable, se the value of t beyond a certain point, nding value of P will become so great erial would be crushed long before it y buckling or caving in, and the formula at case, mislead. Again, if l be made , we are reduced to an absurdity when increased beyond a certain extent. To me case, it would be possible to make long, or, in other words, to make l so P would equal 0, so that a very long in this case collapse with no pressure at e seen, therefore, that not only my subject was incomplete, but that the ren by Fairbairn and others are not all cases of tubes subjected to external t would be an interesting study to find point or with what thickness of metal formula fails. Beyond this point the sure would vary directly as the thick- dy so.—M.I.C.E.

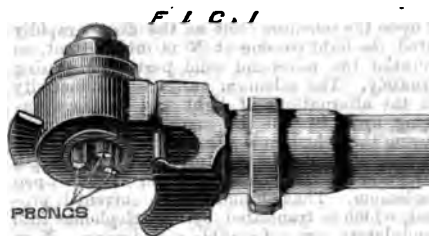
[44286.]—**Hand-pump.**—The top part is screwed out, and a "stuffing-nut" B screwed to it. B is turned out to slip easily over the hollow piston, and the space P is packed with greasy "tow," with a leather washer on top and bottom, and the stuffing-nut screwed tightly down. It would be easier to work if you had a lug cast on the side of the top body, and a lever to work it, as shown in the accompanying sketch. The lever



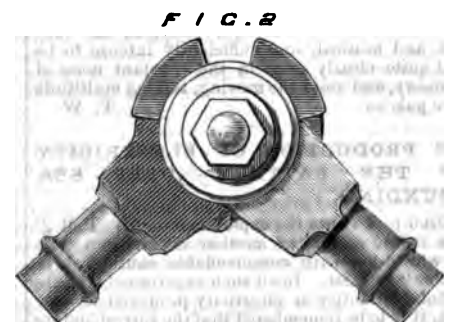
could be made out of flat bar-iron. The sizes of tube I should use would be: outside tube, 2½in. or 2½in., by 16in.; inside tube, 1½in. or 1½in., but I could not say for certain if that size would throw 8 gallons of water a minute without fatigue, but I should say it would. Have strong tube, and make all your joints well.—T. HARRIS.

[44361.]—**Exams.**—Before you can gain admission to the exams. mentioned, a nomination must be obtained. Consuls and Foreign-Office clerks are nominated by the Foreign Secretary. Clerks in the Duchy of Lancaster by the Chancellor of the duchy. Clerks in Parliament by the chief clerk. Inspectors of Mines by the Home Secretary. Should you have influence enough to obtain a nomination, you would probably be examined as soon as a vacancy occurred; but the time is uncertain.—C. S. COACH.

[44364.]—**Brakes—The Westinghouse Hose-Couplings (U.Q.).**—To "A DRIVER."—The Westinghouse brake "automatic coupling" was designed to supersede and dispense with the "tap" which was placed at each end of every vehicle; the same object is, however, attained by placing a valve in each coupling. When the couplings are connected the valves are open; when disconnected

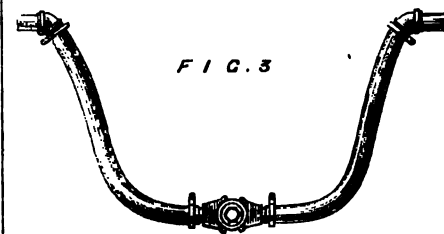


in the ordinary way they are closed; but when drawn apart by the separation of the train they remain open, and thus automatically apply the



brakes. The valve is simply a plain disc seating upon an indiarubber ring, and provided with three prongs. When the couplings are connected the prongs of the one enter the spaces between those of the other; it will, therefore, be seen that the pipes cannot possibly be united without the valves

turning round, and as this rotation causes them to be lifted off the seats a clear passage for air is insured. Fig. 1 shows a side-view of a coupling, and also the three prongs. The couplings are united by taking one in each hand, placing them face to face nearly at right angles to one another (see Fig. 2), and then turning them straight into the position indicated in Fig. 3. This latter figure also illustrates the hose-pipes complete, and the



attachment to the main iron pipe which passes under each vehicle. It has been already pointed out that a very important peculiarity of the Westinghouse brake is that the connections between carriages can be separated by hand without putting the brake "on," thus leaving the air stored on the train ready to be used upon any emergency, and it is a well-known fact that several accidents have been avoided by the use of the air which has been left in the reservoirs at a time when, for some reason, the engines drawing the trains have not been fitted with the Westinghouse brake. If a train breaks loose, the couplings are pulled apart; but no damage whatever is done to them. At the end of each vehicle a holder, or "dummy coupling," is fixed, to which the hose-pipes are attached when not in use. In conclusion, I may mention that the air-pressure within the couplings tends to hold them more firmly together and to insure an air-tight joint.—CLEMENT E. STREETON, Leicester.

[44372.]—**How to Clean Chamois Leather and Plate-Glass Windows.**—The leather should be washed in clean, soft, warm water, with some white curd soap. Dry them slowly and pull out and shake occasionally. Plate-glass looks best washed with a sponge and warm water, rubbed with old linen or cotton cloths; and, lastly, polish with the leather. A very slight dust of powdered chalk improves the polish.—AN OLD LADY.

[44372.]—**How to Clean Chamois Leather and Plate-Glass.**—Wet the chamois leather in water just off cold—not at all hot—squeeze it between the two hands, then lay it flat on a board or table, and rub soap over both its sides; do not treat it as if it were a coarse cloth, but keep squeezing and opening and opening and squeezing it in the hands to get the soap well through it. Next rinse it in several waters till the dirt is out—cold water always. Examine if more soap is wanted; if so, again lay the piece flat and rub the soap over every inch of it. Then press and squeeze and rinse as before until it becomes clean. Hang it up to half dry, then rub it in the hands to soften and stretch it, and continue this until it dries; finally, roll it in a mangle. I shall be glad if any contributor to "ours" can describe a better plan. Take a small piece of the very finest and softest flannel without crease or seam, or a few inches of superfine broad-cloth, dip this in powder blue, and with it clean your plate-glass, polishing with a rag of soft silk or fine chamois leather.—H. O'B.

[44460.]—**Eczema.**—If "W. W." would kindly furnish particulars of his fruit diet, with reference to the above disease (giving breakfast, dinner, tea, and supper—or as the case might be) he would confer a favour upon—AN OLD SUFFERER.

[44478.]—**Circular Saw.**—If "Learner" will look through your back volumes, he will find plenty of methods of mounting circular saws; for instance, on p. 231, No. 555; p. 223, No. 685. Also on p. 32 of the volume just completed there is an illustration showing several woodworking attachments for lathes, including a circular saw with movable guide and table, which I should say would just suit the querist.—C. K. T.

[44485.]—**Value of Olive-Oil.**—If only for lubricating purposes, I should say, Get one of Bailey's testers, which will show the quality of the oil as a lubricant by the time it runs.—S. R.

[44491.]—**Canoes.**—It is to be hoped that if any sailing races for canoes are got up on the Thames, the boats will be built to a standard and fairly safe size. Several lamentable accidents have occurred, even to skilled hands, and if racing is introduced, there will be a tendency to greater lightness and fineness. A canoe of 2ft. 6in. beam is not altogether a safe vessel for racing in on the Thames.—TWOKEENHAM.

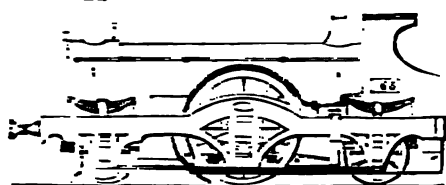
W. H. H. Narrow-Gauge Power.—Thanks to "S. R." for the reply to my query. I shall be glad to be good enough to state what amounts to the value of N.H.P. have inside the engine. As to my second question: I want the answer to a small question—although I should like to know what influence any particular kind of wheel has on the construction of an engine. I am using a 10-hp. power. Of course, leaving room for the engine out of the question.—**ARITHMETIC.**

Velocity, Volume, and Power of Water.—The velocity and volume of a river can be measured by actual measurement of the quantity of water flowing over a gauged sill in a given time. The theoretical velocity is found by $V = \sqrt{2gh}$, where V is feet per second, g is the height of water in feet. The pressure in water is $p = \rho gh$, but the effective horsepower will depend on the machine used.—**S. R.**

Barrel Saw Bench.—"Et Vitam" will be glad to tell what he wants in either No. 1 or 2. But there are several in back numbers.—**S. R.**

Tar and Water.—Heat the tar, stir frequently, and the water will evaporate.—**E. G. M.**

G. W. R. Narrow-Gauge Express-Engine.—"Kross" in his interesting reply to "E. F. C." query, has not mentioned the more recent ones of G. W. R. narrow-gauge express 7 ft. single engines, of one of which I inclose an outline. I have seen several of these lately on the



G. W. R. running both on the Birmingham and London sections numbered from 157 to 166. They have iron wheels, and the framing is somewhat similar to that of the broad-gauge engines; doubtless it was to use the "E. P." referred to in his reply to "E. F. C." They were built about a year ago, and have taken the place of some smaller single engines which had the appearance of having been converted from broad to narrow gauge. I have seen engines of the "1500 class," numbered from 1500 to 1510. No. 1515 is named "James Watson," and No. 1516 "Beaconsfield." No. 1517 is "St. Albans," and No. 1518 is "The Queen," and No. 1519 is "The Queen." I have obtained excellent photographs of several of these engines from Mr. Macdonald, whose advertisement sometimes appears in the "E. M." and who has published a descriptive catalogue of his photographs, including a list of the engines of each of the railways.—**S. R.**

Heating Workshop.—Why not project out of the large square iron stoves with radiating fins, or use of the American stove?—**S. R.**

Apparatus for Drying Powder.—Make a steam-jacket over with movable shelves, and make it in a tank of water that the hot air from the fireman's suit fans blows into and get all round.—**S. R.**

Electric Contact.—My remarks about electricity-controlled works having pendulums was intended to refer to those works in general, and not to Mr. McClellan's in particular. Indeed, I do not see how a pendulum could well be applied to a work requiring to return to such long intervals as a minute. It is evident that with a pendulum, and a contact every second, or two, seconds, the work is controlled by an occasional ring of the current, the ring of the pendulum keeping up the motion the whole. Both Eccles's and other systems have pendulums in the second, and these are having the most successful. As to the contact arrangement, the kind I have used in my experiments consists of a pair of very slender springs, not 0.1 in. long, tipped with platinum. These are mounted in an electric block, just behind the contact pendulum, and about 1 in. from the tip of pendulum-spring. A short length of platinum wire projects from the pendulum, and as the spring comes down the contact spring afterwards. I have no reason to be dissatisfied with this plan. It was worked about five years without being worn out. It may be occasionally, but as my contact block was a pendulum, I would not have been able to. I have had a great deal more trouble with the batteries than with the contact. The plan is one at the Greenwich Observatory, a drawing of the device, which is copied

from the *Horological Journal* (May, 1880). The lower spring is caused to rise into contact with the upper one, by means of a jewel-pin on the crutch-wire, passing under the steel semicircle A. At B are banking-pins to prevent accidental contacts from tremors. I fail to see any special advantage in this plan; on the contrary, I should expect it to offer more resistance to the standard pendulum than that described above. Also I should think it more liable to fail from particles of dust, &c. getting between the springs. However, I suppose it would not be used in the observatory, unless found satisfactory. If Mr. McClellan requires a contact every minute he can try the latter plan, mounting it so that the lower spring may be raised by a pin affixed to scape-wheel. In this case, instead of the steel semicircle A, it would perhaps be better to use a wedge-shaped piece, as the pin is not required to pass in both directions.—**J. E. FLOYD, Birmingham.**

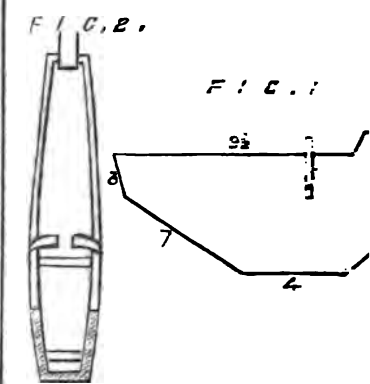
[44535].—**Barrel Organs.**—"Isis" will find the method of pricking tunes on barrels fully illustrated and described on p. 125, Vol. XX. He ought also see the instructions on p. 440, Vol. XIII.—**S. R.**

[44541].—**Texas or South Africa.**—It would be interesting to know why "Bachelor" allows himself so little scope—why he has set his mind on Texas or South Africa? Concerning the latter, I know nothing of Texas I know enough. It is a vast howling wilderness, full of malaria, thieves, and "cow-boys." Undoubtedly an engineman accustomed to the care of machinery in mills and manufactories, would find plenty of employment there, especially if he is young, and not too particular as to what he would do and put up with. But it is a mistake to regard Texas as an El Dorado. Although it is a vast State, and possesses in its different parts a great variety in climate, yet those sections where such work prevails as "Bachelor" could do, are, as a rule, very unhealthy, except for the man who has become acclimatised, or who was born in the sunny (but malarious and unhealthy) South. Men used to machinery are very much needed in this country, but not so much in Texas as in some other more thickly populated and more healthy localities. Let "Bachelor" come to New York, and then strike out to St. Louis, Missouri, or perhaps better still, Kansas city, a flourishing city also in the State of Missouri. He will find in either of these places a demand for mechanics of every description, at good wages. As I said before, concerning South Africa I know nothing. This much I do know. The United States are now the seat of a tremendous trade-boom, where everybody who knows how to work can find it to do at remunerative prices. Every man, woman, and child is better off for the existence of this boom. If it also has spread to South Africa, I have not heard of it. Certainly no man can do better than come here. If, however, he is wise, he will avoid Texas as he would the ague and the yellow fever. Tell the emigration agents, when they try to fill you full of sublime ideas concerning the Lone Star State (Texas) to "go hang."—**B. M. TUTTLE, New York, U.S.A.**

[44553].—**To Stain Ivory Black.**—The pieces are always first polished with whiting and water, and when washed quite clean from the whiting are then prepared for the stain by a short immersion of from three to five minutes in acidulated cold water, in proportion of one part of muriatic acid, the ordinary acid of commerce, to forty or fifty of water, or in an equally weak solution of nitric acid. This cleansing fluid extracts the gelatine from the surface of the ivory, and is essential to the attainment of a perfectly uniform colour. Extreme cleanliness and the absence of any grease or accidental soiling are as necessary, with which view the work in process of staining is at no time touched by the fingers, but is removed from one vessel to another by flat pieces of wood, attached to each other at one end by a flat metal spring after the form of a pair of sugar-tongs, separate pairs being kept for different colours. Subsequently to its treatment with the acid, the ivory is invariably again placed in cold water that has been boiled before it is transferred to the stain. Logwood stain is: make a decoction of two ounces of logwood in one quart of water, and stain; dissolve one ounce of sulphate of iron in one quart of water; then heat the two stains in separate vessels to 100° Fahr., and immerse the ivory in the logwood-stain for fifteen minutes; well wash, and then place it for five minutes in the sulphate of iron stain. From "Hiltschlagel," Vol. II.—**THOMAS STOW.**

[44564].—**New Violin.**—I hope "T. G." will get on better with the present explanation. The leg of the bridge comes down the outside, with a notch to rest on the top edge of soundboard. There must be no connection between the bridges beyond the soundpost, which is placed about two inches from, perhaps less; one bridge carries on its arch G and D strings, the other bridge carries on its arch A and E. There is a small space between the two bridges, as shown No. 2. The total length of

soundboard is 14 in. A letter will reach an address, in adv. column. I will send no receipt of stamped envelope: I will do



"G. J. H." if he will write. Many thanks Harris; the lathe might do the scrollwork tool would be expensive—at least, so I am FIDDLER.

[44613].—**Hydraulic Organ-Blow** reply to "E. F. C." I do not wish the work a shaft. I tried coupling the pist the feeder-handle; but when it got to 2 stroke (at each end) it stopped, and on m valve by hand it reversed. Thanks to "S If he is certain his arrangement would w factorily, without stopping altogether wha is shut off by the bellows being full, I w mence afresh, as he suggests; but it is hard to have to throw away all that I h I have a good pressure of water (about 500 the bore be reduced to 2 in. I do not u the piston-valve. Would you kindly giv with the style of working same?—**ORGAN-GRENDER.**

[44635].—**Boiler.**—Thanks to "Sam's his kindness in answering my question a power for engine with cylinder 34 d looking, however, over the figures he giv not make them tally with my working. 14 in. diameter of grate = 1.56 sq whereas "Sunlight" makes it 1.4 sq Also I reckon there are 14.0625 circular my piston, which would require in round 1.4 square feet of grate surface. Woul light" kindly inform me if I am in error c oblige—**AMATEUR.**

[44646].—**Collapse of Flues.**—If " will say what he really wants, I will t him. Does he wish the question workd incorrect formula which he sent? " should get a "Treatise on Steam Boi Robert Wilson, Crosby Lockwood & GLATTON.

[44672].—**Condensation of Steam.**—of steampipe, if the boiler and engine v short distance apart, is usually one-fourth of the cylinder. But for such a distanc proportions would be needed. Without the possibilities I should advise that t pipe be divided into three sections. The tion say 14 in. diam.; the next section the remaining third of the distance say But in any case, owing to the great leng there will be an immense loss of power, are many instances on record of the res steampipes and the great loss of power I have known cases where, with 35 lb. ste boiler, the pressure was so reduced that pounds could be got at the engine, and sufficient to more than drive it without great point will be also how this long leng is to be protected. If the radiation o pretty completely stopped as far as p then the result will be somewhat bett matter what is done, great loss must ens LIGHT.

[44684].—**Aneurism.**—Of what char it thoracic, abdominal, or where—is it on the inornate, the carotid, the subcl popliteal, the iliac artery, or otherwise right or left chest, under the knee, &c., a sac or fusiform; pulsating or nonpuls cannot be cured wherever it is; but I m following general formula for the smali the patient. Rest x diet - rest x fres light - rest x peace of mind. The cak rest in this formula is founded on string tions and elements; he must give up all and its worries, take off his clothes and and lie there in a horizontal position. Likely, many months, and his diet should what as follows:—Breakfast: bread a 60 grammes = 2oz.; milk, 60 gram Dinner: meat, 30 grammes = 3oz.; t

rammes = 3oz.; claret, 120 grammes per bread and butter, 60 grammes = claret or milk, 60 grammes = 2oz. 8oz. fluid. He should always feel take as little liquid as possible. I not touch the aneurism itself. Nevertheless may require medicine for the of other complications; perhaps a stomach, a congestive liver, an enlarged ailing heart which often accompanies. I don't believe in iodide of potash, puncture, nor some other medical I could name. "Nux" should be without a moment's loss of time, for the cool way he puts the question, might be in imminent danger without all conscious of it. As to operations; Dr. Erichsen's Address to the Medical the palm seems to lie at present ature and Esmarch's new bandage.—

Perspective.—If "J. D." can get at ster Nicholson's "Practical Builder," Kelly some fifty years ago, he will find actions how to draw lines to inaccessible ints within the compass of an ordinary rd by means of an instrument called a d.—J. W. W.—s.

Bending Wood.—You want, for. This can be bent to any shape easily ell boiling in water, or steaming, even. oughly hot and moist, you will find no bringing it to the shape you want. woods will yield to this class of treat- e you buy are thus prepared and bent.

Magic-Lantern Photo. Slides.—thank "Sunlight" and others for y query. The way I have been trying n is by taking a negative from a print; another gelatine dry-plate in a print- gaslight. I have tried several kinds, but failed to get them satisfactory. be perfectly clear glass and the shadows ey were printed, similar to the ones hops, who inform me that they are not m gelatine plates. I have not tried t the sky, as in some pictures that y difficult. In Mr. Dumfries' method how the positive is printed, as you a wet plate against a negative. Any mation will much oblige.—AMATEUR

Pressure of Heated Air.—A cubic asured at 0° Fahr. gives a pressure of uare inch (or one atmosphere), when °, owing to its tendency to double its t temperature. At 300° the pressure 300 = 9.8lb. That is, if the initial 459 were zero; but starting from the perature of 60°, it will be 15 × —DUNROD.

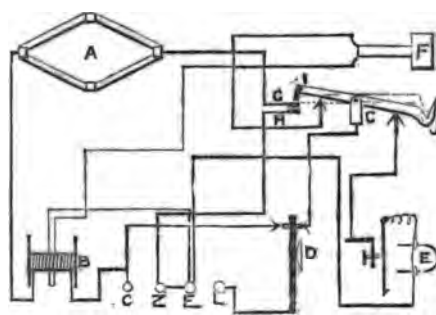
Minerals.—For study, use Collins's 7," published in Collins' series of :Books. Start with the Elementary, he Advanced, and skipping Crystallol- is limited. The tables at the end of ler edition are very good for reference, pers published a year or two ago on ation of Organic Acids to the Discrim- Minerals," may also be useful. If the ocess to a mineralogical collection, in elsewhere, he should take his book i study there, with the objects before g to recognise each of them by "head- paying particular attention to their iposition. To ascertain the constituents by its blowpipe reactions, is a matter ble difficulty, and requires long prac- chemical examination has to be made actions given by liquid reagents are rthy, especially in unpractised hands, ts before the blowpipe, and are quite lied.—DUNROD.

The Sun's Longitude.—I am A Fellow of the Royal Astronomical answering my question as to the Sun's igitude, although I fear that I am too derstand it; but it follows that the rticle 308 of Hymer's "Astronomy," e Motion of the Aphelion," is not et, and I should be glad to know of ich would enlighten me. While upon may I ask if the *Nautical Almanac* for rrect in giving July 1, 4h., for Sun H. K.

Cleaning Violin.—Stale beer or rwards French-polish.—FIDDLER.

Telephonic Query.—I hope this i will suit "Volo non Valeo":—A, B, induction-coil; C, switch; D, ; E, bell; F, telephone; G and H, springs for putting the battery through

transmitter and induction-coil; I, ebonite stud let into the end of lever J, to close local circuit. All



wires covered, with exception of working surfaces. All contacts to be platinum.—SCIENCE.

[44742.]—**Mill Gearing.**—The horse making 2 rev. per min. with wheel of—

	71 teeth	
	2	
Teeth in pinion 11	142(12 × 10 speed of first	
	11	counter shaft
	32	
	22	
	10	

With driver of 61 teeth
12 × 10

Teeth in pinion 11	742(67 × 5 speed of
	66
	82
	77
	5

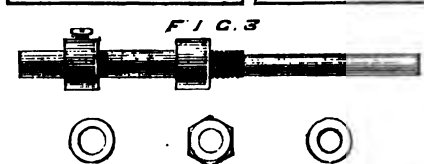
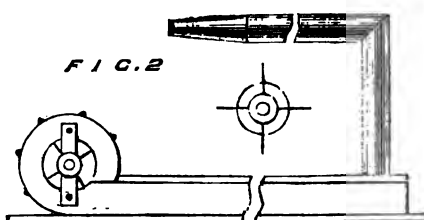
Second counter-shaft 67 × 5
18

Diam. of driving pulley 541
67

Speed required 2,00)12,11(6 diam. of Pulley on
12 mill,
or thus—
Speed required 15,0)121,1(8 diam. of Pulley on mill
120 in inches.

—DELTA.

[44749.]—**Fan for Smithy.**—I send illustration of fan I use by steam for making small iron



DESCRIPTION OF DRAWINGS.—Fig. 1 is plan-view of trough of wood leading to the pipe H (J in Fig. 2, which is an elevation of the apparatus). In Fig. 2 the fan consisting of four sheet-iron blades is shown separately, the disc being of wood 1/4 in. thick, in which the blades are pinned as shown at the periphery. The fan is also seen in part through the wind inlet or suction. Fig. 3 shows the spindle with fixed collar, and movable nut and loose collars.

and brass castings, which is very successful. I convert an old grate into a furnace, which I line with green-sand and brown coals; the blast from

this fan will support a ball 2 1/2 oz. in weight.—E. B. DALL, Fell. Soc. Science, Sherborne.

[44751.]—**Loss of Voice.**—Unless "Lizzie" is of the peculiar temperament which eggs disagree with, she will find great benefit from swallowing several raw fresh eggs per day, say, with an interval of three to four hours between each.—H. O'B.

[44753.]—**Painting on Terra-cotta.**—"Y." will be much obliged if "Marguerite" will give the information so kindly offered on painting in oil and china colour on terra-cotta.—Y.

[44757.]—**Coin.**—ERRATA.—Stephen Bathony should be Bathori; Ferdinand of Stieria should be Styria; "Michael the First, of the house of Romanof," should be Michael, the first of the house, &c.—G. J. H.

[44762.]—**Midland Engines.**—Nos. 5 and 21 are single-framed four-coupled passenger-engines, rebuilt 1878, of the 2 or 40 class, with closed splashers. No. 28 is a single engine stationed at Carnforth, and employed, together with No. 28, to run the night mails to Normanton. In 1879 the old boiler was replaced by one which belonged to some other engine (I believe one of the 800 class). There is, therefore, no date on the engine. 610 is an outside-framed goods engine, built by Kitson, in 1867, and No. 1,463 of his build. 1,160 is a single-framed goods, built by Kitson and Co., in 1875, and No. 2,020 of their build. 1,223 (same class) Neilson, 1876, No. 2,083. 1,312 is a 6ft. 6in. coupled bogie express engine, built by Kitson and Co., in 1876. I do not know the maker's No. No. 22 is one of the smaller rebuilt 800's, rebuilt 1876. I do not know the date of 444, but can tell "J. L. F." that several engines about that No. were rebuilt in 1871-2. If 444 has no cab, the date is most likely 1871. No. 368 was built by Sharp, Stewart, and Co., in 1855, but I do not know when it was rebuilt. Can "J. L. F." give me the dates and maker's numbers of 770, 930, and 990.—MERION.

[44767.]—**Geology.**—I should think that the "Tabular View of British Fossils" (Stanford) would be of some use to J. Hale in naming his specimens; but the best thing he can do will be to compare his fossils with those in some good collection, such as that in the Museum of Practical Geology, London. The Gault ammonites are not rare, several species being met with in other rocks of cretaceous age.—TITTSWORTH.

[44767.]—**Geology.**—J. Hale would probably find some of his fossils figured in the "Tabular View of Characteristic British Fossils," published by E. Stanford, London, price 4s.; but if he wishes to name his geological collection thoroughly, he should try to get access to a copy of the publications of the Palaeontographical Society. These consist of a series of monographs on the different geological strata, with figures and descriptions of all the fossils found in them, and comprise about 30 quarto volumes. This, of course, is too expensive to be purchased by a dilettante student, but many free libraries possess a copy; or if J. Hale is acquainted with a Fellow of the Geological Society, he might be able to obtain the loan of a volume at a time from that society. If J. Hale is near to a public museum he may there find specimens of some species of his fossils named, and if he can secure the aid of the curator of such a museum, he might be able to get access to specimens which are not exhibited in the cases but arranged in drawers, as is often the case in a museum. Instead of ammonites being rare in the gault, they are rather characteristic of it, about twenty-one species being found in that formation.—AMEBA.

[44769.]—**Launch.**—To "SUNLIGHT."—Two cylinders are by no means a necessity. The use of one merely requires arrangements that are not needed with the two. When one cylinder is used, the moving parts require to be merely counter-weighted—when a balance weight of very moderate size is required, as if the engine is balanced, the temptation to stop on the centre is greatly eliminated. You would not need to place the counterweight otherwise than on the main shaft. One 4in. cylinder would be far better than two 2in. ones. As to proportions, I should want to know the pressure of steam you proposed to carry, and up to what speed the engine would be run. I could then tell you the sizes of rods, &c., boiler, and other parts. The class of screw I should advise is the Griffith's, or a modification, and its diam. must be, to some extent, governed by the draught of water of the boat aft. You had also better say the beam of your boat, as that is an element in the consideration of the class and sizes of boiler. Do you propose to make this yourself? As to the engines, there are a variety of plans to save weight, &c., one being to make the boiler-end act as the vertical bed of the engine. I do not altogether recommend this, as it naturally throws undue strain on the plates; still for small work it does not so much matter. Have you patterns of

any kind for the engine, or will you have to make them? I mention this as I have patterns of several sizes and classes, and if I could do anything to assist you, I am at all times pleased to do so.—SUNLIGHT.

[44772].—Beams and Girders.—The arrangement of girders and beams, as shown in the diagram, if tightly bound together, may, for purposes of calculation, be considered to consist of a solid body, with two projections, one at each end, such projections consisting of the ends of the lower girder and beam; now the points of support are situated so nearly below the junction of the projections with the solid body, that a weight placed on the top of the solid body would, if heavy enough, cause the whole to break down through the "shearing" of the projections from the main body. As the resistance to a shearing force varies directly as the area of the section of the girder or beam where the shearing force is applied (such resistance also varying with the nature of the material) we could easily calculate what weight would be required to break down the whole arrangement; but here a difficulty presents itself. The web of the girder is thin in comparison with the flanges, which are $\frac{1}{2}$ in. thick, that the web would collapse before the flanges could be subjected to the shearing strain. Hence, in calculating the strain, it will be safer to take the sectional area of the web only, which is 19 square inches. If a weight, W , be placed on the top of the girder, half the weight or $\frac{W}{2}$ will

represent the reaction at each support. The sectional area of the web is 19 square inches, and the shearing strength of iron is about 50,000 lb. per square inch also, the sectional area of the beam is 285 square inches, and the shearing strength of American oak is 6,000 lb., so we get the equation $\frac{W}{2} = 19 \times 50,000 + 285 \times 6,000$

from which we get $W = 2,200$ tons. One quarter of this would be a safe working strain, or say 500 tons, which may be placed either in the centre or distributed over the length of the girder. I am aware that this value for W is rather under the true value, because before the strains on the web can be brought into action the flanges must be strained to a certain extent; but this again would depend so much upon the straps or bolts binding the several girders and beams together, that I have left out the strains on the flanges, and it is better to be on the safe side. Now let us see what weight can be supported by the lower girder and beam alone. In this case also the girder will fail by the shearing of the webs at the ends. The oak beam will give but little additional strength to support the weight, as, being made of a more pliable material than the girder, it will bend much more than the girder when supporting a weight, so that when the girder is fully strained, the beam will be strained to only a portion of its full strength; the resisting power of the oak beam may therefore be omitted, and there remains only the resistance to shearing of the webs of the girder, or $\frac{W}{2} = 19 \times 50,000$, or $W =$

about 900 tons. It will be seen from the above that the enormously thick flanges are not brought into play at all: this could only be done by making the ends of the webs stronger (where the shearing force is applied) by attaching plates of iron by rivets on both sides of the web; these plates should be at least two feet long. A girder so strengthened would bear an enormous weight, which can be easily calculated.—M.I.C.E.

[44775].—Feed-Water Heater.—"To SUNLIGHT."—Unfortunately, you omit to furnish data of the greatest importance, as bearing directly on the question of the space at disposal for the feed-heater, and also the class of boiler. This last is valuable, as enabling one to better arrange the disposition of matters; thus, for instance, there is the "Green" Economiser, "Hawkesley and Co." Expansion Feed-heater, "Atkinson's" Feed-heater, "Benjamin's," and several others of that class. Then there is "Hamilton and Co." heater—all these being nearly of a class. And besides those named there are many others which I could name did space allow. Then also we have those of an older type, such as the simple form of coil in a tank, as also the one I much like myself, the Annular flow-heater. All the first-named group are somewhat expensive, whilst the last-named are the cheap ones. If you have a chance of fixing a long-heater by the side of, or on the brickwork of, the boiler, then I should recommend the Annular form. I therefore await your statement as to available space, and if a vertical or horizontal would be most suitable. And with this information I will be pleased to fully describe a suitable heater. As to heating factory by the exhaust, I am strongly against anything like a long run of exhaust piping. If the part you wish to heat is pretty close, the run of pipe not very long, and you do not require to utilise the remainder, then you might, under certain conditions, after passing the heater further, make use of the exhaust steam. The length of

pipe would depend on the size to some extent.—SUNLIGHT.

[44776].—Mining.—(1st) I would pump the water from the upper seam to the surface, which would keep you from difficulties as regards the safety of the men. (2nd) So, to free you from the water from the tow seam, place a couple of good strong suitable dams about seven fathoms below your middle seam. (3rd) How you may ascertain the quantity of water your siphons contain per minute. I think you may find very useful rules which will suit your question in a small book by Box on "Practical Hydraulics."—J. MURRAY.

[44776].—Mining.—1. You have scarcely given us enough particulars of the seam in question to allow of a purely practical reply to your query. As the seam of coal worked out above you is filled with water, and the thickness of intervening strata is so small, pillars of considerable size must be left, and the system of working will have to be that known as the "bord and pillar," the bords being driven not too wide. Any attempt at working the pillars in second working will be sure to cause considerable fracture of the roof, and a consequent irruption of water from the old workings above you. You do not state whether there is a constant feeder of water; the question would suggest itself whether there is a sufficient quantity of coal to be worked to render the withdrawal of the water in the old workings a profitable proceeding, as were this done, either by boreholes or pumping, the whole of the coal in the working seam could be removed by "long wall," or in the pillars. 2. Are we to understand you are working a siphon with 30 ft. rise, that is to say, the highest point of the siphon 30 ft. above the water at the tail-pipe, because, if so, you have cause to congratulate yourself upon a performance not equalled in my experience: 24 ft. lift is considered good work, 34 being the theoretical limit. You may calculate the quantity of water running by the following formula where p = pressure in feet, d = diameter of pipe in feet, l = length of pipe in feet, and v = velocity per minute in feet = $2837.5 \sqrt{\frac{p \cdot d}{l}}$

—T. E. J.

[44778].—Loco. "Cornwall."—The diam. is 8 ft. 6 in. It is an old engine of Trevithick's (the former engineer to the N.W.), but has been altered considerably by Messrs. Ramsbottom and Webb. It now has the appearance of a N.W. 6 ft. single outside cylinder in build, only on a much larger scale. Mr. Webb has put a "cab" on it and one of his iron safety valves. The piston, rod, slide, and connecting-rod are much more hidden by the framing than is the case with the 7 ft. 6 in. engines ("Wellington," &c.). The leading and trailing wheels have outside bearings. "Wellington" has a 7 ft. 6 in. driving wheel, single and outside cylinders. The piston, slide, &c., are quite open, and the leading and trailing wheels have inside bearings. It has also a cab and iron safety-valve.—DIOMED.

[44779].—Pond-Making.—The cheapest method would be to line the pond with good clay several inches thick.—A WOULD-BE PIPER.

[44781].—Praxinoscope.—It is not absolutely necessary to have exactly the same number of mirrors as there are figures on the paper, but it tends to the better working of the instrument if the numbers are the same. The mirrors should be fixed perpendicular to the centre.—A WOULD-BE PIPER.

[44781].—Praxinoscope.—I think you will find that when the number of figures differs from the number of slits in the zoetrope, or of mirrors in the praxinoscope, they represent progressive movement of some kind, such as a person running, boat under weigh, &c. If the number of figures and slits is equal, the figures appear to remain stationary, and do not progress in any direction. A little study of the principle of the instrument explains why.—J. BROWN, Belfast.

[44785].—Boiler Firing with Gas.—To deal with the matter fairly, I must say that the boiler described at page 22 is not the most suitable of boilers for using a gas-fire; but that it could, by a very little modification, be made fairly efficient. If I was about to design a boiler for gas-fuel, I should use a different form somewhat. But supposing you had a boiler similar to the description, what I should do would be to have a cast-iron box made to fit inside the fire-box, and to come up almost level with the bottom of the fire-door. For an illustration of the burners see page 477, Vol. XXXII., where you will see my plan for applying it to a boiler of the loco. type. In your case, you would, of course, bring the gas-nozzle and the air draught under the edge of the bottom of the shell; and if you like, it might be either inclined or horizontal; so long as the area for mixing the air and gas is ample, the shape matters little. For a vertical I should certainly use plenty of coke on the burner, which, in a short time, with the aid of the gas, gets a brilliant fire. But with coke or any fuel which does not give off

flame, it is well to keep the mass of the fire as solid as practicable to the heating-surface. Hence: raising the firegrate practically.—SUNLIGHT.

[44786].—Harmonium.—I should advise Grant to have a complete set of 16 ft. reeds in instrument, instead of his proposed set of 13 not. He will then have a bourdon bass and clarinet treble. The clarinet, if properly voiced, will be a beautiful solo stop; the bourdon will add power and depth of tone to the bass portion. I also recommend the broad reeds for the bourdon clarinet, diapason, dulciana, and vox angelica; the narrow reeds will do very well for the 4 ft. flute. The dulciana set should be voiced to produce a soft sweet tone. The dimensions of the p. for the 4 ft. would depend in a great measure on the position of the other pans forming the same board. Be very particular in making the pans, a good tone depends greatly on the proper construction of them.—G. FRYER, Swansea.

[44787].—Guitar.—Guitars range in price from 12s. 6d. to £25; therefore, it depends upon the amount given for it whether you have a good instrument or not. Secondhand guitars are of doubtful value, and it would be wiser to purchase a new one in preference to a secondhand instrument. They are made with peg and machine heads, the latter being preferably the best. You can get a very tidy one for about £2. They are also manufactured with white ivory and pearl edges; these range in cost from £7 to £10. A good guitar tutor can be obtained for 2s. 6d. or £1 from G. Butler, Haymarket, London.—G. FRYER, Swansea.

[44788].—Microscopical.—If "Country Student" will send me his name and address, I will with pleasure send him copies of notes of papers on the matters he inquires about.—J. R. FOCKINGHAM, Handsworth, Birmingham.

[44788].—Microscopical.—From personal experience, I can strongly recommend the "Country Student" to use the microscope specially prepared by Mr. Swift, of Tottenham Court-road, London, for histological research. With regard to his question—viz., how to use the instrument, if he will advertise his address, I will be most happy to give him any information he may require from time to time. The preparation of objects for the microscope, and especially those of a physiological nature, is difficult and intricate. I would advise him to use as his guide, first, for general microscopy, Dr. Carpenter's "The Microscope and Its Revelations," 15s.; second, for physiological purposes, the little book of Dr. Marsh on "Section-Cutting: a Practical Guide to the Preparation and Mounting of Sections for the Microscope," 2s. 6d.; both books being published by Messrs. Churchill, New Burlington-street, London.—E. FOULSTON.

[44788].—Microscopical.—Presuming that "Country Student" wishes to study animal histology, I would recommend him to procure student's microscope of any good maker. Such an instrument, with a 1-6th or a 1-4th and a 1-in. object glasses, should cost from £5 to £10, and he would be able to add other powers as required. He should also obtain Beale's "How to Work with the Microscope" latest edition. If his object should be to study the lower forms of life, Carpenter's "The Microscope and Its Revelations" is a good book for beginners. In studying histology there are four principal operations to be learnt—viz., teasing out—i.e., separating fibres in fibrous tissues such as the muscular, nervous, &c., cutting the sections, staining, and injections of the capillaries and lymphatics. A student would naturally begin with the easiest of these operations, that is, with teasing out. For quite a beginner it is well to begin first separating vegetable tissues. A small piece of cabbage-stalk (in default of rhubarb-stalk, which is better), after being well boiled, may be teased out with great facility so as to demonstrate the spiral vascular tubes. If a "Country Student's" microscope is not provided with an erector (which is an arrangement for reversing the reversed image in the microscope, so that the object is seen the right way up), he must have dissecting microscope which he might make himself with a little ingenuity. It simply consists of a large stage for the object, a holder for simple lens, and an arrangement beneath to cast a flat mirror. Having provided himself with couple of fine needles, each mounted on a wood handle, his equipment will be complete for the present. The boiled cabbage-stalk being placed on a glass slide, with a small quantity of water, may proceed to separate the spiral tissue on dissecting microscope by the aid of the needles beneath the simple lens or compound microscope with erector, as the case may be. When he has acquired great facility in this operation he may proceed to more difficult subjects. A small piece of well boiled mutton, treated in the same way, will give him an insight into the structure of muscular tissue, and when he can succeed in separating this tissue into its component fibres and fibrillae, will have acquired a considerable amount of mass

ity. The above will give him work enough next few weeks; therefore I will say no more at present. Beale's or Carpenter's books will show how to adjust and use the microscope, a former shows all the operations necessary a study of histology.—A FELLOW OF THE AN SOCIETY.

90.]—L. and N.W. Engines.—Lucknow, 868: Sirocco, September, 1874; Harrowby, sr, 1878; Delhi, Ap., 1868; Senator, Sept., Peel, March, 1862; Hector, September, 1870; on, July, 1864; Waterloo, Feb., 1864; Star, 1860; St. Patrick, October, 1874; Tennyson, 1869; Roberts, July, 1864; Princess adra, January, 1863; Thunderbolt, October, Firefly, February, 1865; Clyde, Feb., 1863; areil, January, 1866.—DIOMED.

92.]—Tricycle.—You cannot do better than machine with from 40in. to 44in. wheels, of open-front class most certainly; and if your will permit, a machine that drives both wheels. If you want to save expense, then might have one with single drivers. But at present moment I am awaiting the testing of machine I mentioned at page 65, and which seems to be the best I have yet seen. I will, as I have given it a practical test, let you with the result. Next to this new one, I should myself buy an open-fronted one either both or one of the large wheels driving, going to the amount I had to spend, with, of back-steering wheels, say, 40in. to 44in., preferably chain driving-gear. But that must be the class in which the chain is made with friction rollers. The brake is certainly best drivers, either on the hubs with a steel brake or with spoon brakes acting on the tires. If not over-strong muscularly, then have the driven with level gears. That is, the treadle makes turn for turn with the driving-wheels. If robust, then have your 40in. or 44in. geared up to equal 50in. But don't go over or you will find that at hill-riding it will tell against you. Therefore, for easy at a slight loss of speed, try 40in. wheels, geared. I myself much prefer the chain to intermediate wheel for the drivers, although is a wheel lately introduced that is likely to do work. There is one point more I would on that makers do not appear to consider. It have your back-wheel not less than 13in. diameter, and 20in. to 22in. is better still.

with 20in., and it gives a command and fitness of steering that the smaller wheel fails to. For ease in riding, adjust the seat well. But do not too much reduce the weight back-wheel, or you will find that the steering is uncertain. Such a machine as you describe suits you well.—SUNLIGHT.

93.]—Rook's Tables of Cost and Profit.—"One Who Had to Leave School at Eight of Age" should notice the heading of the first column in Mr. Rook's book. If he wants on 27½ per cent. to the cost price, he will see amount in the third column. If he wishes on 27½ per cent. of the money received from transaction as profit, he will find it in the fourth column. The rule for this fourth column follows:—As 100 less the rate per cent. is to 100 as the amount given to the amount required in the case he gives, may be stated thus:—

As 72½ : 100 :: 10s. : 13s. 9½d.

Business men should calculate their profit on return of the money, and not on the cost price, as there is no profit realised until the merchant has got the money safely into his pocket. Then, and not till then, he calls this amount the purposes of his proportion 100—out of the 100 he has to replace the capital originally invested—and the remainder is profit. Hence, whilst all may return over 100 per cent., a business man can return 100 per cent.—G. HIRST, Whitby.

990.]—Rook's Tables of Cost and Profit.—The "Return" column may be found by multiplying the cost by the rate per cent., and dividing 100, less the rate per cent. Thus, in the example on, multiply 10s. by 27½, and divide by 72½ (that is, 100—27½), and the result will be 3s. 9½d., which, added to the cost 10s., gives the figures in fourth column. This may be simplified by being turned into a vulgar fraction, and then reduced $\frac{27\frac{1}{2}}{72\frac{1}{2}} = \frac{11}{29}$.

Now multiply by 11 and divide by 29, and the result will be the same as above. All other figures in this column under the different rates may be calculated in the same way, some of them may be turned into very simple fractions. For 5 per cent. add 1-19th, for 10 per cent. add 1-9th, for 20 per cent. add 1-5th, for 25 per cent. add 1-4th, and for 33½ add 1-3rd. Some years ago I was a large wholesale firm who invoiced a certain quantity of goods at cost price with 10 per cent. added, as a large trade was done with little risk or trouble, they, at settlement, gave 7½ per cent. discount. They supposed they had a clear 2½ per

cent. profit; but of course it was not so, as they found to their cost at the end of the day. If they had added 1-9th, as above, instead of 1-10th, the profit would have been as they anticipated.—EDINA.

[44794.]—Induction Coil.—Such a coil should give ½in. to ¾in. spark; but if the insulation be imperfect, the spark might be shorter, though perhaps not altogether invisible.—J. BROWN, Belfast.

[44796.]—Calculating Live Weight of Animals.—The following account of the method of calculating the weight of animals by the pen may be found useful to "J. O'S."—Rule 1: Multiply the square of the girth of the animal by the length, both in inches, and the product, multiplied by the decimal .07958, will give the content in cubic inches; which divide by 576, and the quotient is the weight of the animal in imperial stones of 14lb. Rule 2: Multiply the square of the girth by the length, both in inches, and divide the product by 7238, and the quotient is the weight in imperial stones. Rule 3: Multiply the square of the girth by the length, both in inches, and the product multiplied by the decimal .00013816, the product is the weight in imperial stones.—PHILODEMUS.

[44798.]—Tricycle Wheels.—A 48in. wheel should have a hub 6½in. to 7in. between the spokes. The larger the wheel, the wider the hub should be. But although this is a very good rule, still, a wheel of the size you name with the hub but 5in. from spoke to spoke, should be quite strong enough—that is, if the reduction of the width was balanced by additional strength otherwise. The reduction of space would not matter as long as you ran on good roads, and did not violently throw the weight on one wheel at an incline. Looking at the question all round, I should say that if you are a fairly careful rider you may reasonably use the narrower hub with perfect safety.—SUNLIGHT.

[44799.]—Erecting Small Engine.—Let me have the following sizes: (1) length of the bore of cylinder inside the covers. (2) length through of front cover and gland. (3) dimensions of valve-face and sizes of ports. Would you like the general arrangement similar to the sketch of engine at page 192, Vol. XXXII. ? If so, it will give me great pleasure to afford you the information you ask.—SUNLIGHT.

[44800.]—Daniell's Battery.—The fault is not in your zinc-plate, nor is the deposit copper. I think you will find, if you know how to detect it, that the deposit is iron, which results from impure acid or bluestone. If you use sulphuric acid, it should be colourless, while that generally sold, especially at oilshops, is tinged with yellow, due to the presence of iron. Is your bluestone clear, or is the appearance somewhat dulled, and are the crystals free from a whitish incrustation?—S. G. O.

[44800.]—Daniell's Battery.—The muddy deposit is a mixture of copper oxide and the impurities in the zinc. It is caused by the soaking through of copper sulphate into the porous pot with the zinc, and zinc sulphate forms, and metallic copper is thrown down in an impalpable powder, which quickly oxidises into the black copper oxide. It cannot be entirely prevented; a rather finer-grain porous pot may be necessary. Use a semi-saturated solution of zinc sulphate instead of dilute acid, much less waste from local action then ensues.—ELECTRICIAN.

[44800.]—Copper Deposit.—Daniell's Battery.—The querist has some sulphuric acid that contains nitric acid, and perhaps, arsenic; buy the purest you can get of some wholesale druggist, and mix and mix the solution some time before using; that is, let it be quite cold before you put it in the porous cell. I was troubled in the same way, but I now test the suspected acid thus—put an equal quantity of pure sulphuric acid with it in a glass and then add carefully a concentrated solution of sulphate of iron; if any nitric acid be present, a black ring will form where the two liquids meet.—AN ASSOCIATE OF THE SOCIETY OF TELEGRAPH ENGINEERS.

[44801.]—Brass-Melting Furnace.—Crucibles for above are made of fireclay, or of a mixture of fireclay and plumbago; but if "Amateur Brassfounder" will write to Thomas Fletcher, Warrington, as per advt. on page vii. of this week's paper, he will receive valuable information as to small furnaces and crucibles.—A WOULD-BE PIPER.

[44801.]—Brass-melting Furnace.—Much depends on the question, viz., the quantity of metal you want to run at a time, and whether you have gas or not at hand. If you only want to melt, say, 2 or 3lb. at a time, your best and cheapest way, in my opinion, is to either buy or (I do not know whether it is fair to Mr. Fletcher to say this) make an injector furnace of that gentleman's pattern. If you have not got a gas supply, then it is a question of the maximum quantity of metal you would want to run. I would then describe a new class of furnace to do the same in. The metal

must be run in a crucible, preferably a plumbago one, as being cheap in first cost and lasting well also. On having a reply to my questions as to quantity, and if gas supply be available, I will give the desired information. But I should strongly advise a gas-furnace for small quantities.—SUNLIGHT.

[44803.]—Firegrate for Lancashire Boiler.—Your boiler is about 30-h.p., and I should recommend you to use firegrates, say, 7ft. long—firebars in two lengths. Dead-plate from 15in. to 16in. long, and the width of furnace of course. I should also incline the grate a little, so that the end of it nearest the bridge stood about 3in. lower than the front end. To carry the front end, as also the middle and back ends of the bars, I much prefer a simple piece of square-bar iron with the ends bent down—say, 3in. to 4in.—and these bent ends curved to fit the furnace-tube. This saves drilling any holes in the furnace, which I greatly object to. The dead-plate can easily become the doorframe, and the bar that carries the one end of the first length of firebars. Even better than the square bar is a piece of tee-iron with the web cut away to allow of the ends being forged down to fit the tube. Don't have any holes drilled in the furnace.—SUNLIGHT.

[44805.]—Hot-water Heating.—So far as I can see, your plan will do, with one or two exceptions. Don't use the pipe from the tank T in conjunction with the return from the coil. Carry a pipe from the bottom of the coil direct back to the boiler, or, at least, do not connect it with the back flow from the tank until they reach the lowest level of the boiler. The pipe from the tank C may join the pipe from the coil in the return, but it should go in at a side inlet, not to form a direct portion of the return, as shown in sketch. Let all turns be rounded elbows, not right-angle turns, similar to the junction of T with the straight part, as that would tend to check the flow. Also use but one expansion pipe, and that on the coil.—SUNLIGHT.

[44806.]—Jet-Working.—Small chisels of ordinary shape are used in turning jet on a lathe. The action is more of a scrape than a distinct cut. A knife the size of a penknife, with the point bevelled off, and then set like a chisel is used in carving-jet. Jet is first polished on a revolving wooden wheel with rottenstone and water, and then finished off on a board covered with stout leather—often porpoise-hide—impregnated with rouge or lampblack, mixed with a very small quantity of oil.—G. H. WHITBY.

[44807.]—Lighting.—Reflectors that would stop light going upwards and send it out towards the sides of the room might answer. Try a flat tin plate immediately over each burner, with a portion cut away for the escape of heated air and smoke, &c. I have found such an arrangement increase the illumination of distant parts of a room. The effect could be tried with one burner first, the others being turned off.—J. BROWN, Belfast.

[44809.]—Electricity for Light, Motive Power, and Heat.—The proposed plan would, no doubt, succeed provided the windmill was large enough, cheap enough, the house stout enough to carry it, and the dynamo willing to work with such an irregular motor. The above are, I think, all the conditions from the non-fulfilment of which difficulty may be expected.—J. BROWN, Belfast.

[44810.]—Soldering.—Have you tried dipping the soldered work into hot water, with a little ammonia in it. When well dried, you will not be again troubled with the beads of fluid.—SUNLIGHT.

[44811.]—Crank-Shaft.—I should first borrow a couple, if possible, of hydraulic jacks, then remove the cap of the bearing; block up the end of the shaft, lifting it with the jacks until clear of the bearing, so that the brass can be removed. It need not be lifted more than about 6in. to 8in. Having got the one end lifted, next lift the other end in the same way, well securing the shaft from rolling either way. Now fit the new brasses to the shaft and also to the plunger-block, and level both of them up true. Next lower down one end at a time of the shaft into its place again, and the job is done without much trouble and expense. Such a job would not give me any trouble, from the fact that there were no beams overhead to lift by. Anything further you may want to know I shall be happy to tell you.—SUNLIGHT.

[44813.]—Kindergarten.—The information that "India" asks for on this subject would occupy more space than it is likely the Editor would grant; but it will be found in a tolerably concise form in a 6d. pamphlet entitled "How the Human Plants are trained in a Kindergarten," lately published by Messrs. Sonnenschein and Allen, Paternoster-square.—BLANKENBERG.

[44814.]—Lathe.—The small wheel, or rather speed on the mandril, must be according to the

class of work you are going to do. You do not say the height of the lathe-centre. With a fly-wheel of 24in. diam. the pulley on the main shaft for wood-turning should be from 2.5 to 3 in. diameter; but for brass or soft metal it should be larger, as it would drive too fast. For wrought-iron, even of small diameter, you would require to still further reduce the speed, and for cast-iron you would want back-gear to do anything with. Each class of work requires a different speed, with wood the highest, cast-iron the slowest.—SUNLIGHT.

[44815].—Star-Antimony.—The metal is melted, and then allowed to solidify quietly under a layer of slag, in order that it may assume the beautiful fern-like crystalline markings on its surface which have gained for it the above name.—A WOULD-BE PIPEF.

[44817].—Speed of Pump.—If a lift pump is driven fast the barrel does not fill. I should consider that a 5in. pump with 24in. stroke should not be driven over more than 30 to 35 strokes per minute at the outside, as that would give at least 120ft. of piston (or rather bucket) speed per minute, and that is quite enough. Therefore, the length of stroke you name would be the outside when coupled with the speed quoted. Is the above the information you desire?—SUNLIGHT.

[44819].—Coin.—"Alf's" coin is a quarter-guinea, a little light from wear. If Geo. I., the face is turned to right, and arms on four shields in form of a cross; if Geo. II., the face is to left; if Geo. III., the face to right and arms all on one shield.—G. J. H.

[44821].—Clarifying Temperance Drinks.—If "Light and Bright" will advertise his address, I can assist him in this matter. I have had a good deal of experience in this business.—R. B.

[44823].—Inhaler.—To G. H. WILKINSON.—"M. R." has no need to change the camphor-water at all, if he puts into the bottle a few pieces of camphor; without doing so the strength soon begins to diminish. I hope "M. R." will continue the use of the inhaler, and I have no fear but that he will derive ultimate benefit from it. Another very good plan of inhaling camphorated air, and one, too, that in construction is rendered portable, is to get a small piece of quill, say, about one and a half to 2in. long, open at both ends, stop one end with a small bit of cork, fill the tube with angular bits of camphor, stop the other end with another bit of cork, the corks should have a hole or a piece cut out of their sides, to allow air to pass through. The mode of using it is to place the end in the mouth and breathe through it; it looks very like an ordinary toothpick, which many people are in the habit of keeping in their mouths for a length of time together. I know of a gentleman in Liverpool who declared to me that by means of this simple apparatus he had warded off an attack of severe bronchitis which threatened to become chronic. (G. H. WILKINSON.)

[44824].—Photography. The following are two methods by which a high glass may be imparted to photographs without the aid of a rolling-press. 1. Take a clean sheet of glass, preferably patent plate, rub it over with a little beeswax dissolved in methylated ether, so as to leave a thin film of wax impalpable to the eye; coat with plain collodion, wash until all graininess has disappeared, flood with a dilute solution of gelatine, lay the print or prints carefully down upon it, squeeze to remove all surplus gelatine and chance air-bubbles, allow to dry, then strip and mount. 2. Mount the prints in the usual way, size with a clean solution of gelatine, say, gelatine 20gr., water 1oz.; allow to dry, and then coat with mastic varnish, which, for this purpose, may be conveniently diluted with an equal bulk of turpentine. An ordinary copying-press is not of much use, except to keep the prints flat after mounting, but too much pressure must not be applied, or the prints will not dry. Put them face to face with a sheet of blotting-paper between to absorb moisture and prevent streaking. The time of exposure does not depend upon the size of plate or image, but upon the proportion of aperture to focal length. In order to take the large head, you would necessarily bring the camera much nearer the object, the conjugate focus of the lens being correspondingly lengthened, and the time of exposure increased. You cannot, however, fairly expect a 4 plate lens to cover a 4 plate properly. If you work in the open air and have a good light, you would probably succeed better by using the front lens alone. See my replies to questions 11008, 223, and 102. PETER.

[44825].—Distilling Water. If W. Law will use hard soap-sudsing he will find it to answer his purpose. It is what still-merchants use. If you put good hard soap it will leave no deposit. It is.

[44826].—Distilling Water. In an iron steam-jacket that will hold, say, one quart, put two table-spoons water and the best sugar; gently boil till it begins to turn dark. Now lift the pan a few

inches from the fire and keep the pan moving with a similar motion, to keep the contents from burning to the bottom. Go on thus till it becomes as black as Spanish-rice. Now put to cool for ten minutes, then add the weak hot water and when cold, bottle for use.—GEO. J. H.

[44827].—Transparent Decorations.—Use tracing-stuff for your screen, and paint your design with transparent oil-colours. Perhaps it would serve your purpose to place the screen in front of a window. Have the window open and sketch a design in the screen by the aid of a good light-colour. You could have a slide specially painted and by the use of a powerful lime-light with the lantern produce an illumination far superior to the method which you propose.—G. FARRIS SWANSEA.

[44828].—Transparent Decorations.—In reply to "G. D." some years ago my father and myself made some very pretty transparencies in the following manner:—We got some good stout Bristol board (a species of cardboard), and cut the designs out with a sharp penknife. I think there were two, one for each window, and as we were neither of us good draughtsmen we transferred the outlines with carbon paper. One was the royal Crown and motto and the other the Prince of Wales plume and motto. We then procured a couple of steel punches, and made two borders round the outside of each square, after which we painted the cardboard back and front with lamp-black and size, to prevent any light showing through. The various parts of the design were covered at the back with tissue paper of the proper colour, as, for instance, white for the plumes of the Prince of Wales crest and crimson for the Royal Crown. The two borders of round holes were of various colours, and after the whole of the designs, &c., were covered with tissue-paper they were made semi-transparent by being painted over with a solution of gum-arabic. Altogether the result was very good, and those not in the secret had no idea how cheaply it had been done. Possibly it would be an improvement if coloured gelatine were used instead of tissue-paper, as it would intercept less light.—ENCORE SANS PAYS.

[44830].—L. and N. W. B. Engines.—The following passenger-engines are at Camden—viz., 2183 Antelope, 2184 Reynard, 2191 Snowdon, 2192 Caradoc, 2194 Cambrian, 870 Fairbairn, 871 Proserpine, and 872 Wizard, all "Precedents." Also the "large Bloomers," 887 Knowsley, 889 Camilla, 891 Duke, 894 Ariel, 898 Una, and 1003 Tamerlane. There are also the Euston and Camden shunting-tanks, some six coupled saddle-tanks that work goods over the N. L. R. to the docks, one or two of Webb's new side-tanks, and a lot of goods engines. Sorry I can give no information as to the other sheds.—W. B. P.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, H. B. T. S. has replied to 44137, Clement E. Stretton to 44361.

- 44242. Undulatory Theory of Light and Heat, p. 481.
- 44244. Arranging Pianoforte Music for Full Band or Orchestra, 484.
- 44245. L.B. and S.C.H. Engines, 484.
- 44247. Colston Hall Organ, 484.
- 44252. Camera. To Mr. Lancaster, 484.
- 44253. Paper Bowls, 484.
- 44254. Dental Electric Engine, 484.
- 44255. Curious Splashing, 484.
- 44256. Power Absorbed by Machinery, 481.
- 44258. Kites, 481.
- 44259. Analysis, 484.
- 44260. Overhead Motion Pulleys, 481.
- 44261. Gold Pellets, 483.
- 44261. Union of Lancashire and Cheshire Institutes, 485.
- 44262. The Mammoth—a Geological Problem, 485.

44492. Question for Chemists or Others Acquainted with the Manufacture of Bread or Cake, p. 581.

- 44501. Perambulator, Folding, 581.
- 44504. Ferret, 581.
- 44514. Paper-Making, 581.
- 44517. Serap, Book, 582.
- 44519. Tensile Galvanometer, 582.
- 44520. Waterproof, 582.
- 44520. Clipping on in the World, 582.
- 44523. Electric Lighting Apparatus for Gas, 582.

University College, Bristol.—We have received the calendar for the sixth Session of University College, Bristol. It shows a course of lectures extending over all, or nearly all, the chief branches of a liberal and scientific education. Special attention has been paid to its chemical and engineering departments. Each of them in its own way combines theoretical with practical instruction.

QUERIES.

[44831].—Strength of Boiler-Plate "Sunlight" kindly give the rule for calculating bursting pressure of different thicknesses of b and the safe working pressure of the same—example showing the relative diameter and of plates to the bursting pressure.—JOHN W.

[44832].—Heating Small Greenhouse any of your readers kindly inform me the heat a small greenhouse which is built close kitchen wall, on the other side of which is burning all day? I should be glad to know the heat from same, it being an old open gas and boiler.—T. SHARRATT.

[44833].—Logarithms.—Will some of our colleagues with the authors and publishers Young's Essay on the computation of with the most extensive tables that are S. E. D.

[44834].—Division Plate and Fan.—Will any correspondent kindly inform a division-plate should be placed that it may with driving-bolt, which connects cone-pull wheel on lathe-spindle? Also, what prev blowing-fan working, some fans of an merely churning the air without blowing MAMMOTH.

[44835].—Bleeding.—To Dr. ECKSTEIN.—kindness in answering several correspondents taken the liberty of asking if you would give from a child I have been subject to excess from the nose, seldom stops unless plugged attribute the commencement to a fall which wound on the side of the head. I every local advice, and three physicians in each prescription has stopped the bleed but it has soon returned. If I have been and kept my head constantly cool, with cold night and morning, and thus prevented the nose for a month or two, I have the bleed from the towels. I am always trying something. I am 30, eat no meat, total abstinence.—H. C.

[44836].—Hardening Trowels.—I order for small trowels 7in. long, 1 1/2in. wide, I find great difficulty in harden when I dip them in the water, they bend all information on keeping them straight will be received by—COURTNEY BLACKBURN.

[44837].—To "Secunda" Practice maker.—Will you please say if a ball pump-centre is a tool of any utility to a not got a mandril? If so, say what kind done on one: Are the uprighting to WUBANG.

[44838].—Hair-Dyes.—The following nitrate of silver 2dr., ammonia spirit 3 water 1oz., I have tried with good effect but fear that nitrate of silver injures, recommend a safe preparation? The following not to hurt: hydrosulphuret of ammonia solution 3dr., distilled water 1oz.; to be used application. When dried, apply: nitrate (distilled water 2oz. The stench and pungency, intolerable. A nutgall preparation I question whether it does not contain the silver nitrate. Has anyone tried pure n "Walnut Pomade" been found of use? Lastly, I find it next to impossible to stain the hair with my dye, but have touch Bond's Marking Ink, which seems to have B. C. Z.

[44839].—Electrical Contact. Mot "Sunlight" Mr. Lancaster, or anyone else is any reason why nickel, which is near as and does not oxidise readily, should not be electrical contacts? Also, can they help me wish to make a small electric motor to work a fan for blowpipe work at about 1.5 minute. I should like it to be on the table. Would one like that described two do, or would one more like Froment's? How much wire would be required on each many magnets? What battery power? A sketch if possible, would much oblige.—C.

[44840].—Swan's Electric Lights Bunsen cells would be required to keep a burning!—OMEGA.

[44841].—Violin-Making.—To "F" you ever try the following? Fiddle, ordin instead of f-holes a jin. slit down centre end to end. The bridge would straddle the the two free edges. Of course, the belly must.—C. P. T.

[44842].—Paper-Staining.—What will from putrefying when mixed with colour staining and yet not spoil the colours? To have to be kept a fortnight, and is in a ve.—C. L. H.

[44843].—Paper Type.—In common, I many other readers of the ENGLISH MECHANIC like to know something of the paper-type principally for music. It is said to be than other processes, and if that is so, it will become popular.—W. J. C.

[11844].—Reed-Organ.—I am constr on the suction principle, with 22 sets of re get them to speak quickly. I am almost lies in the channelling. As I have them at are jin. deep at CC, to 1 at top C; all th key on same channel, all the channels s should I have them divided? Kindly gi length and depth of channels and length c for one row of broad reeds, bent Sfr. "Tur 4ft., and 1 row of celeste from Mid. C. 1 volumes except 23 and 24, but cannot get s formation. Also if they think the ordinary proved any on the suction principle.—Bor

leaning Lacquered Curtain Rods.—reader of the *ENGLISH MECHANIC* kindly ng the best method for cleaning polished rods, which are lacquered, but have got by dust, &c., by lying by for some years, cannot be removed by any method known at removing the lacquer. Could any of the best way of removing this?—*LOXON*

ld Zinc Battery Rods.—Having over zinc battery rods which I wish to recast, making a few I find them too brittle—can eaders give me a remedy for this defect?—*WALSDEN*.

Mathematical Works.—Will some of ematical readers kindly advise me what d for the 4th stage examination of the rt Department?—*WALSDEN*.

hemical Diffusion of Gases.—Dis-Does the rate of diffusion of gases vary erature? If so, in what proportion? Can mend a cheap work which treats fully on —*WALSDEN*.

aising Flour.—Is it possible to lift bottom of a silk to a height of 20ft. by a t, what size should belt and buckets be to per hour, the best place to receive and ar? A sketch will oblige—*DELTA*.

ooling Water from Condensing it possible to cool the water from con-runs into reservoir and is used over again a blast of air being put into the pipe by a A lift in this direction would be esteemed *DELTA*.

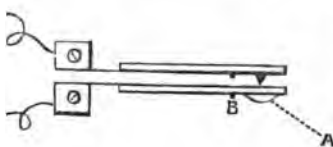
Biscuits.—Will some of your many m me whether biscuit-makers use any in their trade, whether a good arrow-sould be made without sugar, and what ntial to obtain the perfect uniformity of assistance in all biscuits?—*ANNOVBOOR*.

aura Battery.—I have read the de-be Faure battery in the *MECHANIC* of July maise enough to make one from. How are ade? Can it be charged from an induc-s it require a continuous current machine? ler answer these questions and give full construct a Faure battery?—*L'ECLAIR*.

L. Y. R. Tank-Engines.—Will "Lively" kindly say whether the above wing-tanks? If so, do they (tanks) extend driving-wheel? Also are the sand-boxes of splashers as in the new goods locos., or nes as on M. R. tank-engines? A sketch acceptable, as a great deal was said about in Vol. XXVIII. I have an idea that s the M. R. tank-engine. Is this so?—

ot-Bed.—As we are so unsuccessful with ot-beds, and as we require a steady heat rths, I am thinking of making a shallow nised iron tank, about 2 or 3in. deep and lled with water and fitted with an exhaust e heated by a lamp underneath. Can correspondents kindly tell me if the water ! If not, will it if I cant the tank a little mp at the lower end? If this design is not in someone suggest something better to—

aduction-Coil Peculiarity.—I have coil containing 2lb. of 38 silk-covered wire, ut 44 sections, between plates of paraffined as with one tin. Bunsen, a spark 1in. long.

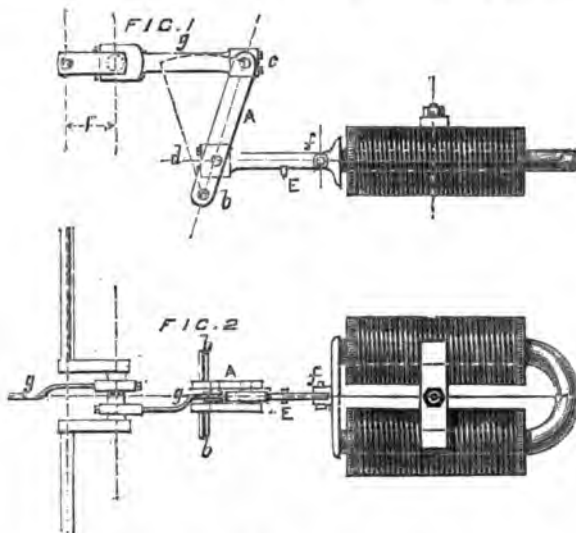


cted this coil to give a shock beyond t in this it falls, the shock being compara-Does this indicate any defect, or is it on he smallness of the wire? The coil is tested by a battery and galvanometer.—

oins.—Will any of our readers kindly give mation respecting the value as curiosities entioned coins? 1 is a silver coin, rather shilling, Charles II., dated 1688. 2. Also than a sixpence, William III., with a the head; both the above are in excellent d are much alike in appearance. 3 I oin (silver) of James II. with III., on the above which is a crown; there is also an und, but I cannot read it. 4 is a thin one side of which is a crown inside a globe ver the globe, all inclosed in ornamental ption round it—GLVGKBESGHERTIST; T, on the reverse side is the inscription VWINGKEL:INNVRNBE (—): in the owns and 3 Fleurs-de-lis placed in a circle No. 4, but older, as the figures are much drawn. The inscription is hardly legible, it to inscription on No. 4, and the letters LUE DANUBE.

lectric Engine.—I want to make one of ne power as an ordinary model steam-piston diameter. I should like to utilise unk that I have got, and propose to do so wn in the accompanying sketch. A is a g beam fixed (at b) in bearings on bed-wn), 4in. from centre at b to centre at c, ween centres at c and d, which gives 1in.

movement to the armature. As partly shown in Fig. 2, the same arrangement of magnet, rocking-beam, &c., is supposed to be on the other side of the crank-shaft, as I want the engine to start without my touching it; e is supposed to be a support for the armature rod. I should be very grateful if either Mr. Lancaster, "Sunlight," or other competent correspondent would be so kind as to tell me: 1. How long the magnet irons should be before bent? 2. What size, and how much wire should they be wound with? 3. The best battery to work the engine with? 4. Whether there is any real objection to the rocking-beam arrangements? 5. How are the wires to be joined up? I have two wires from each magnet—which should be joined to the battery, and which to the contact-breaker? 6. How is the contact-breaker arranged, and what will be the best form for me to use? What is the shape of thing to be fixed on shaft? All I know about contact-breakers at present is that they



change the direction of the current. 7. Would it be better if the connecting rods to the cranks were made straight (and the magnets not in the same straight line) instead of as they are drawn (at g)? 8. The armature is rigidly fixed at f. Would the very small amount of play that will be at d noticeably affect the attraction of the armature?—*C. P. E. S.*

[44858.]—**Options.**—I have lately seen several advertisements recommending investors on the Stock Exchange to give their attention to the system known as "options," and I have examined some of the prospectuses which seem feasible enough, but should be glad to learn if they are bona fide or not. Do ordinary brokers, bankers, &c., make options a part of their business, or are they only dealt in by the more speculative portion of the Stock Exchange?—*VENTNOR*.

[44859.]—**Balancing of Locomotives.**—Can any reader give me a formula for calculating the balance weights in locomotive engine wheels, and the angle which a line (drawn from the centre of driving-wheel to centre of gravity of balance weight) makes with the crank nearest to it?—*J. F. C.*

[44860.]—**Leak in Iron Flue.**—Could some fellow-reader of "E.M." kindly tell me how to stop some leaks in an iron flue at the joints? I have tried common Portland cement, but it falls out when dry.—*SNOWBALL*.

[44861.]—**L. and N. W. Engines.**—Will some correspondent let me know the numbers of the new sheds lately built by the N. W. at Lancaster, Llandudno Junction, etc., also the dates of the following engines, and where stationed:—Zygia, Yakob Khan, Whitworth, Vampire, Una, Trentham, Theorem, Shark, Saddleback, Rowland Hill, Phantom, Peacock, Petrel, and Pheasant?—*DIOMED*.

[44862.]—**Piano.**—I bought a piano about 3 years ago at a sale of new pianos. It will not keep up to pitch, and now the pegs in the wood block wont hold; they have pulled holes in the block quite oval. What would be the best thing for me to do to cure it myself?—*HECTOR*.

[44863.]—**To "Sperans."**—Will you kindly say how the property of a married woman would be legally disposed of who dies intestate during her husband's lifetime?—*ANGLO INDIAN*.

[44864.]—**I. M. E.**—Will any reader kindly inform me the qualifications, etc., necessary to become a member of the Institute of Mechanical Engineers?—*ANGLO INDIAN*.

[44865.]—**Air-Pressure from Fall of Water.**—I should like some information as to the simplest expedient for applying water-pressure to drive a current of air through gasoline to make air-gas, or to work a blow-pipe.—*DUNBOD*.

[44866.]—**Phosphatic Manure.**—I wish to test the action of some earthy phosphate (containing a quantity of alumina), and should be glad to know of any fast-growing plants to try it upon, which would show some effect in the course of a few weeks. Any hints as to the best way of applying it would also oblige.—*DUNBOD*.

[44867.]—**Gilding.**—I want to gild a deal panel and some strained paper. Will someone kindly inform me how the wood and the paper are prepared, and what is used for attaching the leaf to them? When the leaf is put on is it then sized all over? These gold panels I propose to paint on in oil.—*DEVONSHIRENSIS*.

[44868.]—**Pitch of Screw.**—Will any reader kindly

answer the following?—A pantagraph of German make has a screw with a micrometer head divided into 24 parts. The pitch has been found to equal $29 \frac{19 \cdot 99}{24}$ turns for one English inch. To what scale is the screw cut, and what relation has it (the screw) to English inches?—*PANTAGRAPH*.

[44869.]—**Faulty Battery.**—I have a two cell galvanic battery by "Stroud," which, after repeated trials, I have failed to get to work satisfactorily. Will any of "ours" kindly inform me the kind of acids to use?—hitherto I have simply used sulphuric acid and water, but as before stated, they have not had the desired effect. There are six brass pillars on the battery top, which I think don't connect properly with the cells; therefore, I shall be glad if a drawing can be given with the reply showing the proper connection of the cells with

the pillars and the handles to the latter. Must all the wires used be of one thickness?—*CAPTAIN*.

[44870.]—**Railway Rolling Stock.**—I shall be glad if any of my fellow-readers would kindly enlighten me on the following:—I wish to know how the length of the wheel base is ascertained when building carriages, wagons, &c.? That is, the wheel base "centre to centre of journals," of a wagon 15ft. long is about 9ft. But how is this ascertained? A plain simple answer will greatly oblige—*INGLEBORO*.

[44871.]—**Steam-Engine Indicator.**—I wish to make an indicator suitable to use with a condensing engine. I am thinking of Richard's form, and shall be glad if someone will give me the necessary instruction how to make one, specially with reference to the following points. 1. How is the piston packed? 2. What size steel wire must the spring be made of? 3. What special points must be considered in making it to work with a vacuum? 4. What dimensions had I better make the cylinder? Will someone kindly give me a sketch of the principal casting, with all dimensions?—*AMATEUR*.

[44872.]—**Waterproof Paint or Ink.**—How is waterproof ink or paint made as used by poster painters for coloured advertising bills? Could a medium (or vehicle) be made of shellac or resin?—*TICKETS*.

[44873.]—**Steel Drops.**—Could any of the readers of this able paper give me a receipt for removing from a tablecloth and carpet the stains occasioned by spilling a bottle of steel drops thereon? Soap and water has been tried without success.—*MANA FORTE*.

[44874.]—**To "Sperans."**—Will you advise me? A. died in 1879 leaving £2,000, appointing B. and C. executors, and owing D. £20. C. died very soon after testator, and B. realised the estate. Repeated application is made to B. by D. for payment. B., then, after having got possession of testator's estate and owing to loss in his own business, goes into liquidation and his creditors discharge him. No notice has been taken of D. in the business. Has D. any remedy in civil or criminal courts against B?—*W.*

[44875.]—**An Old Experiment by Faraday.**—An old but interesting experiment of Faraday's was the resistance to motion and the heating of a copper plate moved between the poles of a powerful electro magnet. Can anyone tell me whether the placing of the whole apparatus in a perfect vacuum would have interfered with the result?—*F. M.*

[44876.]—**G. E. R. Locomotives.**—Would some correspondent give me the dimensions of the coupled bogie engines; also, of the 5ft. 6in. engines on this line; and, also, say for what work each class is used, and how they perform it? I should also be obliged if someone would tell me whether the 7ft. 6in. singles are considered satisfactory. I have heard they are extremely fine machines. Is this true?—*H. M.*

[44877.]—**Grass Snakes.**—I have several grass snakes; one of them has laid nineteen eggs. I shall be glad if any correspondent will kindly answer the following questions—viz., Are the eggs likely to hatch? If so, in how long a time? And, what should the young be fed on?—*COLUMB NAT.*

[44878.]—**Microscopic.**—(1) Can "F.R.M.S." or readers of the "E. M." give their experience as to the capabilities of Zeiss' objectives for histological work? (2) What objectives should I find the most useful? (3) Would a binocular or monocular be the best? (4) Have not Zeiss' lenses a greater working distance than Hartnack's?—*A. B. C.*

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, OCTOBER 7, 1881.

SPIRAL APPARATUS.

By J. H. EVANS.

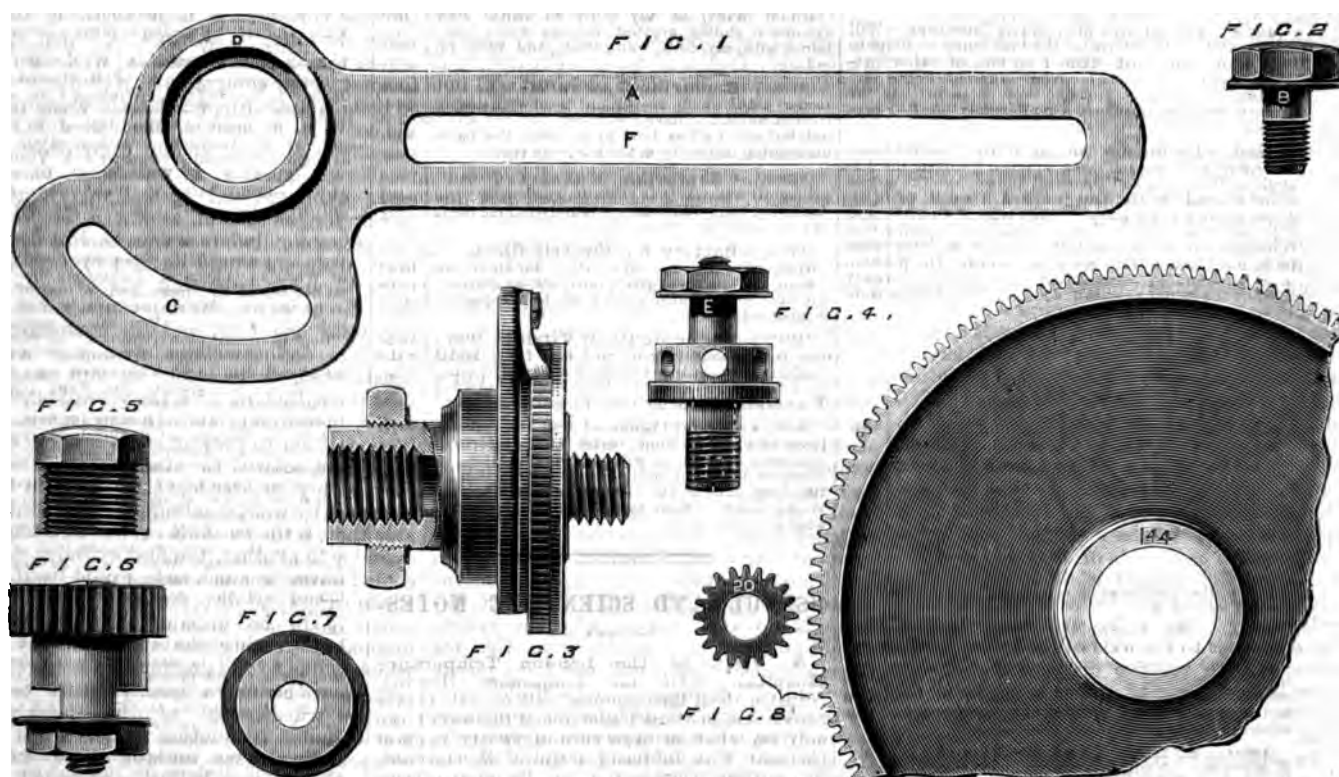
THE last specimen of turning illustrated being that of spiral work, I propose following on with a description of the apparatus, and as it is an adjunct easily added to any lathe worthy of it, I consider the illustrations will be of considerable value to many. I intend, in the first place, to show the apparatus in its original form, or rather, as it is generally adapted, and later on I will illustrate the various improvements I

or pinion, according to the pitch required, on the arbor fitted to radial arms, and the latter brought into gear with another wheel or pinion upon the main screw of slide-rest. Thus far we will take it that the arrangement of the train of wheels is ready to work with, but it must not be thought that it is only to turn the lathe round. To make it work, the action must take place from the winch-handle of slide-rest, and a revolving cutter, or a fixed tool in the slide-rest must be the means adopted for cutting the work. In nearly all cases of ornamental turning, especially where a long twist is required, it will be more satisfactory to use a drill or fly-cutter, with the universal cutting-frame in which it is fitted set at the proper angle to correspond as near as possible with the pitch of the spiral to be turned.

All the work upon which spirals are to be cut, must, of course, be screwed on to the nose of spiral chuck, which is, of course, a fac-simile of the mandril-nose, and consequently all the chucks belonging to the lathe will go upon the spiral chuck. In working, however, it will be necessary to

Fig. 1, working in the slot, seen distinctly in the engraving of lathe-head and marked H in the number of Sept. 9th, with this fitting and the screw as a means of holding it, it only remains to shift it up or down according to the size and train of wheels that are employed.

The spiral chuck, Fig. 3, will be the next thing to make. This must necessarily be long, in order to bring the wheels into line with the arbors. The front wheel has a piece projecting on the end which fits through the body of the chuck, and is held in its place by a screw and washer after the same manner as the wheel of the eccentric chuck. We now come to the arbors, of which there are three—single, double, and permanent. Figs. 4 and 5 show the single arbor in section, the dotted line illustrating where the fitting of steel revolving-pin is. Fig. 5, the metal cap which fits over the half screw and clamps it on to the radial arm. The double arbor is made the same in all respects, except that the fitting upon which the wheels are placed (E, Fig. 4) is double the length. We now



have added to it. Before alluding to the figures on the engravings, I think a short description of the actual machinery, so to speak, will be advantageous, especially to the uninitiated in this particular branch of turning, which in workshop parlance is screw-cutting; but, as adapted to ornamental turning, the productions are termed Elizabethan twists. First then, the apparatus consists of a train of wheels, which form a connection between the lathe-mandril and the main screw of the slide-rest, and it will be seen at once that one cannot be moved without the other; consequently, to divide the work into different parts, it will be obvious that the pulley will be useless, therefore, what is termed the spiral chuck, must be substituted; this chuck is fitted on to the nose of the mandril, and in front a revolving ratchet-wheel, with 96 teeth and detent, is fitted. As before stated, I am describing the apparatus in its original form, my principal object being to show the improvements in the arrangement I now make. On the back of the chuck is a fitting on which any of the change-wheels can be placed, and in working with it one of the wheels must be on the chuck, and that gearing into another wheel

turn the work in its place on the spiral chuck, because, if it is turned on the mandril-nose and then placed upon the chuck, it will not be absolutely true, unless a transfer chuck be used in the first instance; these we shall come to anon. To proceed, there are 16 wheels and pinions, and to give the numbers will be sufficient without occupying space with illustrations of all; the numbers will be 144, 120, 96, 72, 60 (two), 53, 50, 48, 36, 24, 20, 18, 16, 15, and on the permanent arbor a pinion of 30 teeth. These 16 wheels and pinions comprise the whole set in its present form, and are considered quite sufficient for all practical purposes, inasmuch as the coarsest combination of the arrangement can be made to produce one turn in seven inches, and the finest 320 threads to the inch, the latter being sufficient to form simply a smooth cut over a cylinder. An infinite variety between these two may, of course, be obtained.

The radial arm A, Fig. 1, is fixed to the headstock by means of the screw B, Fig. 2, which passes through the circular slot C, Fig. 1, and having a thin steel washer under the head, it holds the arm in its place without extreme pressure. The circular ring D,

come to the permanent arbor, Fig. 6; the object of this is to change the direction of the screw or spiral from a right to left-hand—that is to say, reverse the direction of the slide-rest screw as compared with that of the mandril. For example, three wheels will cut a right-hand screw, four a left-hand, and so on. I intend to give a table of settings when this apparatus is completed, but I may mention that it must be fully understood that the main screw of the slide-rest should be no other than 10 threads to the inch. The arbor, it will be seen, can be moved to any part of the radial arm when fitted to the straight slot F, Fig. 1, and will admit of any possible change being made; and it is by this means that the various wheels employed are connected to the spiral chuck and slide-rest. In most cases only one intermediate wheel is used, employing the single arbor only and the three wheels all in one plane, consequently the spiral produced will depend upon what I may term the two main wheels—viz., those on the spiral chuck and slide-rest screw; for instance, if both are of the same number of teeth, the mandril and slide-rest screw will turn equally, or turn for turn,

and the screw produced will be the same as the slide-rest screw, and this must be, as before stated, 10 to the inch. The difference in the pitch of the screws or spirals is obtained by the difference of the extreme wheels—viz., that on the chuck and slide-rest screw, the number of teeth in the intermediate wheel signify nothing so long as all are in one plane, and it only one is placed between those on the chuck and slide-rest the spiral produced will be right-handed; but to make the same left-handed, it is necessary to place the arbor with permanent pinion of 30 teeth, Fig. 6, between, in order to reverse the movement of slide-rest screw.

It will be observed that the holes in the large wheels are different in size to those in the pinion, Fig. 8, the former being bored out to our standard size of 1½ in., the lathe being ½ in. diameter. The brass bush, Fig. 7, is fitted to the larger holes, and the hole in it is then fitted to the arbor. The large wheels are not so thick as the smaller pinions, the object of this being to allow of the face of bush, Fig. 7, being admitted; it is a nice point in fitting up an apparatus of this kind to have all the wheels in line perfectly, and when the double arbor is employed it requires extra care in the length of the different parts.

There is naturally a little management required in choosing wheels that will admit of the slide-rest being brought up to its work; but the wheels may be changed without interfering with the actual screw or spiral, so long as the ratio is unaltered, and, I may say, that no great difficulty will attend the choice. By way of example, if only two wheels are employed as the train, that is to say, one on the spiral chuck, and one on the slide-rest, all such wheels as may be termed pairs, that is, the one having double the number of teeth that the other has—for example, 15 and 30, 18 and 36, 36 and 72, 48 and 96, 60 and 120, 72 and 144. These numbers, it will be obvious, represent a proportion of one to two, and will, of course, all produce the same relative velocity, and should any of the former of these pairs be used, the screw cut will have twice the number of threads of that in the slide-rest, viz., 20 instead of 10 threads. The choice of which pair of wheels are to be used will simply concern the accommodating of the slide-rest to the axis of the lathe. These remarks as to relative distance of slide-rest from lathe-centres of course apply to all the arbors, whether single, double, or permanent.

In addition to right- and left-hand screws or spirals, it is no difficult matter to produce double, triple, and quadruple, in fact, any number of threads. When the apparatus was first introduced years ago, it was, of course, not nearly so complete as it is in the present day, and the only means of dividing the work into double or triple threads was by shifting the wheels—that is, the teeth were marked and the one shifted round so many each time; but this, I need scarcely say, has been obsolete now for a very long time, and the dividing is effected by means of spiral chuck, Fig. 3. This, it will be seen, has a revolving wheel with 96 teeth and a detent, so that it would be possible to even cut a spiral with 96 separate threads; but this, of course I only mention as illustrative of the action of the chuck to make it more clear. We will assume that a screw with four threads is required; it will then only remain to divide the wheel into four parts, 96, 22, 24, 48, the 96 being the starting-point; but it is in ornamental turning that the spiral apparatus is so useful and so highly appreciated by our amateur turners, and it is when such spirals as are required for the purpose of ornamentation are produced that they are called Elizabethan twists, and referring to my former remarks, a drill or universal cutter

must be always used for cutting such work, and the velocity at which it is driven must be governed by the material used. I have now an arrangement to my best slide-rests that will admit of the operator simply looking on when all the apparatus is set, and it is simply that the main screw of the rest is worked by a tangent screw from the over-head very slowly at the same time as the drill is running at a high speed from the same driving power. I have cut a spiral 12 in. long without turning a handle, and have found it a great saving of labour, and I can safely say that the action is more regular than that obtained by the hand; however, I will not say more upon this now, as I hope to give an illustration of the slide-rest at some future period.

COMPOUND AND FOUR-CYLINDER LOCOMOTIVES.

THE question has been often asked in engineering circles why, if the compound system is so economical and advantageous in the case of marine engines, it has not been introduced with more success in the case of locomotives. The ready answer is invariably that it is too complicated, and that the advantages to be obtained will not compensate for the extra cost and the extra care needed. The locomotive is already a complicated machine, which often moves at a high speed, and designers, at all events in this country, have a decided and not unnatural aversion to the introduction of even an extra bolt. Nevertheless, so long ago as 1876, M. A. Mallet, of Paris, having successfully adopted the compound system on the Bayonne-Biarritz line, endeavoured to introduce compound locomotives in Germany, but not meeting with much encouragement, he did not take out a patent in that country. Since then, at least one firm of German engineers has turned its attention to the subject, and has produced compound locomotives for which a saving of fuel ranging from 16 to 20 per cent. has been claimed, besides an appreciable economy in oil. It seems obvious that if by compounding marine engines a saving can be effected—if in fact the compound engine is more economical than the single type—there is no valid reason why the system should not be applied to the locomotive, for the mechanical details will not long puzzle the skilled engineer. M. Mallet has, we believe, supplied designs for compound locomotives, which are now running in Spain, Austria, and Russia, besides those on the Biarritz and other French lines, a principal feature of his engines being that they can be worked either compound or single, at the will of the driver. A self-acting reducing-valve insures an equality of effort in the two cylinders when working compounded—an arrangement which is said to give excellent results. The firm of F. Schichau, Elbing, Germany, who appear to have taken up the subject after M. Mallet had made his preliminary trials, simplify the arrangement by so constructing the valve-gear that the engines always work compound. The German firm contends that the manipulation of the valve-gear must remain as simple as it is in the ordinary locomotive, the relative best degrees of cut-off in both cylinders being determined once for all, so as to be made automatically and in such a manner that any interference on the part of the driver is prevented. For obvious reasons that is advisable, as it is of the first importance that the work done in the small cylinder should be as nearly as possible equal to that done in the large cylinder, in order to insure an equalisation of strains. This object has been accomplished by simple means, and in such a manner that the driver himself, for all he can find out on the foot-plate, may believe

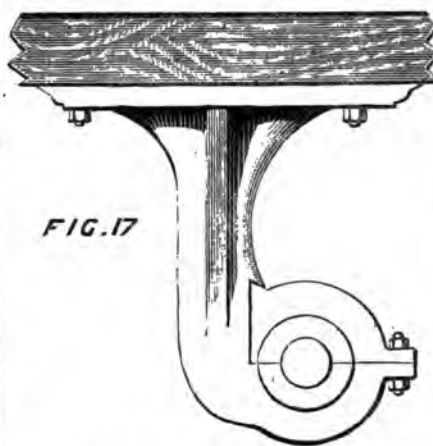
he is driving a locomotive of the ordinary type. M. Mallet contends, on the other hand, that it is necessary that compound locomotives should be so arranged as to work when required as non-compound, and that any simplification of gear which involves the engine always working as a compound is paid for at too high a price. The fact that English locomotive designers have been aware of the existence of the compounds and their alleged economy without making, so far as we are aware, the slightest sign of adopting the improvement, might be regarded as sufficient expression of their opinion, did we not know that the official railway mind is essentially conservative, and not given to exploiting far from the beaten track; but it is not impossible that in this case engineers in this country, taking the 20 per cent. of coal saved with a grain of salt, may look upon a compound locomotive as rather too much of a good thing. Granting all that can be said in favour of expanding steam in two cylinders instead of one, it is not quite clear on which side the advantage lies when all the points are considered; for in a locomotive there are many things to be thought of besides mere economy, even when the latter is so large as 20 per cent., which would clearly mean a very large sum to some of our companies. When, however, so little is done to preserve the steam from the cooling influence of the cylinders, it is scarcely worth while to complicate the machine by the introduction of two extra cylinders and special valve-gearing merely for the sake of saving a few coals. If the extra cylinders are to be introduced, most engineers would declare in favour of using them for balancing purposes, as the most direct way to secure economy, by saving wear and tear, and by conducing to safety. As locomotives are now generally constructed, there is no attempt made to heat the cylinders, with the view of preventing condensation; and, in some cases, very little is done to prevent radiation and cooling by contact with the atmosphere—a source of, possibly, greater loss than the gain to be obtained by compounding. It is incontestable that, if the steam is exhausted from one cylinder to another, the first cylinder is not cooled down so much as it would be if the steam exhausted direct into the air; but the economy to be obtained by the former method of treating the steam is only that which is due to the greater degree of expansion, less the extra back-pressure caused by the transference of the steam from one cylinder to another; and, when the compounding does nothing more for the locomotive, it may be justly regarded as a very doubtful advantage. If it reduced strains and made the engine run easier and steadier, the "improvement" would not have been left entirely in the hands of foreigners, for if engineers are conservative here, they are sufficiently go-ahead in America to have at least made the experiment. On the contrary, there they have also turned the cold shoulder to the compound locomotive, while at least one of their number has taken up the idea exhibited by Mr. Haswell, of Vienna, in the London Exhibition of 1862—viz., four cylinders, the pistons of which receive steam simultaneously on each side, one moving in one direction and one in the opposite. In Haswell's locomotive the cylinders were arranged two on each side of the engine, the connecting-rods being coupled to cranks placed opposite one another. The object of the designer—almost perfect balancing, with the consequent great steadiness in running—was attained; but the complication of machinery was found to be so disadvantageous that this type of engine never became more than an experiment. Nearly twenty years after the exhibition of Haswell's locomotive, we hear that his idea has been taken up in America by

Mr. H. F. Shaw, of Roxbury, Mass., who has designed a four-cylinder engine, which, according to report, does excellent work at high speeds, with more economy than the ordinary type of locomotives. So far as the frame, boiler, and truck are concerned, the engine is of a common class turned out at the Hinkley Works, Boston; but instead of two cylinders 16in. by 24in., it has four, which are 10in. by 24in., and which, being contained in two castings, do not materially increase the width of the engine. The increase of piston-area thus obtained is as 348 to 201, while the space occupied is increased by about 6in. in one direction, and reduced in another. Each couple of cylinders is supplied with steam through one valve, operated by the usual link-motion and rock-bar. This valve, which is one of the most important features of the locomotive, is of the plain D type at one end, while at the other it is a B valve with a bridge, the steam entering one cylinder in the ordinary way, and passing under the valve to reach the other cylinder, both, as mentioned above, taking steam simultaneously. Two valves would be objectionable, because they would unnecessarily complicate the gear and be more liable to derangement; but it was thought that the difference of friction at the two ends of the single valve, owing to the steam passing under it at one end, would tend to slew it out of position, and also cause excessive friction between valve and seat. The result of a practical trial shows that the valve works as easily as the usual plain D valve, and, apparently, with no more friction—probably less, because the steam being admitted at one end under the valve would necessarily help to balance it. The exhaust is indistinguishable from that of an ordinary locomotive, for the simple reason that each couple of cylinders exhausts at the same instant. The driving-wheels are accurately balanced, but are cast without counterbalance weights, except that there are two crankpin bosses, one to receive the pin, and the other to act as a balancing weight. The crank is double, of wrought iron, working in a substantial centre-bearing held in pedestal jaws attached to a girder suspended from the main frame. By this arrangement the action on each side of the engine is the same: one piston is pulling the wheels round while the other is pushing them round; thus nearly all the power of the steam is exerted in rotating the driving-wheels; but with the ordinary arrangement, the power applied to the piston is necessarily transmitted to the bearings as well as to the crank, and there is consequently undue friction and rapid wear of the parts. It is tolerably clear that the swaying motion of the engine, specially noticeable in the case of locomotives with outside cylinders, must be almost entirely avoided when the action is balanced as it is in these four cylinder engines, and experiments with the "H. F. Shaw" fully bear out theory, for we learn that with the throttle-valve fully open and 130lb. of steam, the driving-wheels did not slip, and no swaying from side to side was noticeable, although a heavy train was attached. The total weight of engine alone in working order is a little over 33 tons; the driving-wheels are 63in. in diameter, four coupled, with a leading four-wheeled truck; the locomotive presenting to the uninitiated the ordinary appearance of a common type of American engine, except that the peculiarity of the cranks would catch the eye of the observer. The object of the experiment is high speed with safety; that has been attained, and economy of fuel as well: it remains to be proved how the engine will stand on the repair list when it has been fairly tested over a number of miles run. It frequently takes a train composed of five cars, two of them "palace," from Boston to Providence, 44½ miles, in 57

minutes—a rate certainly not remarkable for high speed, but which is two minutes under schedule time. Probably, if the task were set, the locomotive could do much better than that, and we shall no doubt hear before long further particulars of its performances, which will, we think, be read with more attention than those of compound locomotives, which simply complicate the existing designs without introducing any advantage besides a small economy in fuel, that is probably swallowed up in the extra repairs and first cost of the engine.

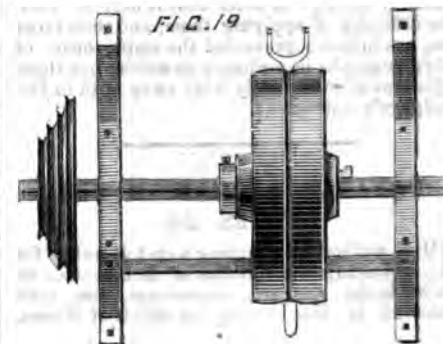
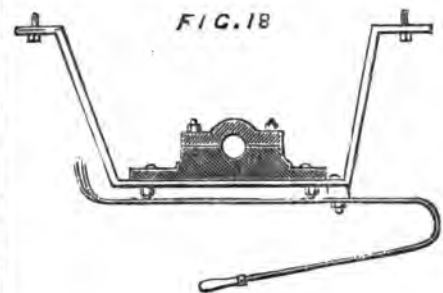
TOOLS AND MOTIVE POWER FOR AMATEURS.—XIV.

AFTER the engine has been fixed in its place it becomes necessary to provide shafting and pulleys, through which to convey its power to the various machines in the shop. A main driving-shaft should run almost the entire length of the shop, or within about 4ft. of it; upon this shaft, which may be 1½in. or 1¾in. in diameter, pulleys or "drums" of different sizes are keyed; the one at the end being fixed over the engine, so that the main driving-belt from the engine-pulley passes up over it. An approximate calculation must be made of the speed of the engine, and the pulleys must be arranged so that the main shaft revolves at about two-thirds of this quantity: thus supposing the pulley on the engine to be 8in., that on the main shaft must be 12in. The average speed of one of these small engines is 250 revolutions per minute, so that the main shaft revolves at about 160 per minute; it is well to know within a little how quickly this revolves, as the pulleys can then be easily calculated for any machine it may be desired to drive. All the drums on this shaft are double the width, on the face, of the belt they are intended to carry, and turned parallel on the faces, excepting the one at the end, which needs to be only the width of that on the engine—i.e., about 1½in., and turned slightly convex, because the belt always seeks to run on the highest part of a pulley, and if this be the middle of the face, it follows that the belt is less likely to run off. We must now consider the means to employ for getting this main shaft in line with the engine-shaft. Let us suppose that the shaft is intended to run in brass bearings seated into hangers of a pattern similar to Fig. 17; it will



be seen that the shaft can be lifted down at any time for alteration, or substitution of drums and pulleys, and is thus the most advantageous form to select. I should recommend the following plan to be adopted: stretch a piece of cord tightly the entire length of the shop, near the floor, and carefully adjusted at each end, so that it shall be exactly parallel with the engine-shaft; this need not be very difficult to arrive at, if a long, straight rod be placed in the bearings of the engine, from which the crank-shaft, etc., have been temporarily removed. Now sling the shaft from the cross-beams of the shop and adjust it by means of a plumb-line and a spirit-level, until it is true with the line, and also truly horizontal. It will not now be difficult to substitute a permanent hanger for the temporary slings; and as these hangers have certain powers of adjustment, the shaft must be tried again

before finally tightening the bolts, and any error in the adjustment corrected. We have now the means of using the power of the engine at any desired part of the shop, and having determined upon the locality of our lathe, let that be the first tool to apply power to. I think I have before said that the lathe should be placed in front of a window so as to get the light direct on to the work; no other position is satisfactory. Our first business is to determine the speeds at which to drive the lathe; without gearing, these speeds should range from 250 to 800 or thereabouts. I cannot give more than these general figures, because the circumstances of each individual shop will necessarily vary so much, so that the calculations must be made by the workman himself. Suffice it to say that what is called a countershaft must be fixed above the lathe and parallel with the main driving-shaft; the bearings of this shaft may conveniently be of the ordinary form shown (shaded) in Fig. 18, mounted in brackets of wrought-iron, about 1½in. by ¾in., and secured to the beams of the shop by coach-screws or bolts; these brackets are tied together at the side nearest window by a transverse bar, upon which is pivoted a shift-



ing-fork shown in Figs. 18 and 19: any similar arrangement will do, but sliding-bars carrying the fork are generally noisy. The shaft itself need not be more than 1½in. diameter, as its length is but short; it carries upon it fast and loose pulleys, and a cone pulley the counterpart of the one upon the lathe. The fast pulley, as its name implies, is keyed fast upon the shaft, the loose one being free to revolve, whilst prevented from endlong motion by the abutment on the one side by the boss of the fast pulley, and on the other by a collar bored to the size of the shaft and fixed by a set-screw.

W. S. BROWN.

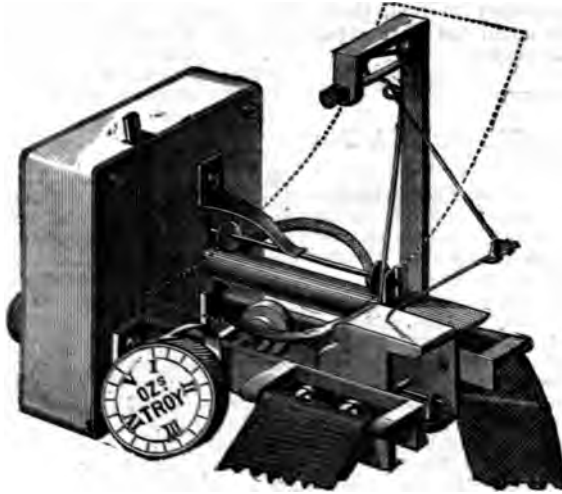
(To be continued.)

DR. DUDGEON'S POCKET SPHYGMOGRAPH.

SPHYGMOGRAPHS or pulse-writers of various kinds have been in use in the medical profession for upwards of ten years. Hitherto they have all been of such monstrous dimensions and of such difficult adjustment on the patient's arm, that their use has been almost exclusively limited to hospital practice. The sphygmograph recently introduced by Dr. Dudgeon, of London, contains all the good points of previous sphygmographs, with this additional recommendation—that it is of small size, 2½in. by 2in., very light, 4oz., therefore can easily be carried in the pocket, and capable of being adjusted to the patient's wrist with the utmost ease and rapidity. It possesses other advantages over

previous sphygmographs—viz., the pressure of the spring on the artery can be altered at will while the instrument is on the wrist, and it magnifies the movements of the artery in a definite manner—to wit, 50 times. The compactness of the instrument has been obtained by making the several parts of the instrument contribute to its stability. Thus, the box that contains the clockwork required to propel the smoked paper through the instrument rests upon the

a treadle arranged to act always in one direction. Fig. 1 represents the contrivance in end view. Fig. 2, is a side view of the clutch pulley with one of the plates removed, and Fig. 3 is a sectional view of the clutch on the line $x x$ of Fig. 2. The appliance is shown on a frame in section in Fig. 1, which carries an upper cross-shaft A and lower cross-shaft B sustained in suitable bearings. The shaft A is the driven shaft, and carries clutch pulley P and flywheel C. The

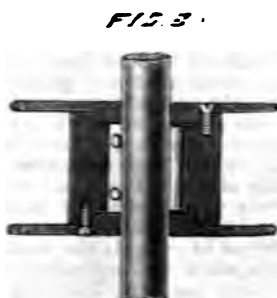
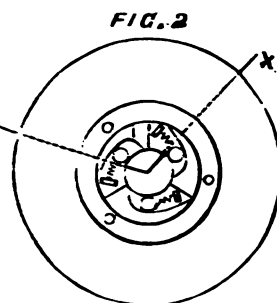
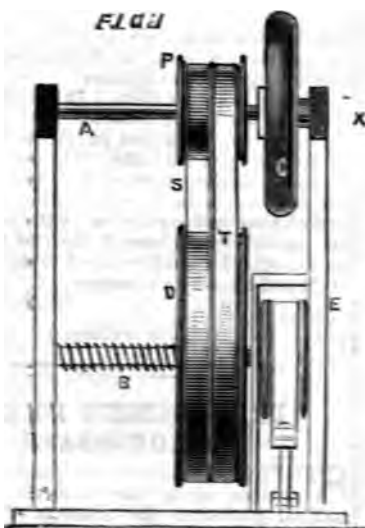


wrist and steadies the machine. In the other sphygmographs the clockwork machinery is all in the air, and requires to be steadied by numerous straps and arm-rests. One inelastic strap is all that Dr. Dudgeon's instrument requires, and it may be used whether the patient is standing, sitting, or lying, whereas the other instruments require the patient to be in a certain position—generally sitting—in order that it may be used. The difficulty of applying them, and their large size, has hitherto prevented the employment of sphygmographs in ordinary practice; but these objections are completely done away with in Dr. Dudgeon's instrument.

TREADLE MECHANISM FOR LATHES, &c.

THE method of adapting a clutch pulley for revolving the spindles of lathes, &c., as shown in the annexed engravings, has been patented in this country on behalf of Messrs.

treadle shaft B carries a large pulley D, and smaller pulley E, both of which are fast. F is the treadle hung by one end to the frame of the machine. From the treadle F a strap passes to and around the pulley E, and from the pulley D two straps, S T, pass to and around the clutch pulley P. These straps S T, are placed side by side, and are wound in opposite directions, so that they pass off at opposite sides. The ends of the straps are connected to the pulleys. The clutch pulley P is bored centrally for the shaft, and formed at the sides of the central aperture with tangential grooves that extend from end to end of the hub, and open into the bore. In the grooves are pins or rollers, behind which are springs that tend to force the rollers towards the shaft. There are preferably three grooves, and the rollers are of such diameter that they will jam between the shaft and the tangent sides of the grooves. With this construction the pulley can turn freely on the shaft in one direction, and will clutch the shaft firmly when turned the reverse way. As shown, the pulley clutches when turned to the left; but that may



Mayo and Perry, of Lowell, Mass. The invention is applicable to all machines, such as circular saws, lathes, &c., in which high speed with comparatively small power is required, and consists in a "clutch pulley of novel construction" and

be changed by simply reversing the pulley on the shaft. In operation, the treadle being pressed down, the strap turns pulley E and shaft B, and the strap T being thereby wound on pulley D, turns the clutch pulley P in the direc-

tion for clutching the shaft A; the shaft is consequently turned, and continues to turn by momentum of the flywheel during the return movement of the clutch. This movement of the clutch by strap T winds the strap S on the clutch pulley, so that the reverse movement of the shaft B will unwind strap S, reverse the revolution of the clutch, and rewind strap T. The reversal of the movement is to be accomplished by a spring or equivalent device. As shown, there is a spiral spring on shaft B connected to the frame and to pulley D. At the forward movement the spring is wound, and reverses the movement of the shaft by its reaction. It will be seen that the treadle always turns the treadle shaft in one direction. The shaft A is turned in the same direction or the reverse according to the arrangement of the clutch. The clutch shown can be used with other forms of treadles, and the treadle used with a clutch of different construction. The patentees claim the combination.

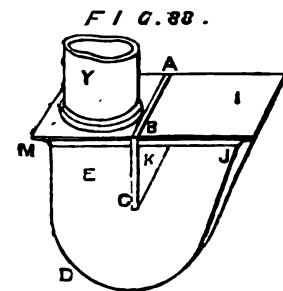
PRACTICAL NOTES ON PLUMBING. XV.*

By P. J. DAVIES, H.M.A.S.P., &c.

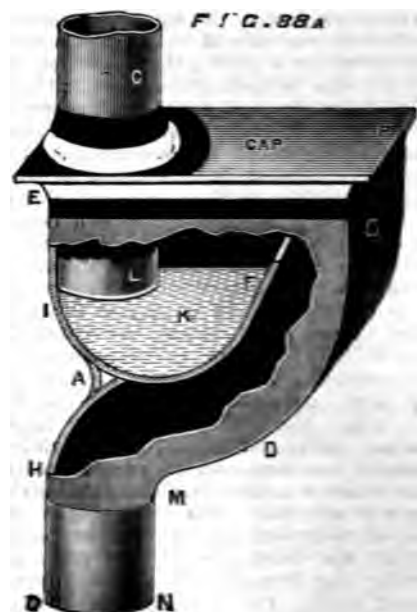
□-Trap with Flat Dip (Fig. 88):

THIS trap being my own invention, I commence by giving my readers the proper instructions for its manufacture.

Make the body, Fig. 88, M D J I, as you would the body of the □-trap, Fig. 79, and then wipe in the inlet-pipe Y. Now measure off from



M to the front of the dip, and with a saw cut the cheek down to the depth you require for the



water-lock; then cut the other side, and finally across the top. Prepare a piece of stout lead L, just wide enough to drop into this cut, and burn it there, or, with a copper bit, solder a good thick seam all round the cheeks and top; or, should you prefer to wipe it in, let the plate be prepared so that it will stand out $\frac{1}{2}$ an inch all round.

The object for making this style of trap,

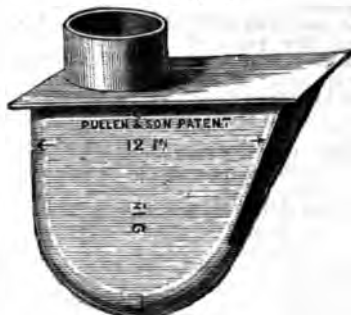
* From the Building News. All rights reserved.

obtain the width across the dip, which is anything to pass from the inlet side to body of the trap.

at Lead Round-Bottom $\square$ -Trap, with Flat Outgo.

Allen's New and Improved Patent $\square$ -trap be had with a round bottom and flat outlet. object of the rounded bottom is too well known to require any comment here. Suffice it to say that this trap (which is now made according to my scale for the $\square$ -trap), is not

Fig. 88, B.



self-cleansing, but proof against waving. It is very easy to fix, and, in fact, possesses qualification that is required in and constitutes a good sound trap. Fig. 88 B, shows elevation.

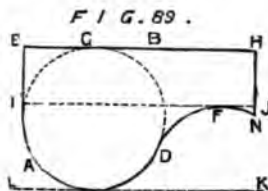
$\square$ Hunch-Trap.

A trap is made to answer the purpose of a hunch-trap (Fig. 69 A, 98, &c) in position where the pipe is required to be continued straight line. For mode of construction see 88 A. Commence by cutting the cheeks out in one piece, then solder on the back G D M, next solder the inner band E to form the outlet lip F, after which the back piece A H; you must then put the trap as in an ordinary $\square$ -trap. This trap is well adapted for use in cases where the urinal, &c., is situated in a recess in wall. See also Fig. 69 A.

$\square$ -Traps.

page 87 in the copy of this journal bearing date July 15, will be seen an old $\square$ -trap, manufactured 1678.

proper method of striking this trap correctly is as follows:—To make a 9in. trap, open compasses 4in., and describe the circle A, Fig. 89; draw the top line E H, cutting the circle as shown. Now draw the water-line



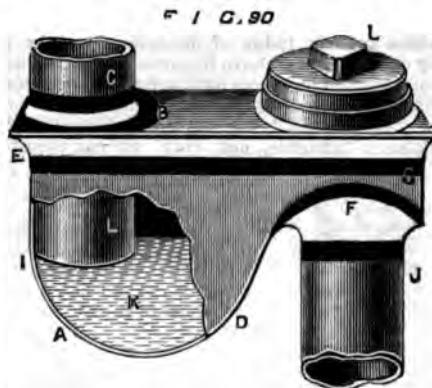
which is generally the size of the dip-pipe; then, assuming the dip-pipe to be 4in., you will keep the water-line down 4in. from the top, if necessary to get a little more dip, you may make it a little higher. Next, with the compasses (4in.) strike the arc D F N, G the water-line, and also the outside of the circle, as shown at D F; then strike the line E I square with the top-line, and G the circle, also strike the outlet end.

If you prefer a sharper outline curve, use compasses at a smaller radius. The trap is made up in the same way as the $\square$ -trap, using that the solder-line round the top does not.

$\square$ -Trap with Solid End.

object of this style of trap is to save a hole in the soil-pipe, and is done by making it stop or solid end, and taking the soil-pipe right down as at J, Fig. 90. Make the hole on the bottom of the band (which should be right at this point), wipe round the check,

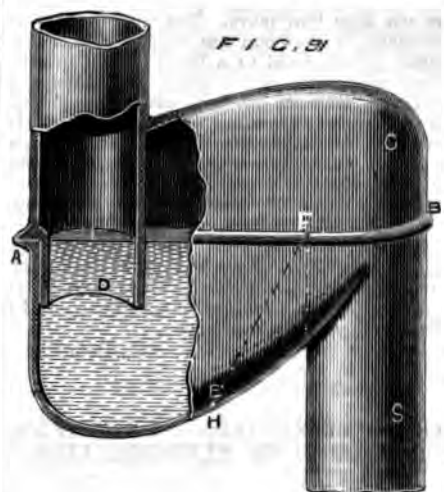
as shown at F. Be careful not to have any sharp angles, and that the trap is not wider



than the outlet, also that the soil-pipe is fixed in a line with the solid end.

The Adeo Trap.

This is an American patent, the action being that of the $\square$ -trap, but made in halves as shown A B, Fig. 91. D is the dip-pipe, S the soil-pipe,

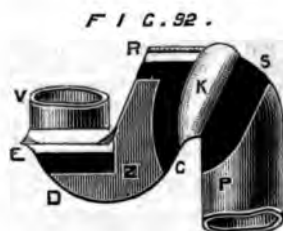


C the cover, E the body. While not wishing to say anything derogatory to this trap, I nevertheless think that it has a fault—namely, the outgo-pipe coming up to the point F. I think if the band were taken up as per dotted line E H, the soil would have a much better chance of getting away. Adeo claims as one of the great merits of his trap that it will not siphon out, but this is nothing if an air-pipe is used. However, it will not wave out, which is a great advantage.

Three-Quarter or Cut-Down $\square$ -Trap.

The title of this trap will explain for itself that it is a modification of the $\square$ -trap, or rather that, owing to inconvenient circumstances in fixing, the $\square$ -trap has had to be slightly altered to render it suitable for its confined or awkward position. To meet these trying circumstances it is sometimes necessary to cut down in the following manner:—

See Y E, Fig. 92. In instances where you can go down 1 1/2 in. or more below the outgo, we



sometimes do away with the dip, and the trap is doubtlessly useful in many places where the ordinary $\square$ -trap cannot be used—viz., for illustration sake under the bottom of a cistern,

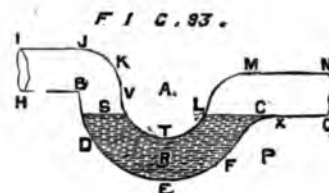
or as an interceptor in a main drain. In the former case you can take the waste-pipe from cistern horizontally to the outside or from under the bottom of the cistern, and into the trap with a knuckle bend. Then, again, it may be used for a child's closet, where, to avoid a step, it is necessary to keep the basin low. These basins should in such an instance fit into a lead hopper, so that the top of the hopper will be above the water-line. But, to be brief, there are many instances where this trap is very useful, of which I will explain further when treating of inside work.

Belly Trap.

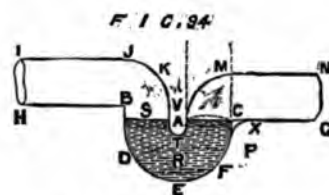
This, though known as the Belly, is actually the siphon. I have been able to trace back its use for at least 3,400 years, and it is beyond dispute that these siphons, or the system of siphonage, was well known even before that date.

As an instance of its antiquity we have only to quote the words of Pliny. He says:—"Water always ascends of itself at the delivery to the height of the head from whence it gave receipt. If it be fetched a long way, the water will rise many times, but the level of the water is still maintained." Fig. 93 is the belly trap, perhaps in an improved form. B is the inlet, which, please notice, has a drop or cathetus from B to the water-line S. This is most effectual for pushing forward solid substances owing to the law of falling bodies accelerating in proportion to the space travelled—i.e., suppose the depth from B to the water-line S to be equal to the depth of water within the trap, then the momentum gained will be of equal force to press this forward. Students in mechanics will find some exemplification of this law in the first lessons of mechanics by that item known as "the two balls showing reaction."

There is, however, another point to be considered in this trap. Fig. 93 represents a very



long trap-body, which holds more water than a trap made after the model of Fig. 94, so that in reality, assuming that an equal pressure of



water is applied to each trap, there would not be as much water removed by that pressure from Fig. 93 trap as would be from Fig. 94 trap. This is important to a degree from a sanitary point of consideration, as in all traps the whole of the water should be changed, if possible, for the very simple reason that the longer water is exposed to poisonous gases, the more it becomes imbued with the poison, and consequently the more injurious it becomes to the health.

To strike these traps out, first mark the dip part T out to the size required—I think the smaller the better, as at Fig. 94. Next decide upon the size of your trap, say 4in.; then from the same point A stretch the compasses to E, which must be 4in. beyond the throat line T, and strike the half-circle B D E F. Continue D to B straight up to the point required as high as you can for the fall; now to this line draw a right line, also having a fall as from H to B, but keep the intersecting point at B sharp from this line; open the compasses to across the other side of the trap at V, and strike the backline V K J, and draw the line I I parallel to H B. Next describe the outlet with an easy sweep, as at E X, but with sufficient rise above the throat-line for the water-lock; draw the out-go line

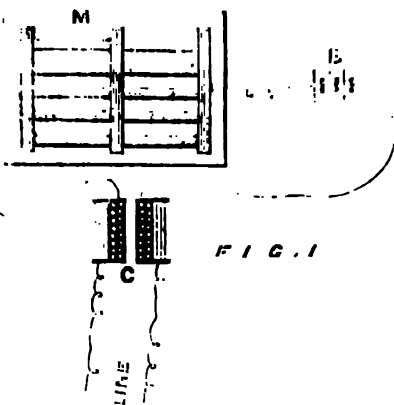
and the top curve I, M, which you can obtain from the point P, or as shown at the intersecting point Q, Fig. 94.

N.B. These traps are generally made in two halves, and soldered up the sides.

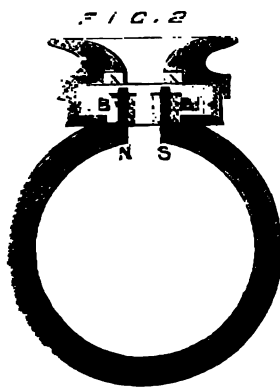
(To be continued.)

THE PARIS ELECTRICAL EXHIBITION.—VII.

(1) ONE of the greatest attractions of the Exhibition is certainly the telephonic audition of the Opera. The instruments employed are Ader's microphones and telephones. Fig. 1

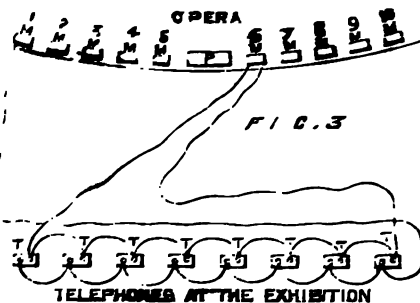


represents Ader's microphone. It consists of a thin pine board, on which are fixed ten transmitting-carbons in the circuit of the battery B. In order to insure greater delicacy, an induction-coil, C, is used, and the line-wire is connected with the secondary coil. This transmitter is much used on the Paris telephonic lines, and is the one adopted at the Opera. Ader's receiving telephone is an interesting modification of Bell's instrument. In Fig. 2 N S is a permanent



magnet of circular form, with two pole-pieces, around which the bottles of insulated wire B B are wound. The particular feature of the instrument is a soft-iron ring, X X, which is placed in front of the vibrating-plate, and which is found to intensify the sounds received. These are the receiving-instruments generally used at Paris, and which have also been adopted for the Opera. In Fig. 3 are shown the connections between the Opera and the Exhibition. A line is run from each side of which are ten microphones M. There are ten telephones at the Exhibition, each connected with a series of ten microphones. There are ten series, placed in front of the Opera. I have shown the connections of the Opera and the Exhibition. The Opera has two telephones, one connected with the Exhibition, and the other with the Opera. The Exhibition has ten telephones, each connected with a series of ten microphones. The Opera has ten microphones, each connected with a series of ten telephones. The Exhibition has ten telephones, each connected with a series of ten microphones. The Opera has ten microphones, each connected with a series of ten telephones. The Exhibition has ten telephones, each connected with a series of ten microphones.

and so on. Now, this mode of connection is very important, for it was at once seen that since the actor is not at the same distance from each microphone, we hear him differently in each ear, and just as by our two eyes we have binocular vision and can judge of distances by sight, so by our two ears we have binocular audition, and can judge of distances by hearing. We can consider this part of M. Ader's invention as a sort of "stereoscope" for the ear. Thus, at the Palais d'Industrie, not only we can perceive



sounds, distinguish every voice and every note of each instrument, but we can also perceive distances; and although we do not see the actor, we can hear him move. The microphones on the stage of the opera are supported on india-rubber pillars, fixed to a block of lead in order that the shaking of the floor, when dancing is going on, may not interfere with the sounds to be transmitted. On referring to Fig. 1 it will be seen that the battery B is short-circuited, and is, of course, liable to soon get polarized. In order to avoid this there are four series of batteries which, by means of commutators, are alternately put into circuit. This part of the exhibition is a very great success, both from a popular and scientific point of view, and there are always hundreds of persons waiting at the doors of the telephone rooms in order to hear the opera for the short space of two minutes.

C. Details.

THE SCIENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING.—VIII.*

By Professor W. GRYLLS, ADAMS, F.R.S.

(Concluded from p. 86.)

The Werdermann or Joel Electric Light.

IN the Werdermann system or the Reynier system, a small thread or point of carbon abuts against a plate or edge of carbon or of copper, and becomes heated by the current so as to give out a glowing light, and gradually consumes away, but more and more slowly as the carbons are more and more improved. In these lamps, kindly lent to me by Mr. Latimer Clark, and in these Joel lamps kindly lent me by Mr. Joel, who has introduced several improvements into the original Werdermann lamp, the resistance of the contact of carbon is very small, about $\frac{1}{134}$ of an ohm; hence it will take several of them—7 or 8 (or perhaps 10)—arranged in series in the same circuit, to equal the resistance of the electric arc. To work these lamps of low resistance, only a low electromotive force is required, and so the result is attained by driving a small-resistance dynamo-electric machine at moderately low speed, or by placing a considerable number of lamps in series, so as to make their combined resistance equal to or greater than the internal resistance of the machine. Thus a Gramme machine, revolving at the rate of 1,200 revolutions a minute, giving an electromotive force of about 130 volts, will give a current of 50 webers through about 10 lamps in series. But this current gives an illumination of 500 candles in each lamp, so that with this current we get an illumination of 3,200 candles in 10 lights. Now, the energy expended to produce this rate of revolution in a Gramme machine, is about 9 or 10 h.p. Hence the Werdermann or the Joel lamp gives at least two lights of 100 candles each for each h.p. of energy expended.

Mr. Alex. Siemens has shown in his paper on "Electric Lighting" that the electric arc, costing 15s. a ton, will produce 1 h.p. of power for 1 hour, and that if a steam-engine be employed to produce an

electric light of 6,000-candle power, the cost would be 5d. per hour. If the same illumination be produced by 15 lights of 400 candles each, the cost would be 2s. 1d., or five times as much. Hence the cost for a 400-candle light would be at the rate of about 1½d. per hour.

Now, by comparison, we may get some idea of the price of the electric light when obtained by means of the Werdermann or Joel lamp. If we compare the light obtained by the Joel or Werdermann lamp with that from the 400-candle light from the arc, we get about 320—or, say, 300—candle power in the Joel light for 800-candle power in the other. Hence the price of the electric light from the Joel lamp should be at the rate of 6½d. per hour for a 600-candle power light.

Now, according to Mr. Alex. Siemens' estimate for gas, the price of gas would be at the rate of about 5½d., or nearly 6d., per hour for the same light. In other words, the cost of the electric light from the Joel lamp would be nearly the same as the rate of 4s. per 1,000 cubic feet.

In estimating the candle-power of lamps, it is usual to place the photometer on the same level with the lamp, so that the surface is illuminated by the rays proceeding horizontally from the lamp. Now, in all lamps, whether Werdermann or arc lights, which are fed by a continuous-current machine, the current passes from the positive carbon to the negative always in the same direction; and in the arc lights, the upper positive carbon becomes worn away into a hollow; hence a portion of this carbon obstructs the light, and the greatest intensity of light is not in a horizontal direction, but downwards, at an angle of about 60° below the horizontal. The illumination in this direction is about three times—or even more than three times—the illumination in the same horizontal plane with the arc; hence, when it is said in the report of the Glasgow tests that a dynamo-machine, at 1,200 revolutions per minute, will give a light of 2,060 candles, for an expenditure of 4 h.p.—the light being measured horizontally—we see that the illumination, in a direction inclined downwards at an angle of 60° below the horizon, would be 6,500 candles for 4 h.p., or at least 1,625 candles per h.p. This will also explain why lights fed from continuous-current machines should be placed at a considerable height above the area to be illuminated. This, combined with the fact that it is far more economical to produce one very powerful light by means of a large machine than several smaller lights to illuminate the same area to the same degree, will explain why Dr. Siemens erected his large lamps at so great a height for the trials of electric lights which we have an opportunity of seeing in the City.

Sub-division of the Electric Current.

The next point to which I propose to draw your attention this evening is the sub-division of the electric current.

It will be simplest to regard first the case when there is a battery of given electromotive force. In this case, according to Ohm's law,

$$E = C(R + r),$$

where E is the electromotive force, C the current, R the resistance of the battery, and r the external resistance. If the poles of the battery be joined by two separate resistances r_1 and r_2 ,

$$\text{then } E = C \left(R + \frac{r_1 r_2}{r_1 + r_2} \right).$$

If the resistance of each branch is equal to r, and if C_1 be the current in each,

$$\text{then } E = C(R + r) = 2C_1 \left(R + \frac{r}{2} \right).$$

Let E = 100 volts, R = 1 ohm, and r = 100 ohms, then $100 = C(1 + 100) = 101C$, and $100 = 2C_1(1 + 50) = 102C_1$.

Hence, nearly the same current flows in each branch as when there is only one wire. If there are 10 branches instead of two branches, and if C_1 be the current in each,

$$\text{then } 100 = C_1(1 + 10) = 110C_1,$$

i.e., the current in each branch is $\frac{100}{110}$ instead of $\frac{100}{101}$. If there are 50 branches, and C_1 be the current in each,

$$\text{then } 100 = C_1(1 + 2) = 150C_1,$$

thus the current in each is $\frac{100}{150}$ or $\frac{2}{3}$, and the heating or glowing effect is $\frac{4}{9}$ ths of its value when only one branch.

Now, if with 50 branches in multiple arc, we divide the external resistance of each branch so as to produce same current as at first through each branch,

* A copy of "Electric Lighting" delivered this year before the Society of Arts.

Then $E = C(R + r)$ at first,

And $E = 50C \left(R + \frac{r_1}{50} \right)$ with 50 branches.

So that $(R + r) = 50R + r_1$,

Or $r - r_1 = 49R$.

Hence, with $R = 1$ and $r = 100$ ohms $r - r_1 = 49$ and the length left has a resistance of 51 ohms. The heating of each of these is $\frac{51}{100}$ or one-half of

what it was with only one branch. Hence the glowing heat or light from such a resistance will be greater than from the unshortened wire, with the weaker current through it. In this case we get 50 circuits of 51 ohms each, so arranged that the heating effect in each circuit is $\frac{51}{100}$, or about one-half of what it was at first. Hence the amount of heat radiated from each is one-half of what it was at first. But there are 50 such circuits, therefore the total heat radiated is 25 times as much as it was with only one branch.

If the resistance of the battery and connecting-wires is considerable, then we see that the addition of every additional branch circuit takes away greatly from the amount of heat radiated from each branch, so that this plan of sub-division by separate circuits can only be adopted with success when the internal resistance is small as compared with the external resistance. We see, then, that with small internal resistance, there is great gain in heating, and, therefore, in light-giving power, by arranging branch parallel circuits in multiple arc; but when the resistance of the battery and leading wires is considerable, the advantage of this arrangement is small, and very little sub-division is admissible.

Incandescent Lamps.

Now, let us consider the case of currents produced by means of dynamo-electric machines, in which the electromotive force is not constant in the same machine for the same speed, but depends upon the resistance of the circuit. An electromotive force of 100 volts produces a current of one weber through a resistance of 100 ohms, and Mr. Swan tells us that this current, through a lamp of that resistance, gives a 60-candle power light. Now, if we reduce the length of the carbon filament in the lamp without altering the current, we reduce the illuminating power in the same ratio. Suppose we take it as $\frac{1}{5}$ th of the length—i.e., its resistance is then 80 ohms, and we shall get a 48-candle power light from the same current (one weber)—i.e., with an electromotive force of 80 volts.

With two such lamps in series, we shall get two 48 candle-power lights, with an electromotive force of 160 volts, sending a current of one weber through them—i.e., the two lamps should give out a light of six gas-burners of 16-candle power each, and should be sufficient to illuminate a drawing-room in many of our London houses.

If we consider now how we are to produce this current, we find that a Bürgin machine, by the expenditure of 6 h.p., will send a current of 24 webers through an external resistance of about 7 ohms, giving an electromotive force of 160 volts. If then we take two lamps in series—i.e., 160 ohms, and arrange 24 distinct series, we shall get a combined resistance of $\frac{160}{24}$, or about 7 ohms,

allowing for the resistance of connecting wires, and there will be a current of 1 weber through each circuit—i.e., this machine should give us 48 lights each of 48-candle power. With a resistance of 50 ohms in each lamp, the number of lamps which may be supplied from the same machine will be double this number. If we reduce our electromotive force from 100 volts to 80 volts, with the same length of carbon in the lamp, then we reduce the current from 1 weber to $\frac{8}{10}$ ths of a weber. This in the same resistance will reduce the illuminating power from 60 candles to a light of about 40-candle power, instead of a light of 48-candle power. Hence, with a given electromotive force, more light is obtained, and, therefore, greater economy is affected by shortening the length of the carbon in the lamp, rather than by diminishing the current through the same length of carbon. Hence, the best results will be obtained in incandescent lamps by sending through them as strong a current as they will safely stand, and making the length of carbon such that the dynamo-machine employed will send such a current through them.

Take another case:—Suppose we have one lamp of 75 ohms resistance—(i.e., about 45-candle power). A Gramme machine or a Siemens's medium-sized machine will give an electromotive force of 100 volts, and a current of about 25 webers, at the rate of 100 revolutions a minute, through an external resistance of about 3 ohms. Hence, if we have 25 lamps in separate branch circuits, or in multiple arc, we get 1 weber through each from such a machine, and get a light, according to Mr. Swan, of 45-candle power from each. Hence, such a machine will give us about 1,125-

candle power illumination. The energy expended would be about 5 or 6 h.p., so that the illumination would be about 200 candles per h.p.

We have seen above that, with the Siemens's alternate current machine, a 400-candle light requires about half a horse-power; so that 1 h.p. will supply two lights of 400-candle power, from an alternate current machine, at the rate of 10d. for three hours. The same illumination can be obtained from gas, at 2s. for three hours. Now, two-thirds of this cost is for the supply of carbon, which becomes burnt in the arc. Hence, without this consumption of carbon, the expense per h.p. is only 10-9ths of 1d. per hour. Applying this to the case of incandescent lamps, in which our carbons do not wear out, we see that by a proper arrangement of the lamps we may get a 200-candle power light at the rate of 10-9ths of 1d. per hour.

Now, Mr. Alex. Siemens also states, in his paper, that at the rate of 3s. 6d. per 1,000ft., the same illumination cannot be obtained from gas at less than 2d. per hour. Hence, allowing 8-9ths of 1d. an hour for the breakage of incandescent lamps, the cost of light by gas and by incandescent and electric lamps would be nearly the same.

If we allow that only a light of 40-candle power, instead of 60-candle power, can be produced at this rate, still the incandescent light cannot be regarded as an expensive light.

Now, in the absence of any actual determination, let us assume the same law to hold in the Brush system as in the Siemens or the Gramme system. In the Brush system a current of 10 webers is sent through an internal resistance in 10 ohms, and an external resistance of 70 ohms. Now, in the Siemens machine, when the external resistance is seven times the internal resistance, the current is only $\frac{1}{60}$ th part of its value when the external and internal resistances are equal, and $\frac{1}{40}$ th of its value when the external is double the internal resistance. The drawback to this arrangement would be, that one-third of the total work expended would be lost in heating the machine.

Taking the Brush machine as worked at present, the difference of potential for each of 16 lamps in circuit is about 40 volts. Hence total difference of potential of 16 lamps = about 640 volts. With an external resistance of 30 ohms, there is a current of 10 webers. Hence, if we arrange incandescent lamps in 10 series, so as to get a resistance of 70 ohms, we shall get 1 weber through each series. Put, then, 7 lamps, each of 100 ohms resistance, in each series, and we shall get 70 lamps from a Brush machine. These 70 lamps are each of 60-candle power, and all are worked by an expenditure of 16 h.p. Hence the candle power is 4,200 candles from 16 h.p., or 262.5 candle power per h.p. If the lamps of this resistance are only heated, so as to give a light of 30-candle power each, then the candle power per h.p. will have to be reduced.

Thus we have seen that it is possible to subdivide the electric current in such a way as greatly to increase the amount of illumination which may be obtained by means of a dynamo-electric machine, especially when the light is accomplished by the incandescent system of Swan, Lane-Fox, or Edison.

The earliest attempt to obtain light by incandescence in a vacuum was made by King in 1843, who applied continuous metallic and carbon conductors, and heated them by an electric current in a Torricellian vacuum. He was followed in 1848 by Staites, who used an iridium, or an iridium and platinum wire, and enveloped the holder in glass or some other non-conductor. In 1872, Konn employed graphite, and rendered it incandescent in an atmosphere of nitrogen, in which there was no wasting away of the carbon. The same principles have been followed, but with greater promise of success, in the more recent attempts at producing illumination by means of incandescence. The earlier attempts failed, either (1) because of the impossibility of preventing the consumption of the carbon or other material, in consequence of the minute traces of air which it was impossible to get rid of with the means of exhaustion which were then known; or (2) because of the presence of other gases, such as hydrogen, which exists occluded in platinum and in other substances. It is only quite lately, since our power of obtaining a vacuum has been so greatly extended, and since we have learnt so much about high vacua from the labours of Mr. Crookes, that Mr. Swan and Mr. Lane-Fox have succeeded in obtaining vacua from which all the air and occluded hydrogen are exhausted, so that their carbon filaments and platinum wire connections remain without being destroyed, even when a current of electricity strong enough to make them give out a brilliant incandescent light has been continuously passing through them for months together. Through the kindness of Mr. Swan, and my friend and former pupil, Mr. Lane-Fox, I am able to show you this evening how well they have succeeded in producing a brilliant, and yet a steady and pleasant, incandescent light. This is a triumph which many have sought in vain, and which could not have been attained except by combining together the results of investigations

which have been recently carried on in several branches of physics.

THE CONDUCTIVITY OF METALS FOR HEAT AND ELECTRICITY.

THE question as to the ratio of the heat-conducting power of metals to their electric conducting power, has lately been made an object of two separate investigations (described in the *Annalen der Physik*), Herr Weber having last year arrived at the result that the generally-accepted regularity of the ratio referred to (according to Forbes, Wiedemann, and Franz), did not agree with his measurements.

One of these researches has been conducted by Herren Kirchhoff and G. Hansemann, who lately investigated the heat-conducting power of iron. The method adopted for that metal they have applied to a series of metals, and at the same time measured the electric conducting power of all these metals—viz., three kinds of iron and one each of lead, tin, zinc, and copper.

From the observed numbers in the experiments on heat-conduction, the temperature-conductivity for each metal was deduced, i.e., the heat-conductivity divided by the product of the specific heat into the density. This showed a temperature coefficient, which was positive for copper, *nil* for zinc, and negative for all the other metals.

The electric conductivity of the metals was investigated by a method theoretically developed by Herr Kirchhoff. From the cubes which had served in the measurements of heat-conduction were cut bars, having the length of one side, and a square cross section of 3mm. to 5mm. A circuit was arranged of the bar, a resistance-gauge, and a battery, and to the bar and gauge derived circuits were added, including the two coils of a differential galvanometer, and having their resistances capable of being measurably varied. The conductivities of the metals at 15° C. were determined, that of mercury at 0° being regarded as unity.

From the table of results, it is evident that the values of the electric conductivity for different bars of the same metal differ considerably, though the densities present only slight differences. The want of homogeneity appeared yet more distinctly when the electric conductivity of different parts of the same bar was measured; in the case of copper, these differences reached as high as 25 per cent. On this account the authors consider they cannot decide, with the certainty they had hoped, the question whether the ratio of the conductivities for heat and electricity in the metals examined is a constant. To answer the question with the greatest probability of truth from those experiments, one should compare the values obtained for the heat-conductivity with those values of the electric conductivity, which relate to bars cut from the cubes near the middle. The ratios thus obtained (for the two conductivities) are:—Iron I. = 2.08; iron, II. = 2.37; iron III. = 2.09; lead = 1.74; tin = 1.64; zinc = 1.72; copper = 1.73.

The numbers appear to prove that the ratio of the two conductivities has in general the same value in various metals, but is different in iron. "Perhaps," remark the authors, "this exceptional position of iron is conducted with its magnetic properties."

The other investigation is that by Herr Lorenz, of Copenhagen, who has lately sought to determine the heat-conductivity and the electric conductivity of a series of metals by quite different methods, for particulars of which we must refer to the original. The inquiry referred to copper, magnesium, aluminium, cadmium, iron, tin, lead, antimony, bismuth, brass, and German silver. The two conductivities were determined both at 0° and at 100°, and after the results of experiment were tabulated Herr Lorenz made a new determination of the heat-conductivities (by the method of cooling), seeing the results arrived at by Herr Weber, published meanwhile, did not agree with his own. In general, the values arrived at by this second method harmonised well with those got by the first. In a table Herr Lorenz presents the values arrived at, for heat conduction in the above-named metals at 0° (K_0) and at 100° (K_{100}); then the electric conducting-power at 0° (κ_0), and at 100°

(κ_{100}); the ratio $\frac{K_0}{K_{100}}$, and finally the ratio $\frac{K_{100}}{\kappa_{100}}$. We extract only the last. It was, for copper = 1.358; for magnesium = 1.398; for aluminium = 1.367; for red brass = 1.360; for cadmium = 1.315; for yellow brass = 1.428; for iron = 1.530; for tin = 1.334; for lead = 1.304; for German silver = 1.314; for antimony = 1.294; for bismuth = 1.372.

"From the tabulated results of my observations," says Herr Lorenz, "appears, firstly, for the better conducting metals, a confirmation of the law of Wiedemann and Franz, since for these metals the ratio of the two conductivities for heat and electricity is nearly constant both at 0° and

100°. On the other hand, this ratio increases greatly for the worse conductors, with decreasing conductivity, affording apparently the transition to the non-metallic conductors, in which, as is known, the ratio in question is still greater.

Secondly, it is found that in all metals (with the exception of iron) the ratio $\frac{K_{100}}{K_0} : \frac{K_0}{K_0}$ is constant and approximately equal to 1.367. Thus we have, for the conductivities K and κ corresponding to the absolute temperature T , $\frac{K}{\kappa} = T \times \text{constant}$,

a law which seems to be still more generally valid than the preceding, since German silver, antimony, and bismuth behave in this respect like the other metals.

Herr Lorenz adds some theoretical considerations leading to the result that "we have probably to suppose, in the interior of a body, besides movements of mass, electrical double-layers, with a difference of potential proportional to the temperature and electrical currents, as various forms of energy."

FEEDING AND SHRINKAGE OF MELTED IRON.*

THE assertion often made by writers, "that melted cast iron expands at the moment of solidification, so as to copy exactly every line of the mould into which it is poured," always sounded to me very absurd. The word "moment" would imply a sudden dividing line between liquid and solid iron. In melting iron, there is nothing sudden from the time it leaves the melter's hands till it is tapped out into a ladle, from which time it cools gradually, the time it will take to cool depending on the shape and size of the mould that the iron is poured into. The amount of expansion or shrinkage will be according to the grade of softness or hardness of the iron and the quality of the ores that the iron is made from.

Soft iron is often grained, and when melted has more life than hard iron, and may expand some in cooling. Hard iron is close grained, and melts quicker, and has more shrinkage than soft iron. Take two solid pieces, three inches square, and pour one with hard iron and the other with soft iron, and have the same sized feeding heads and gates on both, and do not feed either of them; and in the morning, when you break off the heads, you will find the one of soft iron solid, and the one of hard iron, ten chances to one, will have a hole in it. If not seen on the face, cut the casting in two pieces, and you will likely find it honeycombed under the skin, especially if the iron was poured hot. Melted iron, when cooling, cools the fastest at the bottom of the mould and at the sides and cope surfaces, which draws molten iron from the hottest or central portion to supply the shrinkage of the cooling parts. If this central, or last portion of the iron that cools, is not reached with a feeding rod and hot iron to supply the shrinkage, the last parts to cool will be honeycombed or hollow.

There are often castings that cause explosions or breaks through the thickest, and, as is thought, the strongest parts. One cause for this is that there is not one moulder in fifty who feeds a casting in the right manner, or who studies the parts that require feeding. There are often castings that would require a half-dozen feeding heads to make all the parts solid, and in some cases the designers of machinery or the pattern makers will have castings disproportional, so that the thick portions cannot be fed, or the shrinkage of the heavy parts supplied with iron. Such parts would be stronger if they were made lighter, and had what iron there was solid, rather than heavy, with a honeycombed centre.

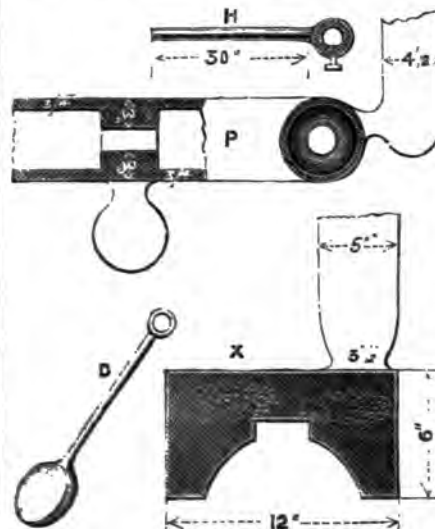
The cut X shows a round die block that was used in a lamp manufactory for pressing a composition of metal. There had been several of them made, but, being unsound, the pattern was taken to another shop, as it was very expensive to throw them away when partly turned up. When the pattern was shown to me and the trouble explained, the first question I asked was if there had been a large feeding head used, and if they were fed well? I was answered "Yes." Further questioning showed that there were no signs of dirt or holes until the casting had from $\frac{1}{16}$ in. to $\frac{1}{8}$ in. turned off it. I gave the job to a man I knew was not afraid of a hot job, and saw that he got hot iron when wanted. He stuck it until his rod was driven up into the feeding head by solid frozen iron below it, and I had the pleasure of telling him that his casting was the best; and solidest the machinist had ever finished up. What the machinist called dirt or holes in the bad castings was only honeycombed or porous iron, caused by improper feeding.

In setting a feeding head on a pattern, it should, if possible, be set or cut on the thickest portion of the casting, or that part of it which will keep the longest hot. The feeding head should be of such

size that it can be kept open, with hot iron, until the casting is set. In starting to feed a casting, the rod should be put in slow and easy, and if the mould is not too deep it should touch the bottom, and then be raised up two or three inches, so that it will not be punching holes in the mould. Some moulders, when feeding, work their rod up and down in the centre, and the slides freeze up and close or solidify while the iron in the mould is yet in a liquid or molten state; or they will put a small feeder on, that will freeze so quickly that they cannot get a rod into it, or if they do it will stick fast, and then they will complain of some one for not bringing hot iron when wanted. A moulder should never make this excuse. He should have the feeding-rod hot, and the head the right size; and instead of working the rod in the centre, work it up and down around the sides quickly, so that the freezing iron will be pushed or worked down into the casting, and the hotter iron in the casting worked up into the feeding head. This keeps the head and casting at the same temperature.

When you do get hot iron, always have a hole worked in the head to hold as much as possible, so that it will help to cut away the freezing iron on the side of the head, making the iron in the head hotter than in the casting. Put in hot iron when there is a good chance to get it, and don't call for it just as you see the cupola man going to stop the cupola up, or do some other as sensible trick, as putting in the rod so that it does not go into the casting, which lets the neck of the feeder freeze. The rod should be kept down into the casting, and let the iron as it freezes at the bottom push it up out of the casting.

There are often cases where the iron or wooden bars of a flask will not admit of a proper sized feeder. In such cases where the bars cannot be



readily widened, the feeder should be built up in length, to make up for the loss in diameter. A small feeder closes quicker and takes more hot iron to keep it open than a large one. Large feeding heads require less work and attention than small ones. With feeders 10 in. and upwards, as soon as the casting is poured put in the feeding rod and work it around for a minute or two to work the dirt up to the surface. Then take the iron dipper, as shown at D, of which a shop should have 3 or 4 sizes: the dish part being about 2 in. deep and the handles about 4 ft. long; and dip out the dirt and as much of the dull iron as is necessary to make room for one or two hundred pounds of hot iron. Then work the rod to mix the hot and dull iron, and throw on some blacking to keep in the heat. After fastening on the holder H, or a pair of blacksmith's tongs to hold up the rod, the moulder can rest from ten to thirty minutes occasionally lifting up the rod to see how the iron is, and that it is not freezing at the smallest part or neck of the feeder. As soon as the neck shows signs of closing up work the rod around to open it and to mix the iron, after which dip out some of the dull iron and pour in some hot iron, and cover again with blacking. Repeat this operation until the iron in the casting commences to stick to the rod, then the moulder should give it all his attention, as the neck will close up if the feeding rod is not kept in constant motion; especially if the iron is hard.

I was at one time foreman of a shop where rolling-mill work was done. The proprietor being a moulder, and knowing the failings of moulders, adopted a plan of feeding his large and small rolls a certain length of time. Rolls weighing about 4 tons he would only allow to be fed 7 minutes. It made no difference whether they were poured hot

or dull. When the time was up the heads would be filled with hot iron and the rods worked open the neck, then taken out and the iron covered with blacking. The plan was a good one so far as showing an outside solid appearance when turned up; but should the roll be broken, of the inside appearance I have nothing to say.

When a proprietor or foreman thinks that I have no men who understand, or who will stick to a hot job until the rod is driven out of the casting, the best and surest plan would be to make the feeding heads without a neck; that is, having the feeder the same size at the bottom as at the top. Then let the head be cut off in the lathe, as is done in the manufacture of cannon or large guns. In such work the gun is cast from 2 to 3 ft. long than wanted, the extra length answering for feeding head.

In writing this article, the subjects chosen are castings that cause trouble from shrinkage, as are good ones to show the principle of feeding and shrinkage. The cut P shows a broken pump, the kind used on a locomotive; and when the castings were bored out they would be porous and dirty in the heavy section. To remedy this they were cast in dry sand, and on end, but with a better result. The thickness of iron on each side of the heavy part is only $\frac{1}{16}$ in., and the heavy part $\frac{3}{16}$ in. thick. My attention was called to the job and seeing the trouble I made two or three castings in green sand, and with a feeder cut into the heavy section, as shown. The casting bored out solid and clean. Casting them in dry sand, and on end, would not make the thick part sound, as the thin part would freeze before the thick, and the iron to supply the shrinkage would have to be withdrawn from the upper and hottest portion to supply the shrinkage below; so that in boring the heavy section, the part that was down would be solid, and the upper part porous or honeycombed. I have often seen castings go out of the foundry that were required to stand heavy strains or pressures, which, if the party that received them had understood the feeding of melted iron and had seen them fed, would never have been accepted. It is not altogether ignorance on the part of the moulder, but the desire to get rid of a hard and hot job, that is the main cause of ill-fed castings.

THE GLACE PROCESS.*

FOR a fine finish use plate-glass, although the first quality French negative glass will answer.

Clean the best side in the usual manner, as when perfectly dry apply very lightly with cotton wool a little prepared chalk; then with a soft brush dust the plate and gum the edges with any kind of gum. Before the gum is perfectly dry collodionise the plate with plain collodion (consistency of such collodion as will flow well), and place it away to dry. The next thing is to soak for one or two hours loz. white French gelatine in 8oz. water entirely free from any particles or sediments and dissolve fully by heat. While yet hot strain through a piece of muslin into a small porcelain dish. Immerse your print in this solution, as when well saturated take it out, scraping the back of the picture over the edge of dish to avoid waste. Place print down on your prepared plate, and press out the air-bubbles by means of a piece of sheet rubber, 5 in. long, $\frac{1}{2}$ in. wide, inserted into the work handle on the principle of the squeegee.

Now when the picture thus put on the glass is nearly dry, damp a two-ply piece of Bristol board previously cut to size, paste on one side, and put over the print, pressing well down with the scraper, especially the edges.

The Mounting.—After thirty-six hours, or when perfectly dry, with the point of a knife cut the picture along the edge, leaving about a quarter of an inch strip, and raise the picture slowly; then trim to size and gum the edge only. Place down on the card, and for a weight cover it with the same glass from which you cut it, or any piece of glass that is straight and clean. All dust or carelessness must be avoided, or a bad result is certain.

You can put one or more prints on one glass only be careful to keep away from the edge, about half an inch or so.

Keep the gelatine solution as cool as you can work it.

If the picture leaves the glass quite clean, you can use it again without recleaning; thus you may use it a lifetime, being cleaned but once.

We understand that the chemical branch of the Royal School of Mines has been constituted a separate department; at South Kensington. The Normal School of Chemistry is placed under the direction of Professor Frankland.

* By JOHN A. SCHMIDT, in the *Photographic Times* (New York).

* By THOMAS D. WATTS, in the *Scientific American*.

SCIENTIFIC NEWS.

THE Dun Echt Circular, No. 31, gives two messages received by the *Science Observer*, one from Prof. Pickering, announcing the discovery of a probable variable on Sept. 13; a red, spectrum banded. The mag. is estimated to be Sept. 12, 8.9; 17, 8.6. South polar mag. 50.5s. and 10' 18' of D.M. + 72°, 735. place Sept. 14 was R.A. 16h. 31m. 32s. 1. 72° 32'. Elements and an ephemeris of it discovered by E. E. Barnard at Nashville, Tennessee, as calculated by S. C. Adler, jun., are also given. On Oct. 11, at 11h. 51m. 32s., N.D. 32° 18'. The elements $T = 1881 \text{ Sept. } 15.01 \text{ G.M.T.}$, $\pi = 271^\circ 32'$, $i = 260^\circ 43'$, $e = 107^\circ 27'$ (mean equinox), $\log q = 9.70535$.

transit of Vulcan, assuming his existence, be expected about Oct. 12 or 13, and observations of the Sun's face will be made in Honolulu, Japan, Sydney, and Hong Kong, with a view of detecting the planet. Some of the ship companies have, we believe, issued notices for a watch to be kept on board such vessels as will be in suitable localities at the time of the calculated transit.

It is rumoured that Sir George Airy is to be awarded the highest possible pension in recognition of his valuable services while Astronomer-Royal. We suppose these rumours mean he retires on his full salary.

His death is announced, at the age of seventy, Mr. A. B. Sterling, who acted for a quarter of a century as assistant conservator of the Botanical Museum in Edinburgh University. was a well-known microscopist, and wrote a valuable series of memoirs for the Royal Society of Edinburgh on the fungus disease of salmon.

At the last meeting of the Quekett Microscopical Club, Mr. F. Enock explained a new method of protecting cells from damage by internal pressure upon the cement, his device consisting of a small metallic ring of angular iron, which at the same time fitted closely against the cell and overlapped the margin of the cover-glass. It was believed that when placed in position and properly cemented round it would effectually prevent the escape of glycerine.

Dr. Bernays, delivering the inaugural lecture of his session at St. Thomas's Hospital, said that at every medical school there were young men who, if the means could be found, would gladly remain another year or so at the hospitals, and assist as teachers in laboratories; instead of a number of colleges for teaching practically and theoretically physiology and anatomy, "everything," said Dr. Bernays, "starved for the sake of South Kensington." He regards it as a waste of means that the seminars, lecture-rooms, and laboratories of our hospitals and other institutions should be so little used compared with their capabilities.

It is proposed to hold an electrical exhibition at the Crystal Palace in December and a few following months, and a council of scientific men is being formed to aid the directors in carrying out the proposal. The Lord Mayor has convened a meeting at the Mansion House on Oct. 24, and it is understood that several of the principal exhibitors at Paris have agreed to send their apparatus over here when the Paris exhibition closes.

The reading-room of the British Museum will be as usual lighted with four Siemens' arc lamps of 4,000 candle-power each; but an addition is to be made in the shape of Swan's incandescent lamps for use in the cloak-rooms and galleries.

The "first sod" of the Giant's Causeway and Strand Electric Tramway was turned last week. The tramway is to be worked on the system developed by the Messrs. Siemens, water-power being the prime mover.

The town council of Godalming have accepted the tender of Messrs. Calder and Barret to light up the streets with electric lamps, the current being supplied by machines driven by turbines. The town will ultimately have three Siemens' arc-lamps and forty of Swan's incandescent lights, which will be placed in the lanterns used for the gas-lights. The three

Siemens' lamps have been used since Saturday last, and it is expected that the installation will be completed in a week's time. The mills of Messrs. Pullman are also to be illuminated by electricity. The lighting of the town will, it is said, cost 19 per cent. less than the gas estimate, while there will be double the quantity of light.

It is generally known that for the proper production of the electric light, steady running of the engine is essential, but, according to a contemporary, "it has been found that the passage of a seam in the pulley-band of a steam-engine on the driving-wheel will cause the light to 'jump' or 'blink.'"

Prof. Hughes's induction-balance has received considerable attention at the Paris Exhibition, and some useful experiments have been made with it. Mr. Elisha Gray doubted its capabilities, and put it and its author to the test by saying that thirty years ago a splinter of metal was driven into one of his fingers and remained there. He challenged Prof. Hughes to find it. Accordingly, one after the other, the fingers were tried until the first finger of the right hand was reached, when the balance gave a signal, and Mr. Gray was convinced, for the splinter, buried thirty years ago, was in that finger.

Pilocarpin, the active principle of jaborandi, a drug which produces profuse perspiration and salivation, and stimulates the growth of the hair, has been found to cause a change in the colour not only of the eyes, but also of the hair. In a couple of years, the use of pilocarpin had effected a change from light yellow to an almost pure black. The drug employed was the hydrochlorate exhibited by hypodermic injection.

Sulphate of quinine has been manufactured from cinchona bark in India by Dr. King, superintendent of the factory at Sikkim. The cultivation of the plant in India, at Darjeeling, is paying well, and lately the Government of Jamaica have offered inducements to settlers who will undertake to cultivate cinchona trees on the more salubrious parts of the island.

The new prison of the Moabit quarter in Berlin, to which have been transferred all prisoners in other parts of the capital, is stated to be the largest in Europe. It comprises six separate buildings. The men's division, occupying one of these, has 732 separate cells, common rooms for 195 accused persons, 40 rooms for keepers, and dormitories for 118 attendants. Each cell has, among other things, an electric bell, and a gas-burner near a table. In the infirmary, special accommodation is provided for accused persons of the upper classes. The governor's rooms are connected with the court of justice by telephonic apparatus, which renders it possible to have any prisoner that is wanted sent immediately to the court. The women's prison has only 70 separate cells and 15 large dormitories. 220 women can be received. The dormitories are divided into boxes, each containing a bed, and these are locked every night when the women have entered. By day the women are kept in workrooms, under female superintendence. Both the men's and the women's prisons have spacious paved courts (with narrow passages built with granite), for exercise.

Bicarbonate of ammonia, $\text{CO}_2\text{NH}_4\text{H}_2\text{O}$, is a salt that is nearly fixed in ordinary air, but M. Melsens has observed (what he considers rather important from a chemical point of view), that it has the property of being very easily dissociated when it is moistened with a small quantity of water. Indeed, while it is otherwise very little odorous, if not wholly without odour, a little moistening makes it give, in a few seconds, a very strong smell of ammonia, and the salt loses much weight under the influence of water, in a few hours (considerably more than it did in the unmoistened state).

A curious case of instantaneous photography is reported from America. It became necessary one day, at the Willett's Point Engineering School (presided over by Gen. Abbott), to destroy a worthless mule, and the subject was made the occasion of giving useful instruction to the military class. The mule was placed before a camera and duly focussed. On its forehead was tied a cotton bag containing six ounces of dynamite. The slide of the camera was supported by a fuse, which was included in the same electric circuit with the dynamite. Thus, on passage of a current, the camera slide and

the head of the animal fell nearly at the same instant. The photo-sensitive plate was impressed with a picture of the headless creature still standing, before its body had time to fall. (See *Scientific American*, Sept. 24).

At the séance of the French Academy on the 19th ult., there were present the following distinguished foreign savants (brought to Paris by the International Congress of Electricity) Messrs. Clausius, Clifton, DuBois-Reymond, Everett, Foerster, Helmholtz, Kirchhoff, Melsens, Spottiswoode, Siemens (William and Werner), Smith, Stas, Sir William Thomson, Warren de la Rue, and Wartinann. The President, M. Wurtz, welcomed them in the name of the Academy, and invited them to take part in the proceedings. Papers by Sir Wm. Thomson and M. Melsens were read at the meeting.

A few years ago M. Henri Becquerel demonstrated, by experiment, the magnetic influence of the earth on propagation of a polarised luminous ray through a column of sulphide of carbon. He has lately repeated the experiment under better conditions (as regards precision and exclusion of disturbing influences), and the following is the result: The yellow rays D, traversing horizontally a column of one metre of sulphide of carbon at 0°, under influence of terrestrial magnetism at Paris, and in a direction parallel to the declination-needle, undergoes a simple magnetic rotation of 0.8697, from right to left for an observer supposed to be lying with his head towards the magnetic pole. This number is a natural constant, which allows of converting into absolute measure all determinations of magnetic rotations of the plane of polarisation, and affords a means of estimating the intensity of a magnetic field by mere observation of the phenomena of magnetic rotatory polarisation in it.

The German Telegraph authorities have been taking measures against an abuse which sometimes occurs, consisting in misspelling a word to bring it within a certain limit. Thus, in the word *Stammprioritäten*, one "m" will be left out, whereby the word is reduced from 16 to 15 letters, the limit for a single "tax-word." (In the correct form it would pass as two.) It is arranged that, should there be reason to think such misspelling intentional, the word shall be charged for as "groups of letters," in which case five letters are charged as one tax-word. Thus the word just mentioned would be charged as three.

The increasing consumption, in Alsace-Lorraine, of the cheap, common spirits from the beet distilleries of North Germany, favoured at once by three years of bad yield of white wines in the Vosges, and the high duties on French red wines, is felt to be a serious evil, drunkenness being greatly on the increase among the artisan and agricultural population. It was discussed at a recent meeting of the Society of Sciences, Agriculture, and Arts of Basle-Alsace, and the Industrial Society of Mulhouse lately offered a prize for a brochure to be distributed among the working classes, depicting vividly the evils of alcoholism, and tending to inspire a horror of it. In some parts of France (Normandy, &c.), disquietude is being felt on the same account. Dr. Claude attributes the rapid depopulation of Rouen mainly to the growing abuse of spirits. In the three years 1877, 78, 79, the excess of deaths over births in that town was, successively, 308, 438, and 1,178.

An electrical apparatus for measuring automatically the rations of oats to be given to horses in large stables, has been invented by MM. Vaillant, Leclerc, and Gourdon. The grain is poured into a certain number of hoppers, whose lower orifice is blocked by a board (valve) fixed at one end of a long lever, which is pivoted near its centre. A heavy counterweight acting on a rod which connects the levers of all these valves, tends to stop the orifices, but this action is ruled by an electromagnetic catch, which yields only when the oats, having fallen into a case supported on a Roman balance, weigh down the balance and close an electric circuit. The motion of the lever-valve effects a second closure of circuit, through a special rheotome, and the valve, once closed, is opened anew. During the closure, the case into which the oats fall is tilted, and pours its contents into a receiver below, which is then withdrawn for distribution. A mechanical stirrer forces the oats to flow into the hoppers.

The French Government has lately forbidden the preservation of articles of diet with salicylic acid, this substance being considered dangerous to health when used in the quantity required to obviate decomposition.

During a recent thunderstorm at Montmaurin, in Haute-Garonne, M. Laroque witnessed a curious electrical phenomenon. In a group of lilies in his garden, he noticed the tallest of them enveloped in a diffuse violet glimmer, which formed an aureole round the corolla. This light persisted eight or ten seconds. When it had disappeared, he went near the lily, and found, to his surprise, that it was entirely deprived of its pollen, while the neighbouring flowers were covered with it. The electric fluid seems to have scattered the pollen.

Some recent observations by M. René Thuré appear to prove that the telephone is very sensitive to lightning. He stretched a copper wire horizontally between two houses, at the height of the roofs, and connected it with earth through the water-pipes. Two telephones were connected with the aerial line. During every thunderstorm, near or distant, that has occurred since this system was set up in 1879, he has been able to hear sounds in the telephones whenever there was a flash of lightning, and this even when there was no thunder audible (so that the lightning was at least 35 km. distant). The sound and the flash seem simultaneous. The former is comparable to the sound of a Swedish match rubbed on the box—a sort of crepitation composed of a very rapid succession of shocks. Once or twice there was only one shock, and sometimes the shocks were very intense, resembling the discharge of a strong Leyden jar. Many years ago, M. Colladon observed deflections in a galvanometer, arising from a similar inductive action of lightning. The telephone, it is suggested, is a very easy method of studying these inductive effects, and measuring the velocity of transmission of such influence to great distances.

The milk of the elephant, according to Dr. Charles Doremus (America), is the richest that he has ever examined, containing less water and more butter and sugar than any other. It has a very agreeable taste and odour.

On the initiative of M. Naville, a group of Paris merchants, bankers, &c., have founded a philanthropic society for instruction in foreign tongues, and developing a conversational acquaintance with these, such as will prove useful in commerce. The Chamber of Commerce favours the scheme with its patronage. The instruction is to be given gratuitously to the young persons following the course.

A new locomotive is to be tried on the line between New York and Chicago, during this month or next, in which crude naphtha will be employed as fuel. The boiler will have no fewer than 2,174 copper tubes, in order that the water shall be distributed in very small quantities between the heating surfaces. The inventors believe that their system will revolutionise the method of firing locomotives.

Nickel Plating.—A simple process of nickel plating by boiling has been described in Germany by Dr. Kaiser. He prepares a bath of pure granulated tin tartar and water, which he heats to the boiling-point, and adds a small quantity of pure red-hot nickel oxide. A portion of the nickel is soon dissolved, as is shown by the green colour assumed by the liquid which stands upon the grains of tin. If articles of copper or brass are plunged into the bath, they become covered in a few minutes with a beautiful white, silvery, metallic coating, which consists almost entirely of pure nickel. If a little carbonate of tartrate of cobalt is added to the bath, a bluish shade, either light or dark, may be given to the coating, which becomes very brilliant when it is properly polished with chalk or dry sawdust.

Rabbits and Goats near the South Pole.—Mr. E. J. Chipman, mate of the whaler, *Pilot's Bride*, who has just returned from a voyage to the Antarctic Ocean, says that the forty pairs of rabbits and the twelve goats that were taken from Cape-towa to Kerguelen in 1875 have thrived wonderfully, the island fairly swarming with rabbits, while the goats number some hundreds. Teal duck are found about the island in large flocks, and what with roast kid and duck, and stewed rabbit, and plenty of Kerguelen cabbage, Captain Fuller's crew of twenty-eight men had an agreeable change in their diet while there.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 51, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made Payable to J. FARMORE EDWARDS.

* * * In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physics: a vice from whence great inconveniences derive their origin."—Montaigne's Essays.

DIAGONAL PRISM AND CHROMATIC ABERRATION—A DOUBTFUL OBJECT-GLASS—PERHELIA OF COMETS—BRIGHTNESS OF THE CHIEF STARS IN URSA MAJOR, &c.—PRECSSION, &c.—INSTRUMENT FOR MEASURING ANGLES.

[19271.]—WITH reference to reply 44669 (p. 71), it may suffice to say that no chromatic aberration should be perceptible under any power with a properly-constructed diagonal prism. "Inexperienced Astronomer" will, though, divide a very close double star better with a perfect plane.

In answer to query 44777 (p. 75), a 3in. telescope that, with a power of 180, shows phenomena of irradiation with Stars, and a hazy image of the Moon (by which I mean a nebulous appearance at her limb), has an undoubtedly defective object-glass.

"Comet" (query 44822, p. 76) will find the dates of perihelia of every Comet which appeared between 1860 and 1875 (inclusive), on pp. 358 to 364 of Chambers's "Descriptive Astronomy." Their times of perigee are not given: nor do I know of any work in which they are to be found.

Mr. S. M. Baird Gemmill (letter 19249, p. 88), must forgive me if I quite fail to appreciate his assertion "that two stars may be of the same magnitude, and yet one be brighter than the other;" because brightness and magnitude are synonymous, and tenths of a magnitude are now quite commonly estimated. Of course if he means that Sirius, Aldebaran, Capella, Procyon, Spica Virginis, and Vega are all roughly lumped together as "stars of the first magnitude," I am entirely familiar with the fact; but this is not a scientific estimation, but a merely conventional one. Having said which, I may proceed to furnish my querist with the most recent photometrical determination of the magnitudes of the stars to which he refers, which I can find; and which was not published at the date of my last communication on the subject. I mean those of Flammarion in his work "Les Etoiles," which is coming out at this moment in fascicules. In 1880, then, the well-known French astronomer found the magnitudes of the seven principal stars in Ursa Major to be as follows:— α 2.5, β 2.9, γ 2.7, δ 3.7, ϵ 2.2, ζ 2.4, η 2.1. This would indicate that, at the epoch of observation, η was the brightest star in the constellation of the Great Bear, followed in order by ϵ , ζ , α , γ , β , and δ . In 1880 Flammarion found α Cassiopeia to be of the 2.5 magnitude. α Orionis he simply marks "var." I have neither Schönfeld's work nor Professor Pickering's essay in my library. I read the latter when it appeared, but cannot, at this lapse of time, charge my memory with any details which it contained.

Nor (letter 19251, p. 88) do I possess Croll's "Climate and Time," which was merely lent me by a friend soon after its appearance, and which I read at the time. Precession is, in one sense, "a result of the Earth's Polar compression," or rather (more strictly) of her equatorial bulging; the tendency of the Sun and Moon to pull the protuberant ring down into the plane of the Ecliptic combined with the Earth's own rotation, being the cause of the phenomenon. Of course, "Paugul" knows how lucidly this is all explained in Airy's "Ipswich Lectures."

Probably as simple an instrument as "Edina" could employ (query 44887, p. 100) would be the ordinary prismatic compass, used in military sketching and surveying. An engraving and description of this will be found on p. 21 of your XVth Volume. A pocket sextant is somewhat more accurate, but is less available where some of the objects between which the angles are to be taken are near to, and others distant from, the observer.

A Fellow of the Royal Astronomical Society.

SELENOGRAPHICAL.

[19272.]—IN our researches into the condition and constitution of the Moon's surface we should not conceal from ourselves that objects seen from the distance of the moon's surface may be rendered almost invisible from the earth from the great distance they are removed from us, and even if we could obtain the best magnifiers we can bear on the Moon they can avail us but little. The most important means we have of satisfactorily solving the problem of the condition of the Moon's surface is, as Mr. Elgar suggests, for one or two formations to be studied systematically by a number of observers willing to devote themselves to the observation of the minutiae of these formations, the delicate objects on their floors: these are the spots and streaks, and we ought to endeavour to ascertain and study the terrestrial analogues of objects on the Moon that we may employ a process of reasoning by which we may account for the production of similar objects on the Moon. Starting from a volcanic origin, the most probable initial phenomenon would be a "spot" more or less persistent in a certain locality. Very many have seen the phenomenon of a dense cloud hanging over a volcanic vent persisting in the same localities for days. It is easy to see that if such a phenomenon were to occur at the Moon all that would be patent to an observer at the Earth would be a spot more or less persistent in a certain locality. This spot would probably possess some degree of thickness—not very much, but sufficient to hide a small portion of the Moon's surface.

The subject of an obscuring medium on the Moon has been mooted of late, and appears to derive some support from the intermittent visibility which certain spots on Plato manifest; indeed from phenomena manifested by Plato and where, the existence is strongly suggested of an obscuring medium, especially in the low-lying tracts of the Moon. The veteran selenographer Julius Schmidt, suggests in his letter to me Oct. 6, 1866, that little craters, crater-rills, crater-rills, situated in the interior of ring-tains, forming the limits of the plain and ginning of the wall-mountain, should be subjected to a searching examination; for, he says, the tific forces have issued, as it were, out of in parts of considerable high mountains, mountain arms, approaching each other narrow valley or a sharp corner. It is in localities that we may expect to find in exhalations, or an evolution of a vapor-racter, capable of obscuring small crater-cones. Of late, some spots have been noticed by Mr. Denning precisely in such situations, which would be a great addition to our knowledge if independent observers were to witness a portion of the Moon that it was and testify that a certain object on it was at a certain time as seen by both.

W. R. Birt.
4, Leyspring-terrace, Cowley-road,
Leytonstone, E., Oct. 3.

LAPLACE'S AND G. H. DARWIN'S SCHEMES OF PLANETARY AND LUNAR EVOLUTION.

[19273.]—IN letter 19249 S. M. B. Gemmill asks what is the relation of these two schemes? They can be auxiliary or supplementary to each other. G. H. Darwin himself points out the possibility that the material of our Moon may have been separated in the way suggested by Laplace from the Earth-Moon mass, not, indeed, when it was still in a nebulous condition, as Laplace would suppose, but long afterwards, when it was partly solid and partly fluid, and that then his tidal reaction would do the rest. He points out that the ring of Saturn would, to some extent, confirm this view. But he thinks that, in the case of our Earth and Moon, it would be difficult to reconcile this view with the numerical results of his previous investigation, and offers his own elegant suggestion instead, which we have mentioned already in the ENGLISH MECHANIC, though, even of this, he says only that it appears to give a possible cause of the separation. He appeals to the satellites of Mars as affording a most remarkable confirmation of his views. It is quite inexplicable on Laplace's hypothesis, taken separately, that the angular motion of revolution of the inner satellite should be greater than that of the rotation of Mars himself. He is inclined to think that the evolution of the planets from the Sun may have been somewhat like that of the Moon from the Earth as proposed by him; but he admits the great difficulty arising from the fact that the tidal reaction between the planets and the Sun is so small that enormous periods of time would be required for their evolution. He thinks, however, that this theory must have some degree of applicability to the planets as connected with the Sun. Though he does not say so, I should quite expect that he would have no objection to the help which Laplace's hypothesis would afford in accounting for the Solar System.

Dublinensis.

TELESCOPES.

[—As everything connected with telescopes to possess a perennial interest, I have the Editor's permission, give a brief description of the process by which I became the possessor of a very serviceable reflecting telescope, culum.

by the letters in the "E. M." what so many were doing in the same way, I procured a piece of glass, hollowing it out by the method roughly to curve, which I consider the easiest and quickest plan: and here, in my opinion, it is a folly for an amateur to spend time and money on a machine; may only use for one or two mirrors, as time expended in hand-working would go towards completing a speculum.

g gauges to so much nicety may also be done with, as it signifies but little to an amateur usually makes his tube after the mirror is made—what the focal length may be, within an inch. I proceeded with the grinding through various stages, up to the polishing, which I shed without meeting any unusual difficulty, but, long before reaching this point, I rough the medium of our journal, the advice of an exceedingly kind and able friend, aided me with a complete body of instructions, every detail of working, including also tubes, eye-tube, and equatorial stand with all of the various apparatuses the mirror when being tested; and one object of my was to say that I will lend these instructions, drawings, &c., to any amateur for one condition of his paying the postage each agreeing to return them at the end of a, or before, if he likes to copy them, and originals back. Any one applying for my advertise his address in the "Address" when I will communicate with him. I these instructions are better than those given in current numbers of the *MECHANIC*, and are admirably calculated to meet the little difficulties a beginner always meets it attempt.

My tube I made of sheet-iron with a stout each end, the speculum cell attached by a syonot-joint; but this merely mechanical as compared with the delicate manipulation of the mirror and flat, and has been many times cribed in back numbers. In attempting a rack and pinion for focussing I could not get my satisfaction, and, therefore, adopted a method, which I will describe at some other time, with the plan I adopted for dividing declination circles. Cotswood.

HEAR'S SILVERING PROCESS.

[—To EDWIN HOLMES.—The first time I tried above I failed somehow or other; but now I have always had good films, and very

ne solutions as given. The 50gr. silver nitrate, potash, are correct, and will silver a 9in. adding sufficient water to make a bath 1in. deep. I used the above in a bath of temperature 66° Fah., film complete in 15

Another time, the above in 50oz. of bath, temperature 63°, film in 20 minutes. Last evening, in 20oz. for 6in. mirror, film in 15 minutes. follows:—Add pure spirit of ammonia, drop

to the 2oz. silver till the brown colour is gone. Then add the 2oz. potash clear with a (the ammonia used altogether will be 1½ drachm.) From stockbottle drop in 1 you get a brown cloudy colour that will be careful to do this. Put this mixture silvering dish, and add enough water to mirror. Stir well. Now, all being ready, achms or 4oz. of reducing solution, and stir

Next immerse the mirror; the liquor will colour for three minutes; the film will not under five, when it will first show on the Do not silver the day you make up your of silver, potash, &c.; and keep every near the same temperature as possible. he great secret of all the silver processes. apply artificial heat to the liquors on any ation beyond keeping them all in a warm Brashear's quantities, as given, are correct. I notice that instead of reserving a little of the 2oz., I use it, and take the extra

our from stockbottle. The process: the precise quantity of tartaric andy is immaterial. I have used 32gr. to 53gr. per ounce without detecting any e. As to the time the solutions turn, it sometimes almost instantly, sometimes a nds—but should not be more than 30 if properly mixed. At temperature of 50° I'd get the film in 20 minutes.

ing, like everything else, requires practical ance. There is a wonderful difference be- sading how a thing should be done and se- lone. The ticklish part of "Martin's" or any other process, is the balancing of nals.

Use pure water, pure chemicals, clean utensils, and you will succeed.

John S. B. Bell., C.E.

SILVERING SPECULA—THE FOUCAULT TEST.

[19276.]—I THINK that Mr. Holmes (let. 12960) will find the following a reliable process—at least it has proved so in my hands, after several previous failures with other formulas. It was communicated to me by Mr. Calver himself, and as I had his permission to insert it in the new edition of Mr. Webb's "Celestial Objects" (which, by the way, is now ready), I transcribe it here.

The quantities are sufficient for a 12in. speculum, but for smaller sizes they can, of course, be reduced. Make four solutions:—A, 350gr. silver nitrate in 10oz. water; B, 524gr. ammonia nitrate in 10oz. water; C, 2oz. caustic potash (pure by alcohol) in 10oz. water; D, 4oz. sugar-candy in 5oz. water, then add 32gr. tartaric acid and boil in glass flask for 10 minutes; when cold add 1oz. alcohol, and dilute with water to make 10oz. The water must be distilled, and the chemicals pure, especially the potash. Good lump-sugar answers well in place of sugar-candy, and methylated spirit instead of pure alcohol. Solution D will keep for a long time unchanged; indeed, it appears to improve with age. The others, however, are best freshly prepared. Clean the face of mirror thoroughly with strong nitric acid and test-tube mop, taking care not to let it run over the edge; swill well with common water (i.e., under a tap) and rub over with clean cotton-wool, finally rinsing with distilled water. Now place it face downwards in a dish of distilled water, wiping off any superfluous moisture from back and edge. Put in the same room all the apparatus, chemicals, distilled water, and a plentiful supply of ordinary water for rinsing. Leave them all undisturbed until the following day—this is an important point, the object of which is to equalise the temperatures of everything used. When ready, take a large beaker, pour in solution A, and then solution B, in equal parts. It is necessary to reserve a small quantity of each solution for neutralising, as will be seen. Now slowly add solution C, but stop directly there is a dark brown precipitate, which does not redissolve by stirring. Clear with a little more of sol. B, and add C and B alternately until C is exhausted. Next add a few drops of sol. A to get rid of free ammonia. Allow precipitate to subside, and filter through glass funnel, stuffed loosely with cotton wool into silvering dish; then pour in sol. D, and stir thoroughly. The mixed solution will rapidly change colour, beginning with a pale yellow, through various shades of brown, to inky black. When the latter stage is reached, gently immerse one edge of mirror, and gradually lower the other until horizontal. The surface should be quite still and free from air-bubbles. Keep face of mirror wet all over (another important item) whilst transferring from one dish to the other. When the operation is finished (which takes from ten to twenty minutes, according to temperature) remove mirror from silvering dish, rinse well with ordinary water (several gallons should be used), and finally with distilled water, afterwards resting it upon its edge on blotting-paper to dry. Set aside for 24 hours, that the film may become quite hard and dry; then polish in the usual manner. If I have not been sufficiently explicit on any point, I shall be happy to supplement it, either in these columns or through the post.

For the small hole in the Foucault test, I found that a watch-jewel (carefully selected by aid of the microscope from several others) of exactly 1-200in. aperture, was infinitely superior to any metallic hole, being as clean and round under microscope as a little planet. Of course, this had to be mounted on a metal plate, which slid in grooves over a large hole in a tinplate screen. It was also necessary to blacken the jewel to prevent transmission of light through its substance. The lamp used was a "Duplex" of 17-candle power. Leicester, Sept. 30. W. S. Franks.

ADJUSTMENT OF MIRRORS.

[19277.]—THE peculiarities in the geometry of the Newtonian flat, to which Mr. Westlake has called attention in letter 19195, are certainly both interesting and important. That the one part of a flat will be immersed in a thicker portion of the cone of rays than another is obvious at a glance, and, therefore, probably better known to opticians; but I question very much whether the majority do know what are the practical consequences of this fact.

Mr. Westlake himself does not appear to have worked out the problem to its final results, to judge by his closing sentence; and I should like to see the opinion of some of our astronomical and geometrical correspondents as to what the practical effect really is. The mathematical attainments required for the complete solution are not beyond those of a large number of our correspondents.

Whatever thought the opticians have bestowed on this subject, a glance at Mr. Calver's "Hints," or at those given by Messrs. Horne and Thornthwaite, both well known to our readers, will convince them that perfect centrality of figure is aimed at in the adjustments. Mr. C. says:—"If the circular reflection is quite central, no further adjustment is required"; and again, "when in perfect adjustment, the large mirror, viewed by the adjusting piece, should appear, as before stated, a complete bright circle, with the image of the 'flat' as a smaller dark circular spot, exactly in the centre," and gives four diagrams.

Messrs. H. and T. do not go so fully into the adjustment, but state on p. 37 that the reflections must be kept concentric.

Pioni Almon.

[19278.]—WILL T. Westlake, in letter 19195 excuse this direct interrogation, when asking if we are correct in inferring from the context that the diagram therein is "original"? Because I have, for some time discussed this subject "in camera" with members of our Astronomical and Optic Association, and constructed for these his (T. W.'s) and others' apparently anticipated (?) improved adjustments, &c.

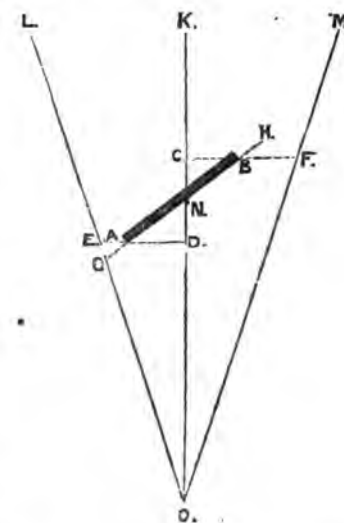
This diagram in letter 19195 curiously resembles one among many of the diagrams and subject matters which I have thus ventilated preparatory to being placed at our editor's disposal for the benefit of the rest of our astronomical and optic amateur readers. It is quite possible such may be a simultaneous elucidation of this subject on T. W.'s part, as well as by "Pangul" in letter 19224.

But (to quote p. IV.) we may very fairly query the fact of its being previously "well known to opticians" since it is only a short time back that an F.R.A.S., possessing the finest of optic means, called myself to account for what he thought was an imperfectly-adjusted flat in an economic portable tripod mount which I constructed for one of his historic mirrors of some aperture.

I think we may safely say that the case of this erratically-adjusted flat in modern telescopic technical practice is pretty clear, since there are very few (query any) telescopes to be found with flats, whose circumferences appear "anything like far enough out of concentricity" to the eyepiece-tube necessary for perfect centrings of the optic axes.

A correspondent of these columns has kindly discussed and reduced this problem (for us) to the following graphic mode for showing the flagrant circumferential eccentricity within the eyepiece-tube of a flat when perfectly geo. "optically" centred.

"Let AB be a short flat (too short), LOM the cone of rays from the eye; OK, the axis of same, and N be the 'optic axial centre' of the flat.



Then $CB = AD$; but, manifestly, DE is shorter than CF . BF is longer than AE —i.e., there is a larger vacancy at BF , than at AE . Produce NA to G , and NB to an equal distance, i.e., to H . There will still be a vacancy between H and FM , i.e., the field of view will not be covered on that side." Hence the apparently great eccentricity of the circumference of a perfectly adjusted flat within its eyepiece tube.

As to the "effect or not" upon the focal picture of a star disc in the eyepiece field of all these geo. thus graphically representable laws of optic ray paths, being usually so ignored, where flats are adjusted with their circumferential peripheries, concentric to the eyepiece tubes. Let "C. W." himself take a so concentrically-adjusted flat, and

watch. "on a starling night," how it side flares, and he will then have to do what the optician is supposed to do by rule of thumb, viz., tilt such flat until this side flare disappears into the disc.

The question still arises, Is such a flat, "even then," properly centred and adjusted? We say, No. Because the central axial ray paths are no longer a "perfect" right angle. And finer exquisite definition fails accordingly. While the larger mirror often gets blamed for this, as though of erratic figure.

The problem of an absolutely perfectly-centred flat is a difficult one; and I think, with our correspondent Mr. Wassell, in one of his late letters, that if the professional opticians would throw down their reserve and help us in these columns, a great good would be done to themselves commercially, as well as to ourselves in student teachings.

The problem of the adjustment (absolutely perfect) of the flat mirror for larger apertures, is one of great difficulty, and requires special counter-reflecting trammels to be devised for this purpose, which are self-corrective by their counter action. Passably fine definition by a good mirror and flat, can exist when not thus adjusted. But that exquisite "same is impossible," can be theoretically seen, when studying closely the problem of oblique reflections (at the focus) in any textbook of optics.

"T. W." also asks, "Does &c., all this 'in any way' affect adjustment of mirrors, &c.?" Supposedly he may mean, "how" does it effect the definition of the eyepiece field; and may be answered most positively. For a thorough study of this prob. geo., and the practical sections of a cone will demonstrate to him that "elliptic planes" (usually employed up to now) "can never" send into the eyepiece field a perfectly circular cone of pencils. Hence the flat must in itself be in shape (superficially) what is generally known as an "egg oval," and have its optic axial centre for the reflection of the larger mirror's axial ray "very considerably" eccentric towards the end, of the egg-oval which has the shorter radii of curve, as well as nearest to the eyepiece. While such reflected axial ray must pass parallelly up the centre of the eyepiece tube. Without which construction, how can the focal defects of obliquely-reflected pencils be avoided? Though we see this plan of construction in no telescope previous to-day. And may not the want of purely correct ray-paths thus adjusted go a long way towards "making the greater share" of the troubles of the modern reflector at its stellar disc focus? Further, may we not, in the face of all this, "more than suspect" that the bad odour of prejudice against the really "far" superior seeing powers of larger aperture in reflectors v. smaller in refractors, though failing in their aberrations of colour and sphericity, is more due to incessant star flares, produced by the modern inaccurate (to pure geo. optic science) construction of reflectors than aught else, from many points of view.

Chelsea, Sept. 16.

A. J. S.

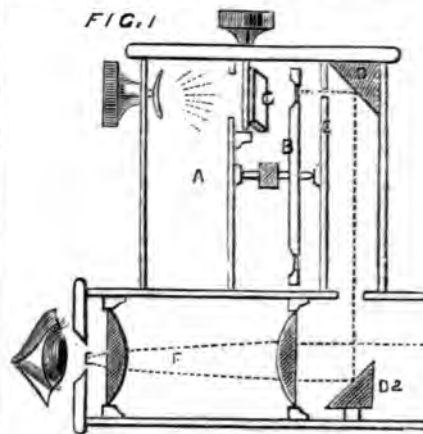
THE ASTRO-CHROMOSCOPE.

[19279].—UNDER the above title, I venture to bring before the notice of the readers of the *ENGLISH MECHANIC* an idea of an instrument for reducing the estimation of the colours of stars to a uniform system. And I am emboldened to do so because, however crude the instrument may be as designed by me, this description of it may possibly lead to somebody inventing a more perfect instrument on a similar principle; at least I hope so. For it is obvious that unless a star can be examined in the eyepiece simultaneously with an artificial comparison star, it is hopeless to expect uniformity in the estimation of their colours as given by various observers.

The discrepancies noticeable in the various estimations of the colour of a star as given by different observers, and even by the same observer at different times, are doubtless as much due to the want of a standard chromatic scale and proper instrumental means, as to the eye-and-memory method now pursued. It is also evident that an instrument designed to supply the means of obtaining uniformity in the estimation of the colours of stars, to be of general use, should be simple in construction, so as to admit of being easily manipulated, and also of few parts so that it should not be liable to get out of order or require frequent adjustment.

The principle of the construction and mode of action of the astro-chromoscope in which I believe I have made a step towards simplicity of construction, as necessary in an instrument intended for general use, may be readily understood on reference to Fig. 1, in which A is the illuminating-chamber, from which the light obtained from an incandescent platinum wire is reflected through an aperture (B) in coloured glass in the front F, and thence through a minute aperture in the diaphragm C, where it forms an image of a star on a plane, or a piece of blackened glass D, from which it is reflected by F placed in the focus

of the eyepiece F, and compared in juxtaposition with the real star by the eye placed at E. It will be seen that the essential portion of the instrument is the colour-disc B, Fig. 1, which it is



intended should carry fourteen discs of coloured glass, two for each colour of the spectrum—a light and a dark. It is important that this portion of the instrument should be constructed with the greatest care, each disc of glass being compared with previously-selected portions of the solar spectrum, so as to insure uniformity in the estimations of the colours of stars as obtained by various observers, each using a different instrument.

The colour-disc, which is represented about the size it would probably be in Fig. 2, is so constructed as to be capable of being rotated only in one direction; so that the reference figures engraved on the milled head of the rotating screw shall always correspond with the same colours on the disc.

By this means the effect of colour-blindness on the observer's part is obviated, as the artificial star is affected in the same degree as the real one, and by the reference-number he knows the true colour of the star; whereas, if he had to trust to eye-estimation alone, he would probably compare it to quite a different colour.

The instrument is intended to be about the size represented in Fig. 3, of which H is the milled



head of the rotating-screw by which the colour disc is rotated and the particular colour under examination is ascertained; I and J are the wires from battery for rendering the platinum wire incandescent, and K is the milled head of a screw by which the screen (G, Fig. 1) of ground glass is

brought in front of the aperture in the illuminating-chamber when of light is required to be reduced—f when observing faint stars.

In using the instrument, should a served, the colour of which does not correspond on the disc, I propose that, should between the light and deep yellow of disc, that it shall be called simply lighter than the light yellow, very light if it should be of a colour between the and the light orange, it shall be called yellow. And the same with respect to colours on the disc; but no other term possible, be used, for the fewer and terms, the less our liability to mistake.

B. J.

COMETS B AND C, 1881

[19280].—THE letter of Mr. J. (ENGLISH MECHANIC, No. 856, page me to send you the inclosed drawing comets B and C, which, during the attracted a good deal of attention, b differences of their aspect little or not noticed in your journal. Comet B was



June 28th, the same night as Mr. Birni could clearly distinguish four envelopes, than the other, starting from the nucleus the gaseous matter melted away in the sky. An "aigrette" was emanating nucleus, in the direction shown, cross and second envelope and reached the Birmingham seems not to have seen the The tail is not given in its full length. faintness in the middle showing a tene separation into two tails.

Comet C was fainter. Only faint envelopes were observed in the head. T tended some distance, broad as in com ended in a long and narrow point as the β Delphini. I have noticed, during s observations, an elongation in direction some one who has sufficient means say w companion is now in that position?

C. Gau

NORTH-EASTERN ENGINE

[19281].—I OBSERVE in your issue of that Mr. John T. Lawrence describes considers to be the typical goods locomot North-Eastern Railway, and refers to the course of his communication. His ac ing sketch is from memory, and I must of the many illustrations showing the u lity of such sketches being relied on and as giving accurate ideas of the present types of the engines of a leading line. I ing somewhat resembles a class of engine years ago. The frames, however, wer differently, though they had outside bars the springs were not underhung. The es

is perhaps of little consequence) was not of the severely plain design given by Mr. Lawrence, but overhung, and was well swept out in curves.

The for-some-time-past and present standard type of goods-engine is not a double but a single-framed engine with ordinary inside bearances with underhung springs (rubber cushioned), and having a forward sand-box. The boiler has not a high firebox casing, as shown, but is flush-backed, as all boilers built on this line have been of recent years. The cylinders are 17in. by 24in. stroke, and 5ft. wheels; there is plenty of heating surface, and the engines are designed to run at a brisk speed in front of a heavy load, and they do it.

The standard passenger-engines are not 6ft. wheeled engines, but 7ft. coupled, with cylinders in the horizontal plane, driving and trailing springs underhung. They are both powerful and speedy. The special correspondent of the *Bridgeport Standard*, U.S.A., whilst in this country, had permission to travel with what he termed the "world-famed 'Flying Scotchman'" from Edinburgh to London, riding on the engine. At one part of the road—the 22 miles' straight level run between Thirsk and York with a N.E. 7ft. coupled engine—he described the running as splendid, as he timed a mile every 52 seconds until the cathedral city was approached. This agreed with the driver's time. The special thoroughly enjoyed his trip, and refers to it in his paper in eulogistic terms, paying high compliment to the steady attention and intelligent care of the drivers.

Mr. Lawrence refers to different designs of engines having one size of wheel, 6ft., and lumps them together as a class. This should not be so: a class built with 6ft. wheels for a special work might appear years, perhaps, before an improved class with the same diameter of wheel. Further, it should be understood that the North-Eastern Railway is a gradual amalgamation of a number of smaller lines, each having their different peculiarities of design in engines, and these must be run off, being superseded as they wear out by the standard types from headquarters; hence the apparent different designs by one railway.

There is one remark made by your correspondent with reference to the Leeds and Thirsk branch which does not appear very clear. Referring to it, he states that "for heavy gradients, curves, and all that make railway travelling unsafe stands perhaps unparalleled." The curves and gradients are certainly present, also tunnels; is there anything else? The official printed instructions are clear and very definite; block-working is used, and, in fact, "all that tends to make railway travelling safe."

Mr. Lawrence makes inquiries as to the North British engines; the new goods-engines have 18in. cylinders by 26in. stroke, are single-framed and six-coupled, having 5ft. wheels; the typical passenger-engines are 6ft. 6in. coupled bogies, 18in. cylinders, 26in. stroke. Melrose, Abbotsford, Galashiels, Hawick, and Netherby are representatives of this class; the latter engine was the principal of the N.B. contingent at the "George Stephenson" centenary. If the readers of this useful journal desire to possess a good idea of the different types of engines used on nearly the whole of the English and Scotch railways, they could not do better than send for a descriptive catalogue issued by Mr. R. H. Bleasdale, 136, Park-road, Aston, Birmingham, who, as a locomotive photographer, has taken some hundreds of engines of all classes, and in addition has recently taken and issued copies of most of the engines, old and new, represented at the Stephenson Centenary. Amongst the old ones are the veterans, Rocket, Invicta, Locomotion, Murdoch's, Trevithick's, Brunton's Horse-leg Engine, Blenkinsop's Rack Rail Engine, Killingworth Billy (built by George Stephenson), and some others. The whole form a tolerably connected history and show the development from 1784 to 1881. The most important of the older engines, viz., William Hedley's "Puffing Billy," was not at the show, though it was the first practical locomotive ever made, was the first locomotive Stephenson became acquainted with, and from which he obtained the ideas which led to his ultimate pursuit of locomotive engineering. Mr. Bleasdale issues photos of this engine.

Gateshead-on-Tyne. Ramsey Kendal.

METROPOLITAN DISTRICT ENGINES.

[19282.]—THE locomotives used by the above company seem to undergo very little improvement, and I have seen some dated 1880 which appear to be from the same design. The bogie wheels are placed about 4ft. apart, and the lateral and radiating motion is controlled by a lever centred 5ft. or 6ft. behind the centre of bogie, so that its radiating motion is always in a certain proportion to its lateral motion. In Mr. Adams' system the wheels are placed from 6ft. to 7ft. apart, so that the bogie is in itself much more steady in running; it can radiate from its own centre, which also controls the lateral play, these two motions being quite independent of one another. It is clear that the bogie on Mr. Adams' system is more efficient, and can

adapt itself to the requirements of the road exactly.

Now let us see how the weight is distributed. On the bogie we have 10tons 5cwt., driving-wheels 16tons 11cwt. 3gr., trailing-wheels 15tons 15cwt. 1qr.; so that the bogie has actually less than one-third the weight on the four coupled wheels. This unequal distribution is caused by having a leading bogie, with four coupled wheels 9ft. apart, with a large firebox between them, side-tanks, including condensing apparatus over them, and a coal-bunker overhanging the trailing wheels.

The tractive force of these engines is not sufficient, being a fraction over 100lb. for every lb. of effective pressure on pistons, a very good proportion for fast passenger engines. The driving-wheels being 9ft. apart, gives room for a large firebox, which is one good thing these engines possess; but on the other hand, the steam-dome, with safety-valves on top, is placed close to the chimney.

A better class of tank-engine may be seen on several lines working the local traffic, such as the L.C. and D. with cylinders 17in. by 26in., driving-wheels 5ft. 3in. diam.; Midland, 17in. by 24in., 5ft. 6in. wheels; new South-Eastern tank-engines, Great Northern, 17in. by 24in., 5ft. 6in. wheels; Lancashire and Yorkshire, 17in. by 26in., 5ft. 8in. wheels; all of which have four coupled leading wheels, with inside cylinders and trailing bogie, and weight more evenly distributed.

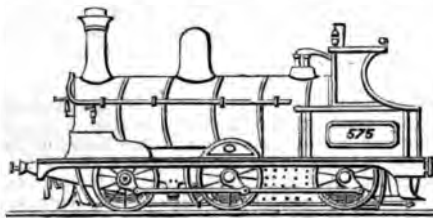
I should like to see some six-coupled engines put on that line, with wheels about 4ft. 6in. diam., placed about 5ft. 6in. apart, with a pair of trailing-wheels, with radial axles, under the coal-bunker, inside cylinders 18in. by 22in., which would give a tractive force of 130lb.; the six-coupled wheels would carry a weight of from 35 to 40 tons, and 10 or 12 tons could be put on the trailing-wheels, so that three-fourths of the total weight would be available for adhesion, and the weight on any one pair of wheels would not be excessive; the boiler I would have of large diameter, with about 220 tubes 1in. diam., with a grate-surface of 18 or 19 square feet. Such an engine would be able to work the Metropolitan trains with ease, and with more economy.

Sept. 26.

E. L. P.

NEW L. AND Y. R. GOODS-ENGINES.

[19283.]—I beg to inclose a sketch of a new goods-engine employed on the L. and Y. R.,



which may, perhaps, be interesting to many of your readers.

This engine, from the designs of Mr. W. B. Wright, Loco. Supt., is one of 50 recently ordered by the company. The cylinders are 17in. dia. by 26in. stroke.

The wheels, which are all coupled, are 4ft. 6in. diameter.

The heating-surface of the tubes is 943½ square feet, and that of the firebox 90½ square feet, being a total of 1,034 square feet.

W. J. Barker.

Osborne View, Leeds, Sept. 27.

L. AND N.W.R. ENGINES.

[19284.]—THE undermentioned are "Precedent" class: cylinders 17 × 24, coupled 6ft. 6in., same as described before. (15) Crewe, (1) Camden, (8) Rugby, (6) Northampton, 857, Prince Leopold (15); 858, Sir Salar Jung (15); 859, Yakob Khan (15); 860, Merrie Carlisle (15); 861, Amazon (8); 862, Balmoral (8); 863, Meteor (8); 864, Pilot (8); 865, Envoy (8); 866, Courier (8); 867, Disraeli (8); 868, Condon (8); 869, Llewellyn (1); 870, Fairbairn (1); 871, Proserpine (1); 872, Wizard (1); 883, Phantom (6); 1105, Hercules (6).

Egeria.

THE TRICYCLE.

[19285.]—I AM very glad that the practical experience of a gentleman such as our friend "Paugul" is made public on this question, as it shows that theory and practice in the question of size of wheel certainly go together. I am fully certain that a moderate wheel runs easier, and I would just mention, on the question of wheel-size, that there is not so much loss or gain consequent on a large or small wheel as it appears. Let any one lay off two circles, the one representing a 40in.

and the other a 50in. wheel. Now, on inspection, it will be seen that the 40in. wheel would feel but very slightly, additionally, the depressions in a road, more than the larger one. The inequalities of the average road are not great, and in the vast majority of cases there would be no difference at all. The main difference, speaking justly on the matter, would be that the smaller wheel, running at a slightly higher speed, coming against an obstacle, would transmit a little more shock to the rider (the seat being the same), although, from the extra velocity of the rim, it would run over it as easily, almost, as the large wheel.

"Paugul" will also see that exception is already taken to the term used by both him and myself of centrifugal force. As this is, I think, to be explained, I would say that by it I did not mean to assert that it was centrifugal force in the true meaning of the word taken scientifically; but that I used it as expressing in popular terms what we all know is really momentum. Still, desiring to express myself in language that is best understood by the great mass, who, although not abstruse scientists, are highly interested in matters pertaining to the tricycle, I used the term as best calculated to familiarly explain what I desired to make clear. I, therefore, must be on that point absolved from the apparent misuse of words. "Paugul," in similar manner, no doubt, used the same term at page 64; and although he mentions "centrifugal force," yet we all know what he really means, and that no doubt he has done as I did—viz., used it as a term better understood than another by the general riding public. I trust in saying this I am not in any way encroaching on the explanation he will no doubt make on the matter.

I still hold to my statement as to the advantage of the 40in. wheel, and I cannot accept "J. H.'s" hypothesis. First let me say that the difference in the length of tire on the 40in. and the 50in. machine is in round figures about 2ft. 6in. This length of tire and rubber will weigh but a very little, and does not balance in actual use; the extra speed due to the smaller wheel running faster, plus the additional speed the rider makes on his treadles, due to the easier running of the machine. In other words, the larger wheel takes more power to drive it, and therefore does not allow the rider to increase the pedal speed without pretty quickly feeling it. Therefore I take additional exception to having to press the treadles with a power of, say, 50lb. at each revolution of the treadles, when I can get the same speed by placing, say, 30lb. on the treadle only, but repeating the operation a few times more per minute. Up to a certain point, a rider can easier make more revolutions per minute with less pressure than he can apply a greater pressure fewer times per minute. And this is the reason why one feels hill-riding. There we have the dead push against the treadles applied for a greater length of time during each revolution, as the machine slows her speed, and hence we rapidly tire out. Therefore, I prefer a wheel which enables me to make, say, more turns to the wheel, but with less pressure on the treadles per revolution.

The plan of altering the speed, as shown by Mr. Steel, is certainly a good one; that to make both wheels drive is better than one, is a fact under some conditions, notably when climbing a hill. But to do this we cannot well use the open-front machine, which certainly is the one I prefer to any. And let me add that it is not generally known that the double-driving is not all the gain it appears; for instance, taking the case of the "Salvo," is Mr. Steel aware that this double driving-gear is really but SINGLE gear, except on perfectly level roads, or wherever the resistance is perfectly equal against both wheels. On rough ground the driving is not equal, but whichever wheel meets with most resistance it drives with the least force. Hence the so-called double-driver is but little better than a single one really. To remedy this a new plan has been employed by one firm, which I believe has the rare merit of always applying the power to the outside wheel in all courses, which is the reverse in the other makes. I hope shortly to have something more to say on the question after trying one.

Sunlight.

[19286.]—I SHOULD like to say a word or two on this subject. A great many of "ours" have suggested, lately, sundry gears and plans for hill-climbing. I think they are all a mistake, and departures from that simplicity which ought to be a chief characteristic of a tricycle. The best type of machine, to my mind, because of its simplicity, is the "Meteor" class. But it has two defects which are greatly exaggerated in other types. Our friend "T. F." has hit upon one—namely, the seat with its stiff springs, which are only a benefit to the repairer. When I go over a stone, I say, "there goes 13 stone bumped up in a fraction of a second to the detriment of the machine." Then what a sudden check to the forward motion the coming down is. I entirely go with him in all he says about the seat, and speak from experience. In fact, the "go" of a machine (other things being the

same' can almost be predicted from the easy hanging of the seat. The other defect is the smallness of the toothed wheels in comparison to the drivers. Some makers even go so low as to put a 4 1/2 in. toothed wheel on a 40 in. driver (for appearance sake as I suppose); this gives increased friction, fewer teeth engaged in the chain, and a tremendous straining of the chain to adapt itself to so small a circumference. In a 40 in. driver, with a 4 1/2 in. toothed wheel (4 in. on the pitch circle) just think of the odds against the rider in the leverage. Rider, machine and friction, and that with a 2 in. lever against one of 20 in. No wonder chains stretch, hills refuse to be mounted, and a "little mud" means "much labour." Let the toothed wheels bear some reasonable proportion to the drivers, not 1 to 10, but 2 or 3 to 10, and the seat to the pattern of "T. F.," and we shall soon hear of tricycles being useful tools instead of fine-weather toys. Roller and ball bearings are useful in increasing the price, but plain bearings well hardened are the best for rough work. The *very best* bearing I know of is a *rice* bearing. How many, in making all look bright, rub the grit, &c., into the fittings. What kind of a break do I use? My two feet thrust together on to the pedals. All others are useful to loosen the tires and to supply snares for too-confident riders. Solus.

[1928].—There is one point in tricycle construction upon which most riders have strong opinions, yet I have never seen it fully discussed, namely, What are the relative merits of front and rear steering? My own views on this subject have been through years past, of a rather weathercocky kind, and at present they are not much more settled one way or the other. All I can say is, I have learned more. It is only by carefully weighing the evidence for and against each side that an impartial decision can be arrived at. I shall try to state the case as fairly as I can, hoping that others will give us the benefit of their experiences. The views of mere theorists, of beginners, or of those who have through long usage become habituated to one kind, are of little worth. It is the opinions of riders who have given fair trials to both systems that will be most valued.

Front steering.—The simplicity of former machine more open to front view, easier of access; weight well placed when leaning forward.

Against.—Position of sight; owing to tendency to lean forward, the seat has to be fixed so far back, leaving little room to place rider at a disadvantage the leaning time.

Front steering.—Wheels will upon driving-wheels when leaning. Better in view.

Against.—Complicated frame. Seat more or less out of position in front, consequently, it is not easily reached when the rudder is behind.

When leaning back.—There is a tendency to lean forward off road and overturn backward, necessitating a safety-tail, projecting behind with "tail," or without (Devon) a small wheel at the end next ground.

I would say here, only I consider it may help to try the question closer to the question at issue by putting and answering the following queries:—

1. What is it of the utmost importance that there should be the greatest precision in, and most strength in, the steering?

2. Ascending hills, especially at a quick speed. Here the machine has a tendency to lean forward, and it is not of much consequence to have rider's weight fall upon the driving-wheels, but it is absolutely essential that the rider should have an extra good grip of the handle.

3. When a machine has the greater portion of its weight thrown upon the driving-wheels, and only a small one upon the rudder, is it an advantage to prevent it slipping?

4. On rough roads, and when ascending hills.

5. On rough roads, and when ascending hills, the advantages and overcome the disadvantages of each system in the machine, I am sure, in the construction of other contrivances.

W. H. Westropp.

There is a tendency to have the greater portion of the weight thrown upon the driving-wheels, and only a small one upon the rudder, is it an advantage to prevent it slipping? On rough roads, and when ascending hills, the advantages and overcome the disadvantages of each system in the machine, I am sure, in the construction of other contrivances.

speeds arrangement, which I am patenting, there are no loose keys at all, and every part is quite tight and rigid.

With regard to brakes, I have designed an arrangement by which both wheels must receive the same amount of pressure or brake-power under all conditions.

I do not remember to have ever seen it in use; but the principle is so obvious and simple, that I am surprised it has not been universally applied. The details could not be explained without a sketch, but I can describe the general principle. The brake consists of a straight bar, having a suitable-shaped spoon formed at each end, the distance between the spoons being the same as the distance between the two driving-wheels. A hole is drilled in the bar exactly central between the two spoons, and the bar is capable of vibrating freely upon a pin put through this central hole, the pin being firmly fixed to a bolt or bar sliding in fixed guides, the axis of the sliding-bar being at right angles to the axis of the spoon-bar. The whole is so arranged that, by pushing, or pulling, the sliding-bar, by means of the ordinary thumb-brake lever, or otherwise, the two spoons advance towards the two driving-wheels, and press upon them, and equally on both wheels, because the fulcrum of the brake-bar is exactly equidistant from each spoon. Two small springs, acting at equal distances from the fulcrum, pull the brake off when the thumb-lever is released.

William Granger.

Birmingham, September 26.

[1928].—By the time this is in print, no doubt my explanatory statement on the matter of the exception to the term "centrifugal," taken by one contributor, will be in print also. I would also say that I quite agree, so far, with "Pangul's" idea, that it would be well to speed one wheel up and the other down. In fact, that was the basis of the plan I suggested originally.

I quite agree also with Mr. Stacpoole Westropp, and the further we go into the question the more I see our ideas really converge. 40 in. is the size wheel I think almost as good a diameter as possible. The only matter, so far, that we do not think identically, is the question of speeding. Well, there are points of consideration that I have since again looked at, and I think that, for anything like a hilly country, or if the rider be not quite as strong as the average, that the 40 in. wheel, geared level, would be the best mode of combining speed and easy running, so that the divergence of views between us has now narrowed down to a very fine point.

I see that your contributor also is about the same height as myself, and whilst riding this week, I considered the question of the shorter crank. That I am not altogether blind to his theory of the length of crank, I am about to try a run with a temporary arrangement to reduce the throw of my 6 in. cranks to 5 in., and shall carefully note the result. And when he states that the machine should be built "to suit the rider," I am bound to say that many circumstances have arisen that strongly support that statement.

There are two other points that, so far, have not been touched on in your valuable journal. They are the questions of band-brakes and spoon-brakes on the driver, and that of lighting the road, or the best tricycle lamp. Just let me take the question of friction brakes on the hub. At one time, from practical experience of what a friction brake would do in connection with various engineering requirements, I was inclined to somewhat believe in it, until I gave the question some little consideration, when at once I saw two reasons why it was defective, and my attention has been further drawn to two accidents this week, distinctly traceable to this form of brake. One was that of a gentleman who rides an open-front machine with unequal wheels. Coming downhill on a strange road, he suddenly, on turning a corner, saw a declivity of such a grade before him that fearing the fate of poor Mr. O'Brien, he sharply applied his brake. Result was, the machine not answering to it at once, he applied it with additional force, when the brake suddenly gripping the wheel, locked it, as it were, and in an instant, turned the machine sharp across the road, at the same time pitching him out over the smaller wheel with considerable force. Luckily, he escaped with a few bruises.

Another No. 2 was caused by the brake refusing to leave, and resulted in the machine and rider running into a bank, ejecting the one and overturning the other, but without any serious results, luckily.

Two both of these accidents were distinctly traceable to one cause—viz., oil from the axle having fallen on the inside face of the brake. The defective construction of the brake, in not having a side only I have not mentioned at the moment. But I am sure, having it to readers like this, the hub of

the wheel is about the worst possible place to apply a brake to. If it is, why, then, all these years engineers who have had the control of winding machinery must have been quite wrong to use a brake nearly or quite as large as the driver, if one but little larger than the axle would do as well or better. I therefore need not, I think, point out this fallacy further. I am quite willing to allow certain claims that are raised against the spoon-brake on the drivers; but it is better to shorten the life of the rubber tires than the existence of the rider owing to an accident due to a faulty brake.

On the question of lamps, and the best place to affix them, I should like to have a few opinions. I am myself using one that gives a very fine light; but from the original design it is next to impossible to use it in other than one position. What is wanted is to place the lamp in a position that enables the rider to see his road well, and also to be free from shadow. None of the lamps or plans for fixing have met this difficulty. I am expecting a new lamp from a firm in whom I have every confidence, as knowing the requirements and dealing with them effectually. And I hope next week to have something to say on it. The hub-lamp of the usual kind throws a shadow of the rim on the road; that, in my mind, is most objectionable. Mine, which fixes on the backbone, is better, as the entire width of the machine is well lit; but, unfortunately, the feet and treadles, as they pass the lowest position, throw most unsightly shadows, which also may fall on just the spot you need to see and avoid. For instance, it is not pleasant to run into a grating running the same way as the road, and into which your driver, perhaps, falls between the bars, very possibly picking you off. Not long since, I saw a gentleman come to grief this way, and I assure you I am very careful of that street-sewer, and, therefore, value any plan to enable me to thoroughly sweep the road, with light sufficient ahead to avoid such traps in time. Sunlight.

[1929].—"SUNLIGHT" (19228, p. 65) says the velocity of the rim of a small wheel is greater than that of a large one, at the same speed. How he makes this out is a puzzle; the velocity of the rim is the same for all size wheels, and the curve being greater it naturally sinks deeper into every irregularity, and not only strikes with more force against the opposite side of the depressions, but also requires to be lifted a greater height to overcome them, owing to its going to a greater depth. A tricycle-wheel does not, in practice, skim over the tops of irregular places in a road; on the contrary, it goes to the bottom of each with more or less of a concussion, and has to be lifted out again.

As to what is the best size wheel in a hilly country, this depends so entirely on the weight and strength of the rider that no rule can be given. I measure 5ft. 11 in. in my stockings, and weigh 175 lb., the average military weight for my height. I am fairly strong, but not much accustomed to heavy work, and am not a good walker, about eight miles' walk tiring me considerably. I should not choose over a 36 in. driver, not speeded, for anything like a hilly country. I have a 42 in., and find this quite as large as I like for perfectly level roads, with occasional slight inclines at considerable distances apart. I have no faith whatever in large drivers, and believe, for long-distance travelling, in all weathers, a driver of about 34 in. and a 6 in. crank-throw is far the easiest. Of course on level, dry roads, the power is more than is necessary, but one leg may be on the rest a good part of the time, and the average result is, that at the end of a long journey a rider is much fresher when he has not needed to exert anything like all his power in any part of the distance. I like to have a good deal more power than I need, and take things easily. A bicycle-rider with a large wheel may, on a warm day, be discovered by the steam rising from him when he has got to the top of a hill, but I do not care for this sort of thing. A high speed and a wet shirt have no charms for me. T. F.

[1929].—"NOTWITHSTANDING" "Sunlight's" unqualified adhesion to "Guido's" theory as to the practical effect of reducing the diameter of the "toothed wheels over which the chain passes," I cannot think it will stand the test of careful examination. I do not suppose anyone who has studied this point would deny that there is a proportion between the friction on the crank-axle and the diameter of the toothed wheel, which it actuates; or that this friction is increased by decreasing the diameter of the wheel. But, with a rotary crank, the position of the pedal (which represents the radius of the lever), and, consequently, the direction of the power, are always changing. Hence, without going beyond the question of the crank-axle alone, it presents a problem too complex in its character to be settled by a diagram dealing only with the frictional consequences of the velocity ratio of a straight crank with the direction of power constant. "Sunlight" had been content to stop here, his arguments and conclusions would not have been so

pen to dispute, as, I think, they now are. But when he goes on to assert that "an immense pressure will be thrown on the bearing of the chain-wheel A," "Guido" seems to me to be taking a rather untenable ground. If "A" were like a fly-wheel, hanging on its axle and revolving in the air, it might be so. But the case is exactly the reverse. The driving-wheel (of which A is a part) sits on the ground, and the weight of the tricycle same, with its rider on it, hangs *inside* "the bearing of the chain-wheel A." How, then, can any amount of "pressure" on the outside of A (short of a pressure sufficient to alter the contour of the spring) affect the friction between that bearing and the axle suspended within it?

Nor is "Guido" very lucid in his terms, when he says, "as regards the chain, there is a little drawback in the fact that it will not have to go round so often on a small-pulley machine." One can, of course, understand what is meant. But the practical importance of this "little drawback" could, I think, have been much more fairly represented if "Guido" had said:—"There is a considerable drawback in the fact that there will not be so many teeth to cause friction by their engagement and disengagement with the chain on each revolution of the smaller pulley." The number of meshes any chain will "have to go round" is simply an accident dependent on its length as a whole. The real point at issue is the number of teeth in the wheels, because it is by those teeth that the cause of friction in each revolution must be hunted.

Hence, it is obvious that the real kernel of the question lies in the best accommodation of two antagonistic influences. On the one hand, the larger chain-wheels may reduce friction on the crank-axle; but they multiply points of friction by introducing additional teeth. On the other hand, the smaller chain-wheel effects a reduction of tooth friction, but it puts something more on the crank-axle. I leave out the question of "strain on the chain," because, until the chain is proved to be unable to bear it, this remains a *passive* and not an *active* element of the problem.

Thus the best size of chain-wheel is clearly a matter of compromise, and although exaggerated illustrations may be legitimate enough in dealing with abstract principles, the conclusions drawn from them become very liable to mislead when applied to concrete questions, unless carefully guarded in their practical application. "Guido" illustrates his case by comparing chain-wheels of 5in. and 6in. diameter respectively. But, as a matter of fact, I do not know any machine with a driving tooth-wheel so small as 3in. In my own "Cheylesmore" this tooth-wheel is 5in. full (or about $\frac{1}{2}$ effective, from central line of chain); and although I do not think there is any pattern among the leading types of tricycle which I have not carefully tried, I can truly say that I never mounted anything equal to the "Cheylesmore" as an all-round roadster. I confess I cannot understand "Sunlight's" trouble with the chain of his machine (supposing always he has adjusted its tension properly), unless he has got hold of an unaltered machine of the earliest issue. I know that at first there was some difficulty of this kind; but so far from this being caused by the small size of the driving chain-wheel, it would have been aggravated exactly in proportion to the increase of its diameter. The difficulty was solely due to the bearing of the chain-wheel being made too short, and to a want of sufficient solidity in the fitting of the cap for the roller and cam-box. This defect of pattern was almost immediately corrected by the makers; and from my own experience of some seven months of very rough work, I can hardly conceive that any similar difficulty could show itself with the corrected pattern as made since. Although I am in the constant habit of taking short cuts across somewhat knotty commons, I do not know what it is to have the slightest difficulty with the chains or their wheels. And although my tires have suffered somewhat severely from an amount of rough riding, which some of my friends tell me is not fair-play to any machine, yet the "Cheylesmore" does not seem a bit the worse for its usage in any other point of its constitution.

In connection with the gearing question, the result of a great many different experiments in a country abounding in rough and hilly roads, is that I am now using 44in. drivers, fitted with 14 teeth, and driven by 16 toothed wheels, giving the equivalent of, say, 47in. drivers. I confess I now and then conceive a fancy for 48in. drivers, with 16 teeth, driven by 16 teeth, which would give the equivalent of 45in. drivers. But I am so well content, and so seldom dismounted by any but extraordinary hills, that I hesitate before making another change. In no case, however, should the gearing be exactly level. The odd tooth is most important in distributing wear and lubrication. To give some example of the hills I think a tricycle should climb, I will take the Isle of Wight as being familiar ground to most southerners. Of course there are many hills which it would be

sheer waste of strength to try to ride. St. John's-hill, out of Ryde, is a teaser towards the top on a hot day; but can be done. Otherwise there is nothing to dismount one either way between Ryde and Sandown, at any rate on a "Cheylesmore." On the same machine I have often ridden up through Shanklin, and a few weeks ago I rode from Sandown to Cowes without leaving the saddle. The distance is not much, but I think a man in his sixth decade has not much reason to complain of his three-wheeled machine or its gearing, if in a run of that length, he can take in succession, and without a dismount, the hills from Lake to Apse Heath; out of Arreton; out of Newport on the Cowes-road, and past Park-hurst, over the crown of the hill. I may also say I have ridden the same machine over Portadown, from Horn-dean to Portsmouth Harbour, without a dismount. These do not represent the steepest gradients I have made the machine ascend, as our own country supplies plenty that are more trying in every respect. But the above being well-known ground, will give a better idea of what I expect of a good tricycle, when writing on the subject. I would not have entered upon anything like an itinerary, but that "Sunlight" says "theory is not proved by practice"; and so, perhaps, an appeal to practice may be the best refutation of "Guido's" theory that there can be "no earthly purpose" in reducing the number of teeth in a chain-wheel, except "double strain with a proportionate increase of wear and tear." Any way, one is justified in "speaking well of the bridge that carries one over." And I am such a firm believer in the practical value of all mechanical principles, that when I find practice appears to contradict any of these, I generally mistrust the form or the proportion in which the theory so disproved has been propounded; and this is where I fancy "Guido" is in error. D. H. G.

FOG-SIGNALLING AT SEA.

[19202].—As "Saul Rymea" has opened up this important subject, permit me to observe that the ideal to be aimed at, whatever difficulties may be encountered in practice, is certainly the indication by vessels of their course. If lighthouses and coast signal stations can proclaim their names, ships can surely announce their approximate courses. The objection urged by "Faugul," namely, that a fog renders it extremely difficult, and sometimes even impossible, to determine the direction whence the sound comes, may be easily overcome by the use of a simple ear-tube. By applying such a tube to the ear, and sweeping it round the points of the compass while the signal is sounding, the direction of the signal can at once be ascertained by noting the augmentation of the sound when the tube is pointing towards its source. The position of the vessel and the course in which it is steering having been thus ascertained, a collision is rendered next to impossible.

J. A. Westwood Oliver.

110, Ingram-street, Glasgow, Oct. 1.

MEDICAL REPLIES.

[19293].—As to "Bleeding" (44835), about which "H. C." asks me for advice, he is one of those somewhat rare persons who suffer from the "hemorrhagic diathesis," and are vulgarly called "bleeders." These cases are well known to medical men, but they are incurable so far as any direct remedy goes. His living largely on fresh vegetables, and taking no alcohol, is his best course, and I advise him to adhere to that. Abstinence from tobacco also would probably be beneficial. Such persons bleed excessively from having a tooth extracted or from any trifling wound. He should never undergo any surgical operation without informing the doctor fully as to his peculiarity, and his occupation should be such as does not expose him to casual wounds. Bleeding from a wound is naturally provided against by three processes: 1st, In large bleeding, the patient faints, and thus the heart's action is for a time very weak, and there is but little blood-pressure in the vessels. This diminution of blood-pressure in the arteries stops the outflow of blood. The faintness should be encouraged as a curative process, and the patient should be allowed to lie upon his back in a cool, airy place and kept quiet, without any effort being made to revive him and set his heart going actively again until the bleeding vessel has been ligatured by a surgeon. During this low state of the circulation two other curative processes have time to work. The stem of the wounded vessel contracts, and the wounded portion especially closes up. The stagnating blood in the stem of the wounded vessel coagulates and forms a plug upon which the contraction can act, and this plugging *plus* the contraction of the vessel, seal up the wounded part, and prevent a further loss of blood. But this plugging and contraction need time, and that time is given by the faintness which naturally occurs on any considerable loss of blood. If brandy and other rousing agencies are officiously used in these cases of faintness, the

soft, newly-formed clot is driven out of the wounded vessel, a second attack of bleeding occurs, and the patient may die. Nothing can be more mischievous than rushing to "do something" without seeing what is to be accomplished when—over an accident occurs.

In cases of faintness from bleeding, the curative efforts and the patient's chances of recovery are frequently destroyed by some well-meaning but foolish bystander dosing the patient with brandy, when what he needs is to be let alone. In cases of bleeding, therefore, let the patient be comfortably settled on his back in the place where he has fainted. Open the windows, or see that there is abundance of fresh air by keeping bystanders at a distance.

If there be a bleeding wound upon the surface of the body, or a deep puncture which has wounded an artery, use such local measures as would check the escape of gas or of water from a punctured gas or water-pipe—i.e., place a clean finger-tip upon the spot whence the blood spurts out, or pass a clean finger gently down to the bottom of a punctured wound and keep up such pressure upon the point where the blood is felt to issue as will stop the escape.

The finger must be kept there until a surgeon has arrived and has tied the two ends of the artery with a piece of silk, just as one would tie up the end of a divided india-rubber gaspipe with a piece of twine. But to ligature an artery one must generally enlarge the wound and lay bare the artery above and below its wounded point. If there be no large artery wounded and no jet of blood, but rather a general oozing from some considerable wound, fold up a clean handkerchief and lay as a pad upon the wound, and over this keep up a gentle pressure with the hand, just so as to stop the bleeding. Meanwhile, put some ice into a bladder or cloth, and this laid upon the handkerchief will suffice to stop the bleeding from most wounds. As soon as the patient can swallow safely, give him thirty drops of turpentine upon a piece of loaf-sugar or in a little milk. The turpentine may be repeated every half-hour for a few doses. After the bleeding has been efficiently stayed half an hour or more, the wound should be carefully washed with clean cold water or with carbolic acid water (one part in 20), the tips of the wound brought accurately together and retained there by cross strips of plaster, which take an adequate hold of the skin on each side of the wound, and may be relied upon to keep its edges in apposition; then the folded handkerchief or other compress wetted with carbolic water should be laid over the wound, and the whole retained in position by a bandage carefully wound round the limb so tight as to hold everything well together, but not to injure the skin or stop the circulation through the limb. While there is danger of further hemorrhage keep ice applied, and afterwards keep the part perfectly at rest.

Every day squirt some carbolic water into the compress which covers the wound until it is drenched sufficiently to prevent putrefaction. The outer bandage may be rearranged from day to day, but the pad should be left to consolidate with the wound and form a protective scab, until all comes off together, when the wound will be found perfectly healed. In more serious wounds there are few circumstances in which a medical man cannot be consulted as to management when the emergency has been tidied over. It will be seen that the treatment of the bleedings to which operative mechanics are liable is altogether a mere matter of common-sense, and in every shop there ought to be some one man clever enough to meet such emergency until a doctor can be obtained. No directions that I could give would enable a man who did not understand anatomy to attempt to tie an artery, in a position where cold and pressure properly applied would not stop the bleeding. Still, if on parting the lips of the wound, the cut end of a bleeding vessel can be seen, no harm can be done by seizing it with a pair of tweezers and tying the end with a piece of strong thread or fine twine. The ends should be left to hang out of the wound.

A punctured wound of the large artery in the neck or in the groin is almost necessarily a fatal accident, unless a really able operating surgeon be within call. In these cases cold has but little effect; a tight bandage cannot be applied long without producing other evils, such as choking the patient, or causing mortification of the limb; and hæmæstatic medicines, such as oil of turpentine, fail. But here the pressure of the finger-tip upon the wounded point, as already described, will preserve life for hours, or even days, if several friends take turns at it, and if a competent surgeon cannot be got within that time, little further can be done. Sometimes, after a few hours' successful pressure with the finger-tip, the application of the ice-bag, and the administration of turpentine, such a wound can be successfully plugged with a roll of linen, made up to fit the wound, and so fixed as not to press upon other vital parts. Large arteries are surrounded (or

section with important veins and nerves, and the divided artery must be tied to prevent it even temporarily safe. It is a hard, a cold head, and all one's courtesy lay bare and pick out such an artery. Even well-known operators, surrounded by assistants and applied in a hospital, have made a fatal mistake, or even tying, an important artery in place of the artery of the heart. To return more to the "H. C." He may have noticed a peculiarity in his blood, and which it fails to clot properly, or to plug up a wounded vessel, may be a deficiency of contractile force. His practical course is to use a wire, operative or accidental, and use of the cold pressure and turpentine, bled. The use of fresh vegetables are a valuable for all persons who work with light trusses, or who bleed in any way.

James Edmunds, M.D.
No. 10, St. Paul-street.

REDUCTION OF ELECTRICITY IN THE BATTERY.

That the phenomena to which I allude (letter 1831), is not to be explained by the supposed existence of a film of oxide, or of oxygen on the surface of the platinum plate is, I think, proved by the fact that the current is occasioned by another such "clean" platinum plate to which has been coated with a film of oxygen. In the case the current is in the opposite direction to that occasioned by opposing the film of "clean" platinum.

Explanation lies, I imagine, much deeper, and affects the production of electricity by means than through the agency of magnetism. The explanation of "Electrical" any satisfactory, for, according to existing theory electricity can alone be produced as some chemical combination—a theory which is to doubt.

Experiment, there appear to be no fresh products whatever.

of gas—or some portion of it—is simply taken from the one plate to the other, and the accompanied by electric action. Surely not pregnant with meaning.

W. T. R.

OBLONG BALLOONS.

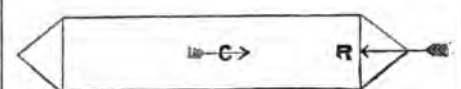
As I desire to avoid controversy, I will try to be brief, and those who dislike oblong balloons is simply a means of resistance, to make a few simple experiments.

A sheet of notepaper round a ruler or rod from the joint; pass a needle and thread across the middle, gum a disc or

on wall, and by the thread, above and below, in a strong draught of wind, the amount of strain will keep it end on. The thread is removed and the paper will fall from a height as the Monument, and will be out of the way, and if of thick or may make in its short axis.

and will, like a pocket, be fired from one end, and will not fly and say, nor will a slip of paper, and the same law holds good in a way to be formulated as this: that a pressure very passing through a resisting medium, to give the greatest area of resistance. Expanded this C in the

of iron with sharp rigid cutwater, in an incompressible medium, and a large round-ended elastic



gas-bag, floating or moving in a very elastic medium like air. At the same time the tendency to move side on is there in both, and in bluff or spoon-bowed ships or boats is a conspicuous feature.

The only way to keep an oblong balloon even approximately end on, is to place the propelling power at the bow, and pull it through the air, or hold it by that end against the wind. Levitation, or transport by balloons, must, from the nature of the case, be confined more or less to translation with the wind, as the whole affair must needs be light and bulky, two features opposed to progress through or against the air or a wind.

When air-currents are well known, and hydrogen-tight balloons can be made, and condensed gas cheap and portable, much can and will be done by them in exploration, especially as they can carry and use photographic material, and the photophone will enable communications to be easily made.

The secret of flying is not yet out; and, in this direction, I believe the study of the laws that enable large birds to soar, will yield better results than that of flapping or flying. The muscular effort in the latter is fully ten times that of the former.

I have just been watching two of the bald-headed adjutants through my telescope, 3½ o.g., power 60, and, to all appearances, they were as motionless and rigid at 3,000ft. up as stuffed specimens, swinging by a wire, slowly going round in huge spirals and rising, almost every feather visible, and the only motion I saw was at times the fan-like tail was set at a different angle, barely detected though.

My father and two uncles made the first balloon that rose in England (I believe) with M. Lunardi, and filled it from six hogheads with hydrogen. I therefore take some interest in ballooning. But the secret of rising and soaring is the great secret to solve for the future.

Upper Asam.

S. E. Peal.

ERRATA—ELECTRIC CONTACTS—ELECTRIC DIAL-WORKING.

[19296.]—No. 858 of "ours" is just to hand, and I hasten to correct an error in letter 19147, p. 620, which you have kindly published. In column 3, 25 lines from the bottom, before "chromatic aberration" insert "over-corrected for." A trifling error occurs also in the couplet—the last word should be spelt "aglee."

In support of what "Sunlight" says about the use of gold for electric contact surfaces, I would like to be allowed to say that I have an electric dial worked by an astronomical regulator, in which the contact breaker is tipped with virgin gold drawn into a wire, flattened, and soldered to the springs. This dial has been working continuously since Jan. 20th of present year; it makes three contacts per minute, and has not missed once in more than a million contacts. The battery used is a Leclanché, single cell, about a quart size. As I am only a tyro in electrical matters I thought that the dial was doing nothing more than ordinary work (though I knew that contact surfaces gave some trouble by oxidising, but to what extent I did not know); but, on reading J. E. Floyd's answer, on p. 582, to query 44531, in which he seems to think that a mile in 20,600 would be fair work; it struck me that my dial must be doing remarkably well, being 50 times better than "Watchmaker's," in the query alluded to.

I want to work a number of dials off the same motor clock, and would be glad if some kind correspondent, "cunning" in electrical matters, would tell me if it would be better to use one wire running from dial to dial throughout the series, or to have a separate wire to each dial. Some of them will be at a distance of several hundred yards from the motor clock.

Sept. 14th.

Nova Scotian.

ON THE PURIFICATION OF COAL-GAS.

(Continued from p. 90.)

OF THE PURIFICATION OF COAL-GAS.

THE first step towards the purification of coal-gas is the condensation of tar (hydrocarbon) and with finely-divided carbon in suspension, and some weak ammoniacal liquor.

There is no special process in use in this country for the complete removal of the tar. The gas, when cooled to about 50° F., deposits most of its tar, the remainder leaves the gas during its passage through the washing apparatus, and even the purifiers must demonstrate their efficiency. The removal of the tar and the cooling of the gas should

be two distinct operations: the first a process of filtration.

The present mode of retaining the gas in contact with tar until nearly all the tar has settled out is certainly prejudicial to the illuminating power besides being an incomplete process. The subject has not yet received the attention it deserves.

WET PURIFICATION—AMMONIA.

There is, perhaps, no portion of the process of gas-manufacture that has given rise to more baseless hopes than the scrubbing or washing as a means of removing not only the ammonia, but also carbonic acid, sulphuretted hydrogen, and carbon disulphide; for, it being known that ammonia combines with carbonic acid and sulphuretted hydrogen, and ammonium sulphide with carbon disulphide, it has been thought that the whole process of purification might be effected at this stage. Others, who have not gone so far as this, have claimed their ability to remove all the carbonic acid, because it is known that ammonia has a greater affinity for that body than for the other impurities. It is only necessary, they say, to keep the gas long in contact with gas-liquor, and all the carbonic acid will be removed. If it were possible economically to recover free ammonia from gas-liquor the necessary number of times, and to use it in this manner for washing the gas, no doubt the whole process might be made complete without the use of any alkali other than ammonia.

In unwashed gas, from good gas-coal, there are to be found per cubic foot—

- 1·7 Grain ammonia,
- 14 Grains carbonic acid, and
- 11 Grains sulphuretted hydrogen.

Supposing that the whole of the ammonia were employed in removing carbonic acid, and that as $(\text{NH}_4)_2\text{CO}_3$ be formed (a supposition not likely to be realised, and quite unsupported by any analysis of gas-liquor) there would be by the simple process of washing, 4·4 grains of carbonic acid eliminated from the gas, or about one-third of the total quantity. This is a consummation not at all suggested by anything that occurs in practice.

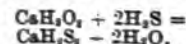
Actually about two grains of carbonic acid with 5 grain sulphuretted hydrogen are removed from the gas in combination with the ammonia of the gas-liquor. This liquor is very variable in composition. The following analysis—giving the ammonia combined with carbonic acid and sulphuretted hydrogen in grains per 100 cub. cm. or percentages if the specific gravity of the liquor be assumed at 1,000—may be interesting:—

Ammonia.	Carbonic acid.	Sulphuretted hydrogen.
Grms. per 100 cc.	Grms. per 100 cc.	Grms. per 100 cc.
1·11	1·35	·36
1·24	1·14	·32
1·51	1·68	·51
1·62	1·98	·50
2·51	2·51	·43
3·17	3·92	·52
6·01	7·13	·52

There are small quantities of ammonium, sulphuretted, and ferri-cyanide found in gas-liquor, but their successful working up into saleable products has not yet been effected.

DRY PURIFICATION.

There are now in the washed gas 12 grains carbonic acid and 10·5 grains sulphuretted hydrogen, with about 4 to 5 grain of sulphur as carbon disulphide to be removed. For the first-named impurity, calcic hydrate is used, for the second hydrated ferric oxide, and for the third calcic sulphhydrate, prepared by saturating calcic hydrate with the sulphuretted hydrogen in the gas. The reaction is—



For the process purifying vessels are used, fitted with tiers of sieves, on which are placed the purifying materials. These vessels, for economical and certain results, should be eight in number, disposed in four pairs. Each pair is so connected with valves that either vessel may be worked first or alone or separately. The depth of material in each vessel is from 24 to 36 inches, disposed in six tiers. The area per million cubic feet per diem of each vessel is about 350 square feet, giving a capacity of about 28 to 42 cubic yards of material per million. These quantities are based on gas containing 12 to 15 grains carbonic acid, and 10 to 15 grains sulphuretted hydrogen per cubic foot. The first pair of purifiers is for carbonic acid, the second pair for the bulk of the sulphuretted hydrogen, the third pair for carbon disulphide, and the fourth pair for the last trace of sulphuretted hydrogen.

There are, however, three possible positions, of which the second is selected for general purpose.

1st pair.	2nd pair.	3rd pair.	4th pair.
1st. Oxide	Lime	Lime sulphide	Lime
2nd. Lime	Oxide	Lime sulphide	Lime
3rd. Lime	Lime sulphide	Oxide	Lime

I amply heat a forcing house of moderate size. To fully advise you, it would be necessary to much more detailed information. But with before me, I should gladly help you.—SUNLIGHT.

[4834.]—Division Plate, &c.—Division plate be carried in a collar in front of the locking of the back gear of your lathe. Many are fitted. It depends, of course, on the space between the mandril gear-wheel, and the headstock; but this is generally sufficient. Let me know the distance between. I will send you a sketch of the necessary arrangement. The reason some small fans of amateur make fail to more than churn up the air, is that they are designed. Frequently I have even seen them at the reverse way, whilst the constructor aimed where the deuce the air went to, as there none emitted from the delivery. There are such fail from the improper shape of the of the fan-wheel, as also from excessive space, due to the case being out of shape, or in construction. A fan is a most easy to construct—that is if the constructor knows principles involved, and how to apply them.—G.H.T.

[39.]—Electrical Contact, Motor, &c.—I regret our valued friend, Mr. Lancaster, will fully to this. But, in the interim, I would say that, although nickel might answer in respects, still, under the influence of the coal spark, I have but little doubt it would fail. Even platinum, after some time, if be no friction on the contact, becomes encrusted with a something that may be termed I think. If I were going to design such an, I should prefer a Trouvé motor. The one at page 16 would not be anything like enough. If Mr. Lancaster, from press of matters, is unable to reply, again draw my ion, and I will help you. But, at the present, really too much engaged to be able to do both for and you the justice I could desire to, want of time.—SUNLIGHT.

[40.]—Swan's Electric Lights.—You require about 40 of ordinary quart Bunsens as a good steady light. Of the square cells 30 would do. See advertisement.—GEO. G. WELLS.

[41.]—Violin-making.—The reason why a would fail, having a pin slit down the middle of its soundboard or breast, is because the would tie the two halves together by the of the strings, as completely as though—that is without a soundpost—and not much with a soundpost. A free edge or free reed have its motion directed from a centre, and is free to act, or else the sound is muted.—J.E.B.

[44.]—Reed Organ.—As "Bombardon" the back volumes except 23 and 24, he will as scales he inquires for on p. 389, Vol. and p. 586, Vol. XX.; and as to the lengths, take two-thirds the length of vibrating of reed for the reed aperture, and one for the pallet aperture (the latter on the sition that there is only one reed to a el). On p. 586, Vol. XX., there is an illu- n of a pan for 2½ rows of reeds, which, the scales there given, may, perhaps, suit correspondent; but it is doubtful, because already said that he cannot "get satisfactory nation" out of his back volumes, and also as he appears to want to make an affair that all hope no one but himself will waste time tempting. Harmonium reeds must be ad down severely to adapt them for the suc- rinciple, and then they won't be so good as mericaa reed; and as to putting them on channels as "Bombardon" has made, the ould astonish an apprentice. Don't have hannels at all is good advice in such a case, rtainly ordinary reeds are not "improved any a suction principle," though, as I pointed out 429, Vol. XXXII., there is no reason why a mium should not be made on that principle. ply ask, *cui bono*? At the place just men- d, the very same idea as "Bombardon" has, I hoped, settled. He must have divisions in hannels, or no channels at all. I should like ow where "Bombardon" got his idea from, e certainly never learnt it out of his back es.—SAUL RYMEA.

[44.]—Reed Organ.—Channels are not red for a reed-organ constructed on the suc- rinciple. My advice to "Bombardon" is Dispense with channels and procure a tube- for the required number of vibrators. ary harmonium reeds will not do for this, as are required to slide in the grooves situated e bottom part of each tube or cell. The ican organ suction-reeds can be obtained any respectable instrument dealer. "Bom- n" is making his instrument with 2½ sets. dition of a sub-bass consisting of 13 notes t. tone and the octave coupler would greatly

add to the value and beauty of tone of the instru- ment. If "Bombardon" desires to know the dimensions of the various tubes and how to attach the octave-coupler, I shall be most happy to supply him with all the necessary information. I have a beautiful instrument at home with the following arrangement of stops:—Treble stops: dulciana, flute, kalophon, and principal forte; also a tremola acting on all the stops of the treble portion from middle C. The kalophon is a solo stop of a celeste character, but only producing a slow wave. The stops of the bass portion are diapason, principal, sub-bass, and diapason forte. The octave-coupler is a mechanical stop which, when drawn, doubles the power of the instrument without necessitating an increase in the number of vibrators. If "Bombardon" will make an instru- ment like the one I have partly described, he will have a reed-organ which will give him satisfaction, and if he will decide to make it I will furnish him with all the information required in as brief a way as possible.—G. FRYER, SWANSEA.

[44846.]—Old Zinc Battery Rods.—It is, I think, the mercury in the old rods that causes it to be so very brittle. It is an advantage from an electrical point of view, so I should retain as much of the old rods in recasting as possible, using them carefully. The remedy is, use 3 parts old rods, 1 part new zinc.—AN ASSOCIATE OF THE SOCIETY OF TELEGRAPH ENGINEERS.

[44846.]—Old Zinc Battery Rods.—It appears to me that you have not removed the dross sufficiently well. It must be remembered that a very great proportion of the zinc is affected by the electro-chemical action. My advice is to melt it again, and if necessary, even then again. You will doubtless find a lot of foreign matter each time, and a very small quantity is sufficient to materially affect the molecular arrangement. If the rods are from an ordinary Daniell of the Government form, that is, unamalgamated, it is very advantageous to throw into the pot a little amalgamated zinc. If, again, it is desired to use the newly made zinc for such a battery as the Grove, Bunsen, or Fuller, properly performed amalgamation will nullify any deleterious effects that might arise from bad metal.—S. G. O.

[44848.]—Chemical Diffusion of Gases.—Dissociation.—Since the rate of diffusion of a gas depends upon its density, and as gases expand when heated, it follows that the diffusion will be altered by rise in temperature. The diffusion of a gas is inversely proportional to the square root of its density—in other words, the lighter the gas the more rapidly it will diffuse. If the densities of two gases be d_1 and d_2 , they will diffuse in the proportion $\frac{1}{\sqrt{d_1}} : \frac{1}{\sqrt{d_2}}$. Oxygen is sixteen times as heavy as hydrogen, and the latter gas therefore diffuses four times as fast as the former. I know of no separate work on dissociation; the subject can be got up only from the best textbooks on Chemistry. If the querist can read German, he might with advantage read up the portion of Lothar Meyer's "Moderne Chemie," which treats of the subject.—B. Sc.

[44849.]—Raising Flour.—It is possible, but not advisable, to do this by a worm. The best plan is to elevate with belt and cups if the lift is vertical; but if the trunks for belting could be made sloping, then ordinary webbing with wood chogs fastened on it would answer the purpose, at about one-third the cost of the belt and bucket arrangement. Shall be glad to reply further if necessary.—FLOUR-MILL MILLWRIGHT.

[44850.]—Cooling Water from Condensing Engines.—Yes, quite possible. An arrangement something on the plan of the waterfall condenser would do all you want at the extra cost of a very simple appliance and a fan. Let me know the capacity of the reservoir, the average quantity of water used for the condenser per minute, and the temperature of the water in the reservoir at present. I would then see what size, &c., you would want the cooling apparatus through which the water would be sent the last thing before being taken off to the condenser of the engine.—SUNLIGHT.

[44857.]—Electric Engine.—A one-inch crank for a vibrating electric engine would want a magnet of 40lb. weight at least to work to any advantage, and such a magnet with a powerful battery would not be equal to a 2in. cylinder steam-engine; the rocking arrangement is very objectionable. The best and most scientific electric engines with cranks are those of Rouse, Boubourze, and Hjorth, illustrations of which you will find in most treatises on electricity. In the plan you propose the magnet armature would be better if fixed on the rocking lever B C (page 99) in such a manner as to be pulled downwards instead of horizontally. Will give you further information if required.—J. SUTCLIFFE.

[44858.]—Options.—The less "Ventnor" has to do with options, or any other form of speculation, the better for him. The best firms on the Stock

Exchange do not encourage this class of business, and no member of the Stock Exchange is allowed to advertise.—A BROKER AND MEMBER OF THE STOCK EXCHANGE.

[44858.]—Options.—My advice to "Ventnor" is, Have nothing whatever to do with Stock Exchange speculations, or he will certainly lose his money. It is gambling, and the motto is "Heads I win, tails you lose." Only speculators deal in "options," of which there are three kinds:—1. The "put and call," by which the operator agrees to take or to deliver stock at a certain price on a fixed day, and for which a certain sum of money is paid when the bargain is made. 2. The "put," by which the operator has the option of delivering a certain quantity of stock at a certain price on a certain day. 3. The "call," by which the operator has the option of claiming a certain amount of stock at a certain price on a certain day. I should recommend "Ventnor" to study Arthur Crump's book "The Theory of Stock Exchange Speculation," published by Messrs. Longmans, price 10s. 6d., before he commences operations. If he then persists in his course I fear he will only have the "option" of pocketing his losses.—G. H., WHITBY.

[44861.]—L. and N.W. Engines.—You gave date yourself of Una, No. 998, in "E. M." of July 15th, as May, 1862. I am not up in dates, but can tell you that Una is at Camden, Trentham at Rugby; Saddleback, Phantom, and Pheasant at Northampton; and Rowland Hill at Crewe—or they were lately.—W. B. P.

[44861.]—L.N.W. Engines.—Yakoob Khan, April, 1877; Whitworth, Jan., 1865; Vampire, October, 1874; Una, October, 1861; Trentham, Feb., 1851; Shark, Nov., 1874; Saddleback, May, 1879; Rowland Hill, October, 1861; Phantom, May, 1877; Petrel, May, 1879; Pheasant, May, 1879. To "Diomed."—I should like to know the number of Yakoob Khan: its reputed one is 859; but 859 is a goods-engine, which is, or was, stationed at Birmingham a short time ago.—FORTUNA.

[44865.]—Air-Pressure from Fall of Water.—Very much depends on the question whether you have but a moderate supply of water under a good pressure, or an abundant water supply, with a slight fall only. In that case, a plan something like the mode employed at the old Catalan forges would come in handy. If you have good pressure, then you may use a jet of high-pressure water to force in a larger bulk of air, similar to an injector. The air, after passing the throat of the nozzle, separates, and can then be used as wanted. What quantity would you require of air per hour?—SUNLIGHT.

[44867.]—Gilding.—I do not know whether the following method will suit the querist, but if it should, he is welcome to it:—The panel should first be well rubbed with fine sandpaper, in order to obtain a perfectly smooth surface. When the panel is perfectly smoothed, it should then be primed. Then afterwards apply a coating of bright red paint. A good brush will be required for this, in order to give the panel a smooth coating of paint. Let this thoroughly dry; then size over with gold size, and when tacky apply the leaf. When quite dry the gilded panel can receive a thin coating of colourless varnish if thought necessary. This method, which is thoroughly reliable, will only apply to the wood, not to the strained paper. Do not apply the paint too thick.—G. FRYER, SWANSEA.

[44875.]—An Old Experiment by Faraday.—The answer to this query is No. The friction of the revolving disc against the air is so small as not to produce any sensible rise in temperature. The heating effect is due to induced electric currents produced in the disc by its movement across the lines of force of the magnet.—B. Sc.

[44878.]—Microscopic.—"A. B. C." will find Zeiss's objectives very good for histological work, as their definition is so very clear, and their working-distance—at any rate, in the high powers—so great. I have made much use of a 1-20in., and have found it easier to manage, and capable of working through thicker cover-glass than a dry 1-8in. by Ross. A 1in., 1-4in. or 1-5in., and a 1-20in. for high power form a good set for histological work. The binocular is to be preferred to the monocular for low-power work, but it is useless for anything over a ½in. objective, and even that must be specially mounted in a short mount for the purpose. If you purchase Zeiss's lenses, see that you have them to suit your length of body tube, as he makes them either for the short Continental model or the usual 10in. English tube. I do not think they stand deep eyepieces quite so well as good English objectives.—THREADLE.

[44888.]—L. N. W. Engines.—(7) Scorpion, (97) Atalanta, (117) Tiger, (222) Lily, (723) Olive, (802) Red Gauntlet, (806) Waverley, are Trevithick's, with 7ft. 6in. driving-wheels; (479) Mastodon, (626) Emerald, are Webb's 6ft. four

crushing! And would not the girder, in better position at the bottom than at the top!

Tube.—Can any correspondent recommend a tube by A. Collard, a notice of which I read some time ago? Is the fingering or blowing difficult? It is a very ordinary C. F. Can the pitch be as most of the pianos here are a note at a time? Is it considered an improved instrument? Cost and other particulars will oblige. Hughes will kindly answer, should it meet him.

Defect in Pianos.—To Mr. DAVIES.—My goes out of tune just at the break between strings and the wires. Being a musician on a number of pianos, and I notice the more or less in all cottages—except some instruments. Is this defect caused by the being too near the edge of the soundboard, or too thin for its length, or is it a weakness? Your explanation of this problem will be appreciated. —OLD THUMPER.

Fine Surface on Cold Rolls.—What means of getting a fine surface on cold rolls? We, as a rule, press a brick when in motion, and afterwards allow them to rest. Are there any special bricks used for fine surface? —W. RICHARDS.

Electro-Magnets.—To Mr. J. SURANT.—I want to make a magnet to lift 50 lb., to drive a pump as described by you, to turn a musical box. I have round iron 12 in. long, and proportionate size. I want to know what number wire and how much to use to wrap it from end to end continuously? Is the iron with a flat bottom? After I have pole, where shall I commence to wind the wire? or bottom? and then where connect the wire? Please state fully and oblige. —

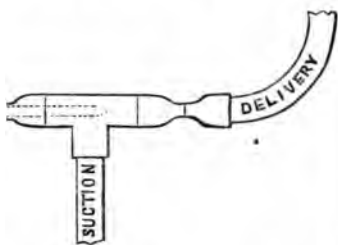
Coil.—To Mr. LANCASTER.—Will you tell me how to make a small coil for giving power to a pump? I want one not to cost more than half a guinea. I have looked at back numbers of E. M., but do not find what I want. Also, what battery to use, or what would be the least price for which I could get a coil for showing vacuum tubes—not to be used for anything else. I am sure this information will be received by many of "ours" as well as by—

Strain on Crank-Pin.—To "SUNLIGHT."—You oblige me with formula for calculating strain on crank-pins? —W. H. B., Bradford.

Order of the First Order.—Will any tell me how to find the position of fulcrum of a lever? A plank is 20 ft. long, and two boys, each weighing 15 stones, are seated on one end. The other end sits a man whose weight is 12 stones. In what position of fulcrum so that they may be in equilibrium? —W. H. B., Bradford.

Ghost in the Telescope.—Would respondent "F.R.A.S." tell me the cause of a ghost? I mean a round patch of light like a star in the field, in my case a little s.p. the field. —J. F. E.

Injector Pumps.—I have frequent trouble with injector pumps from 6 ft. to 20 ft., purpose fit up temporary injectors with steam tees and couplings in the following



very convenient. The necessary parts are small, and they require a very short time to make. The following points I have found must be observed:—1st. Both suction- and delivery-pipes must be smooth as possible inside. 2nd. The diameter must be equal to that of the T-piece. 3rd. The joint at bottom of delivery should be about 1 in. coupling diminishes to 1/2 in. 4th. The pump project a little more than half across to suction. There are some points, however, which I have been unable to find out, and should be glad if any of your correspondents would assist me. The injector will work at once without other times I have been two or three days working with one, although I have made it as simple as possible. They will not lift boiling water. A stream of cold water is allowed to run of the suction-pipe. I have not found the ending in steam-jet to make any difference in power (within certain limits), but the hotter will be the liquid delivered.

Tricycle.—Have any of "ours" seen the "Tricycle"? I have only seen it at a fair, and it is as easy as a bicycle. It is quite a

Force-Pump.—I have a force-pump, used for filling a w.c. cistern, but which is at present useless, as, before I can raise any water, I have to take off the top cap and charge the water each time (about three times weekly) by troublesome, besides wearing the screws.

Now, being situated several miles inland, where there is no direct public conveyance, skilled plumber's labour becomes very expensive, and I am desirous to remedy the thing myself if possible. In view of the above circumstances, I desire the advice of such practical men as Mr. P. J. Davies or others, who, from experience, know the annoyance suffered by derangements such as this.—FORCE-PUMP.

[44923.]—Decolourising Agent.—Can any of "ours" recommend a decolourising agent that is not poisonous, or can be effectually eradicated from the liquor after doing its duty? I have to bleach a liquid that is eventually used as an article of diet, and whose colouring matter is a vegetable product (burnt sugar). Chlorine answers well as far as decolourising goes, but, being such a deadly poison, would spoil the liquor as an article of food, unless it can in some way be rendered innocuous. Is there anything I could add to combine with the chlorine in the solution, and thus either counteract its presence or deposit it? Any suggestions or names of works on bleaching agents will much assist.—AN AMATEUR CHEMIST.

[44924.]—Telegraph Circuits.—Would "Sigma," or any of the expert electricians who contribute to the "E.M.," kindly give their opinion on the following query?—Would an electric telegraph circuit of about twenty miles in length, with two wires, second wire for a return instead of earth wires at each end (or, in other words, a metallic circuit), both wires perfectly insulated with no connection to earth on the circuit—would such a circuit with four instruments or two instruments on it be entirely free from the effects of all earth and atmospheric currents, and lightning during thunderstorms? And, would any metallic or return circuit from one mile to one hundred miles be free from above interruptions? If not, how are they affected, and what is the action? —TELEGRAPHIST.

[44925.]—Valvaline.—Can any of "ours" give me any practical information as regards a lubricating oil for cylinders called valvaline? Have tried one kind of cylinder oil, and had to give up using it because of cutting the valves and cylinders.—P. M.

[44926.]—Photography.—Will some kind friend say how to remedy very small pinholes in, mostly, the sky of gelatine negatives? They, of course, untouched print dark. I have tried Indian ink with water, and have had much difficulty in getting it to take at all on the varnish, and when I do, then the remedy is worse than the cause, for I get a white spot in the print.—R. K. W. H.

[44927.]—Matt Varnish.—Wanted, recipe to make what I believe is called as above. It is something in ether, which, when poured on glass and evaporated, leaves an appearance exactly like fine ground glass.—R. K. W. H.

[44928.]—Artificial Leg.—I have made an artificial leg, as diagram, which seems to answer pretty well,



except in one or two respects. A, the body of the leg is made of stout sole-leather. The whole length of B is best flat steel, having joints for the knee and the ankle, and shaped to fit the leg. C, the foot, is made of stout willow wood, very light and tough. D, the toe, flexible indiarubber; the sole, also, is of indiarubber. E, the thigh-piece, is made of leather, to strap over with three buckles. F, a leather socket, which fits into the hollow leg, resting on the top of the leg, with a piece of stiff sole leather forming a ledge. The leg is sewn firmly up the back, and holes cut through for ventilation. The instep goes over too suddenly, almost with a jerk, and the foot rather "dips." How can I remedy this? Could I have any other method of fixing the foot? I am troubled with the top of the leg, just under the knee, rather hurting me, sometimes taking off pieces of skin, which makes walking very difficult. I should be very glad to make improvements on this, and would be very glad of help. I may mention that the limb is amputated about 13 in. below the knee.—ONE IS A FIX.

[44929.]—Rotary Steam Engine.—Will "Sunlight" or some reader of the E. M. who knows, kindly explain the principle of "Rotary Steam-Engine," mentioned in *Scientific American* for Sept. 10, as connected with "Siemens's Dynamo-Electric Machine for Electric Railway," at Paris Exhibition? Is it simply on the same principle as a turbine water-wheel, or is it so arranged as to receive the full pressure of the steam? I am very anxious about this query, and at the same time I think it is likely to be of general interest, so I trust some of our able contributors will not pass it over.—ANXIETY.

[44930.]—Cosmorama.—Will any correspondent oblige by informing me the best and cheapest way to make a peepshow to amuse and interest a number of

young persons? It must be light, portable, and small. I suggest it should be circular in form, with transparent pictures, and with a lamp in the centre. If any suggestion better I shall be pleased. I want it to be shown to four or six persons at a time through a whole school of them.—COSMORAMA.

[44931.]—Battery to Recharge.—Will some of "ours" kindly inform me how to recharge a 100 cell Léclanché medical battery made by the Silvertown Telegraph Co.? What chemicals to use and how to use them? —NOVICE.

[44932.]—Colours in the Sunlight.—"Plateau" asserts that white may be distinctly seen in the light of the Sun at an angle of 12°, yellow at one of 18°, red at 23°, and blue at 36°, but that in ordinary daylight these angles must be half as large again. Will "F.R.A.S." kindly state whether the above assertion is correct? What is meant by ordinary daylight? —ACONITE.

[44933.]—The Cissoid of Diocles.—To "F.R.A.S."—Have any other methods of constructing this curve line been discovered, besides those given in Newton's "Universal Arithmetick," and Emerson's "On Curve Lines"? If so, by whom, and where described? —ACONITE.

[44934.]—Chamfer Planes.—Would "Joiner" kindly oblige a fellow-workman with details of chamfer plane with circular bottom, shown at Fig. 3, letter 19246, p. 69 of *ENGLISH MECHANIC*, as I wish to make one to work any bevel? —C. C., Uxbridge.

[44935.]—Galena Plating.—Have any of "ours" seen any specimens of galena plating by Prof. Reynolds's principle? On what material has the process been successfully applied? Can specimens be obtained? —B. B.

[44936.]—Analysis of Milk.—Will Mr. Allen, or some practical chemist, kindly inform me what book contains the most complete information on the analysis of milk? —J. H. M.

[44937.]—Pianoforte.—Will some brother-reader tell me the number and sizes of wires to re-wire grand piano, 6½ octave, and oblige? —T. G. A.

[44938.]—Indian Dialects.—What languages are spoken in Afghanistan and Baluchistan, and are they written in any other than the Persian or Arabic character? Are any characters in use in British India besides the Persia-Arabic, the Sanskrit, the Singalese, the Tamil, the Carnataca, and the Assamese? —MURANO.

[44939.]—Brass-Founding.—I have attempted casting brass bushes and other cored castings, but have failed to some extent. I melt the brass (old brass) in a plumbago crucible, and mould in black-moulder's sand, with wooden flasks or boxes. On pouring the melted brass into the mould, it spatters a little, and afterwards, on examining the casting, it has a rough surface, and the core-hole, which should be perhaps 1/2 in., is over 1 in., and has the appearance of being blown. Can any person tell me the reason for these defects, and give a remedy? I made my cores with black sand and horse-dung, wet with a little clay-water—i.e., water from fireclay. The brasses, on being worked, are very soft and light yellow in colour. What proportion of copper must I add to make gun-metal? What quantity of broken glass should I put in the crucible with the brass? How can I bake the moulds with wooden flasks? Would holding a red iron over them do? —YOUNG IRELAND.

[44940.]—Boat.—My object is to make a boat 12 ft. long for sailing. Being a novice, I am puzzled about the ribs, and should be obliged if some reader would tell me how to bend them. I thought solid bulkheads might do instead. I would make it a lifeboat by leaving only 6 ft. open in the centre, the rest decked and made air-tight.—T. B.

[44941.]—Medical.—Will Dr. Edmunds say what I ought to do in a case of permanent palpitation? A little medicine has been taken, and a belladonna plaster applied, but they have little effect. I am not out of my teens, and have been assured that it would pass off.—SUFFERER.

[44942.]—Calculating Weight of Rivets for Wrought Ironwork.—Will some of your readers kindly explain the mode of calculating the weight of rivets required for wrought ironwork, such as girders, tanks, boilers, &c., and if they know of any list published giving this and rules for diameters and pitch of rivets according to the thickness of plating? I should also be glad to know what percentage of rivets is allowed in calculating the net weight of such articles.—P. D.

[44943.]—Tricycle.—(1) Is the gearing for tricycles, as shown in letter No. 19227, applicable to the Special Salvo? (2) Could the lever be made to work in the opposite direction, so that when the hill-climbing gear is required, the handle may be pulled towards the rider, as I find it a great help to have something to "pull at" in going up-hill? (3) Could one large wheel be substituted for the two on the pedal shaft, so that moderate inclines would be mounted at a greater speed? This would, of course, prevent throwing the pedals out of gear in going down hill.—SPECIAL SALVO.

[44944.]—Heating Gas-Bath.—I have a gas-bath where the heating surface is the bottom, which is double, the heat passing between and out at the other end. The diameter of exit-pipe for burnt gases and waste heat is 2 in., and this just carries it off, allowing the gas to burn with a good draught, and straight up from patent burner to bottom of bath. The bath being next the outer wall of house, I thought it would be feasible to carry exit-pipe to outside of house, and thus remove burnt gases, and especially the carbonic acid, which is a real poison, right away from bath-room. All very well in theory; in practice, after doing this, I found there was not enough draught, and, instead of burning as before, the gas flickered all about and up the sides, and, in fact, that it might not do. I then put a cone and elbow on the outside to prevent down-draught, still the gas burnt as badly as ever. If I disconnect the pipe that goes outside, the gas-heater burns all right, but directly it is connected (with same size tube) through the wall, all is wrong again. I shall be glad of any hints, as it is desirable to take the carbonic acid out of the room.

and so make this form of bath perfectly safe.—GAS-BATH.

[44945.]—**Firing.**—Would some reader of the "E. M." tell me the best mode of firing for a Cornish Boiler? A sketch of the shape of fire will greatly oblige.—F. J. N.

[44946.]—**Harmonium Stop Ineffective.**—The Dulciana Bass stop does not produce any effect, as, upon drawing it out, it does not subdue the tone in any way. Could any of our practical friends say how I can remedy it?—MARK.

[44947.]—**Bicycle Route, Preston to York.**—Could any of your readers direct me as to my best route from Preston to York for triecyle, and any hint as to hills, &c., that may be avoided?—W. SINGLETON, Longridge.

[44948.]—**Lathe Chucks.**—How is that dark mottled appearance obtained which is on American chucks and similar articles? Will it prevent rust?—W.

[44949.]—**To Mr. Lancaster.**—Deschanel says (p. 861, 3 680 D), "Two simple notes of 300 and 320 vibrations per second will yield 20 beats in a second . . . but simple notes of 40 and 60 vibrations per second will not give beats." Is this perfectly true, and why? Of course, I can understand that one interval is a semitone, and the other a fifth, but I cannot see why two pairs of simple tones, both differing by the same number of vibrations per second, should not produce the same number of beats.—JOHN FORREST.

[44950.]—**Gas-Burner.**—I have lately had one of the "Albo Carbon" burners fitted in my study, and, though it gives a remarkably fine light, it makes such a terrible smell that it is almost impossible to remain in the room. Can anyone suggest a remedy? I have tried opening the ventilator as soon as the light has burned up, but have never been able to get rid of the smell. What is the composition of the so-called "Albo Carbon"? Are the fumes unwholesome?—N. P. S.

[44951.]—**Ship-Stove.**—Would someone inform me through your paper whether there is any stove suitable for warming a cabin on board ship? An ordinary coal-stove would be too hot, gas is not available, and mineral oils, such as paraffin, &c., are not allowed on board.—C. E. G.

[44952.]—**Fitting up Telephone.**—I have to fit up a telephone to work over about 500 yards. Can I use one wire (and earth as return) for bell telephone and microphone transmitter? I propose making a Crossley transmitter. Is it the best? What should be dimensions of wooden diaphragm? I should like to use one battery for bell and transmitter. Will any reader give sketch of automatic switch, and general arrangement of instruments?—GLATTON.

[44953.]—**To Mr. Lancaster.**—May I beg Mr. Lancaster to kindly inform me (1) what is the most convenient machine for electric lighting for amateurs? I should be very much obliged for sketch and some information on the kind of iron, wire, &c., required. I want to make a small machine (not more than about 100 candles) and without permanent magnets. (2) How to make a flat micrometer for double stars?—AMIE.

[44954.]—**Spectroscopy.**—To "F.R.A.S."—I would be very much obliged to "F.R.A.S." if he would tell me what is the cheapest and most convenient star spectro-scope for amateurs? My instrument is a 5 $\frac{1}{2}$ refractor. It is equatorially mounted, but the mounting is not a good one.—AMIE.

[44955.]—**Fur Inside Teapot.**—How can the fur inside an old Britannia-metal teapot be removed?—WAR.

[44956.]—**Diamantine.**—Would some of "ours" kindly tell me the proper use and way to use diamantine on watchwork? Is it used the same as redstuff?—GUYOT.

[44957.]—**Coil.**—I constructed a small coil about twelve months ago from information I obtained out of Dyer's book on Intensity Coils. The following are the dimensions and particulars of coil:—Length of reel, 3in.; diameter of reel ends, 2in.; core, 3in. diameter. Two layers No. 18 primary wire, and twelve layers Secondary No. 30. The Primary begins at one end and finishes at the same end as it began; the Secondary begins at the other end and finishes at the same end as it began. It is arranged merely for giving shocks, and works splendidly with a bichromate bottle battery; but, as I am desirous of connecting the primary and secondary together so as to form, if possible, a medical coil, I should feel greatly obliged for the necessary information as to how to proceed.—J. G. K.

[44958.]—**Fossils.**—I shall be much obliged if "T. G. F." or some other geologist, will kindly tell me where to go for some of the fossil fruits in the London clay? Are there any to be had at Highgate Hill? If I go there, can you kindly say who I should apply to for permission to look for them? Are they deep in the deposit and difficult to get out? Is there any place near Hammersmith where they can be found? Are there any shells? And, if so, how many varieties?—J. HALE.

[44959.]—**Silvering Gilded Watch Face and Barometer.**—I have a watch difficult to read in a bad light, also, a barometer that requires re-silvering. Will anyone tell me how to proceed in both cases and how to re-black the figures?—No SIG.

[44960.]—**Planisphere.**—In making a plan of the Zodiac upon a flat surface containing the Ecliptic, must the size of a deg. of declination be the same as that of R. Ascension, or must it be less? Thus, if 10 deg. of R. Ascension measure 1in., must 10 deg. of declination also measure 1in.? Also, will the curve to represent the Ecliptic be a regular curve as if drawn from a centre? Also, can such a planisphere be purchased ready-made? I want to make or possess one, so as to show the relative positions of the planets.—EBOB.

[44961.]—**Webb's Four-Wheel Coupled Engines.**—Will any correspondent kindly give a list of

Mr. Webb's 5ft. 8in. four-wheel coupled engines?—FORTUNA.

[44962.]—**Dissolving Gold and Silver.**—How can I dissolve gold and silver with acids, and reduce them to the metallic state again, with and without alloy?—S. GOLD.

[44963.]—**Contraction of Volume of Sulphuric Acid on Dilution.**—When sulphuric acid is mixed with water, the resulting volume of dilute sulphuric acid is less than the sum of the volumes of water and sulphuric acid used. Some years ago I asked through these columns for explanation of this—that is, the philosophical explanation—but I merely received replies giving the chemical explanation. I suppose the contraction is due to the fact that on the formation of the acid hydrate, the atoms or molecules of which the compound is composed are drawn closer together, and—here comes my difficulty—since the atoms are drawn closer together, the interstices or space between each individual atom must be less than it was before contraction. Now, what becomes of the annihilated space (if I may use the term), or what becomes of the medium which filled the space? What is this medium? Is it something akin to the "luminiferous ether"?—CHEMISTIANA.

[44964.]—**Kendal Brown Snuff.**—Would some person be good enough to furnish me with information on the above?—J. O. NEILL.

[44965.]—**Steam-Press.**—Name the best maker of tobacco steam-presses which leave the sweetest odour after the tobacco has been finished, and how managed?—J. O. NEILL.

[44966.]—**Hydromotor.**—I should feel greatly obliged if "Sunlight," or any other correspondent, could give me a description of the hydromotor lately invented by Dr. Fleischer, and say if it would be suitable as an auxiliary power for yachts. I should also be glad to know what kind of engine and boiler would be the lightest and occupy least space for the same purpose, and how many horse-power would be required to propel a vessel (say) of 35 tons at the rate of six or seven miles per hour, and what arrangement of screw would least interfere with her sailing and steering qualities, and if the engine and boiler might be placed very far aft?—S. S.

[44967.]—**Steam Propeller.**—To "SUNLIGHT."—Would it be of any use to attempt to convert my propeller?—BACKWOODSMAN, British Columbia.

[44968.]—**Application of Foucault Test to Mirrors.**—I wish your correspondent "J. C. L." would explain in your paper the exact method in which he applies the Foucault test to mirrors. I have never yet been able to use it. Where should the pinhole of light be placed? where the cutting-off screen? and where the eye to see the lightened mirror?—R. E. C.

[44969.]—**Anglo-German Concertina.**—I have a very good German concertina, which I intend altering to a 26 key Anglo-German. Can anyone tell me if the reeds are fitted in the Anglo the same way as in a German? If not, will someone describe how they are arranged?—MUSIC.

[44970.]—**Caledonian Engines.**—To "CARSTAIRS."—Three months ago I sent a query to "Carstairs" (issue of July 1st, query No. 44103), asking the above subscriber to favour us with a sketch of a Caledonian S-footer. I am quite sure that the query escaped his notice. Might I again solicit his kind attention?—KRAULOPHON.

[44971.]—**Electric Tricycle.**—Now that electric force is so utilised in many ways, especially in the latest plan of electric tramways and railroads, is it not feasible to fit up a tricycle with electric driving power, which would not be too heavy, expensive, or unsightly for use? Can any of our readers describe a small and sufficiently potent electric motor that would be of avail for tricycle riding? Is there any motor without a battery or needing only a very small one? The tricycle could be also fitted with foot pedals to help up-hill, or to increase speed on any incline, as in the present tricycles. Or, is there any pneumatic or other electro-magnetic contrivance that can be pleasantly utilised for the purpose? A few answers will greatly oblige.—F. YELWOC.

[44972.]—**Compact Battery.**—In No. 861, p. 56, "E. M." a battery is described in which some slight mistake in measurement seems to me to exist. The zinc plate is 15in. long, and the flannel envelope only 21in. Is there an error here, or is the flannel meant to be stretched so as to be able to cover both sides of zinc? What thickness and kind of copper and zinc is the best to use? (an any kind reader give me an approximate estimate of total cost to make one as described with 100 cells? and the expense per hour of maintenance? What kind and thickness of paper is to be used between the cells?—F. YELWOC.

[44973.]—**Electric Light.**—What is the smallest number of cells and kind of battery that will give an electric light capable of lighting (for reading purposes, &c.) a small room 10ft. square, and 10ft. high, and the cheapest and simplest lamp to be used with the same? Would some kind reader give descriptions for making the above, and an estimate of cost?—F. YELWOC.

[44974.]—**Melting Scrap Zinc.**—Will some correspondent who knows kindly inform an old subscriber to your valuable paper of the best method of melting old scrap sheet zinc? Some kind of flux is required to make it run properly for casting rods for Daniel's battery.—S. H. M.

[44975.]—**The Carpenter Brake.**—Wanted, a short description of the Carpenter brake as now being tried in Germany.—A DRIVER.

[44976.]—**Brakes.**—Will someone kindly say if Clarke's hydraulic brake, tried at Newark in 1875, is in existence now? If so, where is it running or working? Also, was Kitson's steam-brake tried at Newark? I know it was in the programme, but I wish to learn if the engine 892 really went to the experiments.—A DRIVER.

[44977.]—**Hydrogen.**—I find it stated in Roscoe's "Chemistry" that hydrogen is rapidly evolved from ammoniac solution at 40° C. when Zn in contact with Fe

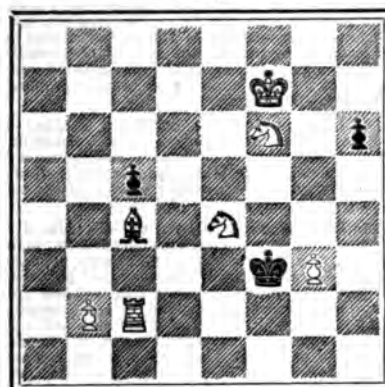
is placed in it. I have quite failed to obtain the gas by this method. Will some chemical reader suggest any possible causes of failure?—S.

CHESS.

ALL Communications for this department must be addressed Chess Editor, 22, Chancery-lane, W.C.

PROBLEM DCCII.—By C. PLANCK.

Black.

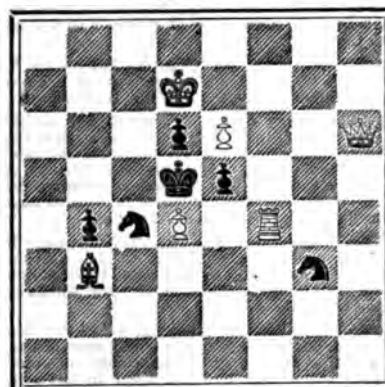


White.

White to play and mate in three moves.

PROBLEM DCCIII.—By G. J. SLATER.

Black.



White.

White to play and mate in three moves.

SOLUTION TO 697.

White.

1. B to Q 7.
2. Q to K 6.
3. Kt or Q mates acc.

Black.

1. Anything.
2. Anything.

SOLUTION TO 698.

White.

1. R to B 7.
2. Q to B 5 (ch).
3. Q or P mates acc.
2. P to R 7.
3. P makes a Kt mate.
2. R to B 6 (ch).
3. Q mates.
2. Q to Kt 5.
3. Q takes P mate.

Black.

1. K takes R or (A).
2. Anything.
- (A) 1. B takes R or (B).
2. Anything.
- (B) 1. P takes P or (C).
2. Anything.
- (C) 1. K to R 2.
2. Anything.

PROBLEM 700.—A Black Bishop is required on Q R 7 if this problem to avoid an obvious mate in two by 1. K takes Pawn.

PROBLEM 702.—This problem gained the first prize at the Preston Guardian Problem Tourney, which was confined to composers resident in Lancashire.

NOTICES TO CORRESPONDENTS.

CORRECT SOLUTIONS TO 697 by W. J. Jubb, S. L., C. Planck, W. W., and "Tri"; to 698 by W. J. Jubb, L. L., C. Planck (a little gem), W. W. (a beautiful and difficult piece of strategy), and "Tri."

S. L. C. (Marlboro').—Your solution to 695 is quite correct, but in 696 you have overlooked Black's only defence to stay the mate, namely, 1. B to B 3.

W. J. J.—See above as to Problem 700.

A. T. (Newport) and C. P. (Dulwich).—Contributions received with thanks.

"Tri" (Strood).—You should give more than one variation where there are several distinct ideas embodied in a composition. In 698, you only give one line of play

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, OCTOBER 14, 1881.

CELESTIAL OBJECTS FOR COMMON TELESCOPES.*

THERE can be no doubt that the publication of the "Celestial Cycle," of the late Admiral Smyth, in the year 1844, developed, even if it did not create, a taste for observational astronomy in this country which has borne, and continues to bear, the most remarkable and gratifying fruit. What, however, the "Cycle" did for units and tens, Mr. Webb's admirable little book has accomplished for hundreds and thousands; and it would be scarcely an exaggeration to say that by far the greater proportion of amateur observers in the United Kingdom at this moment owe their devotion to astronomy, and their power of contributing in a useful and enduring form to uranographical science, to the publication of the first edition of the work whose title heads this notice. The possessor, however, of that thin little 8vo. volume, into whose hands the present edition may fall, may well be excused should he be tempted to suppose for the moment that he has an entirely new work before him—so numerous have been the additions, and to such a degree has the book been rewritten. Let us see to what extent, and in what direction, Mr. Webb's work has been enlarged and improved. Such an examination may justify the recommendation which we here, in the outset, make to every possessor of a telescope who may see these lines: forthwith to become the possessor of a volume from which he cannot possibly fail to derive perennial delight and instruction.

The first modification which the work has undergone takes the form of the addition of a large number of double stars from Struve's Great Catalogue (together with others from those of his son and of Burnham), and of Nebulæ from Sir John Herschel's Catalogue; making in all, 1,500 fresh objects. The aim of our author in adding thus largely to his original lists is, as he tells us in his preface, to provide material for the possessors of the larger instruments now so general, which are removed altogether by their size from the category of "Common Telescopes," as defined by him in his three previous editions. In this portion of his work, Mr. Webb acknowledges the valuable help which he has received from a considerable list of eminent astronomers, a goodly proportion of whom, we are gratified to be able, en passant, to say, are numbered among our own correspondents and contributors to these columns.

Mr. Webb begins at the beginning with a description of the telescope, and (fully alive to the importance of a thorough acquaintance with his tools by the workman) gives ample instructions for testing, adjusting, and using the instrument in both its forms. Incidentally he speaks highly of the "telescope-house," devised by Mr. Berthon, and described and illustrated in our XIVth volume. Having thus familiarised the student with the apparatus which he will have to employ, the author proceeds to give a detailed account of (practically) all that is known of the telescopic aspect and physical structure of the various members of our own solar system. The amount of industry here exhibited is extraordinary, as note is made

not only of what we may call standard observations of the various heavenly bodies (such for example as those of Herschel, Pastorff, Carrington, and Langley, of the Sun), but records of out-of-the-way observations have been unearthed, wherever they appear trustworthy, and illustrate any fresh point of physical structure. Among such interesting addenda to descriptions to be found in most other astronomical works we may mention a complete catalogue of the transits of suspicious black spots across the solar disc, and details of abnormal appearances in and about the various planets, &c., disinterred from records to which comparatively few people have access. The chapter on the Moon supplies a charming introduction to the study of selenography; and the illustrative map, which forms the frontispiece to the work, is without doubt the best popular one which has yet appeared. We are glad to miss more than one name from it, which only tended to make Lunar nomenclature ridiculous. With the possible exception of No. 479, we can find no one among those retained in the list which has not a just and legitimate claim to appear there. In connection with names, we may here remark that in a very excellent chart of Mars which illustrates the description of that planet, we observe that Mr. Webb has taken the bull by the horns, and boldly adopted those given by Mr. Green to the various Areographical details in his monograph in Vol. XLIV. of the *Memoirs* of the R.A.S. Our Author's chapter on "Comets" will be read with considerable interest at present, when the sixth of those mysterious bodies which have visited us this year has just made its appearance.

In closing our notice of this section of the work, we must mention the one solitary error or fault which we have detected in the course of a pretty careful perusal of its pages. We refer to the method adopted of indicating the relative sizes of the planets. Mr. Webb speaks, for example, of Mars as being "only about twice the size of the Moon, and not much more than half as large as the Earth," the truth being that it would take seven globes the size of the Moon to make one of equal bulk with Mars; while Mars himself possesses only between one-sixth and one-seventh the bulk of our own world. In the same way Jupiter is said to be "Eleven times" and Saturn "Nine times" larger than the Earth, although, taking their diameters in miles, as given by the author himself, it would require 1,369 Earths to equal the bulk of Jupiter, and 668 to fill the same space as that of Saturn. The fact is, that he means that the *diameters* of the planets exceed, or fall short of, that of the Earth in the proportions indicated; but it is surely a very misleading way of speaking to talk of their "sizes" doing so. Size in ordinary parlance is invariably synonymous with bulk.

The third division of the volume under review is devoted to "Stars, Clusters, and Nebulæ," and is a very mine of information on the subjects on which it treats. As we have intimated in a previous part of our notice, 1,500 fresh objects have been added in this section of the book to the already extensive and typical selection contained in the previous edition. As must be known to many of those who will read these lines, the Constellations are treated of alphabetically by Mr. Webb; their contained double stars being first described, and the Clusters and Nebulæ following in a separate section. In addition, though, to this, every object is catalogued in its order of Right Ascension; which, being given, together with its Declination, and the page on which it is described, forms a valuable index to the Sidereal portion of the volume. There is a very curious table given, too, of the positions of "Starless fields"—i.e., void or blank spaces in the celestial vault. A third

appendix furnishes a large and interesting selection of Telescopic Objects in the Southern Hemisphere; and that admittedly great authority on the subject of meteor showers, Mr. W. F. Denning, closes the work not unworthily by an exhaustive table of all such showers as have been, so far, recognised.

Such is, what we feel to be, an inadequate account of a book which may fairly be described as a pocket encyclopædia for the amateur observer: a book which, so far as we are aware, has no counterpart, and has certainly no rival in any other language. The certainty that this new edition must be speedily absorbed by a large public, whose hungering and thirsting after it has been but faintly indicated indeed by letters which have appeared from time to time in our own columns, suggests to us, in conclusion, to say one word to the author himself. Eminence, like property, has its duties as well as its rights. He has himself created the want for a work, which has been, in the present case, but too tardily supplied. We can, then, only express a hope that the astronomical amateur will not be kept waiting as many years for Mr. Webb's fifth edition as he has for the fourth; but that it, together with the sixth, seventh, eighth, and so on, may make their appearance after somewhat more reasonable intervals than the fourth has done.

THE ECONOMICAL PRODUCTION OF OXYGEN.

IN an article on some possible uses of oxygen, which appeared in our impression for December 5, 1875, we referred to the processes of obtaining oxygen in an economical manner, which had been devised by Bousisingault, by St. Claire-Deville and Debray, and by M. Tessié du Motay. In the atmosphere we have an abundant supply of that valuable gas, and, for the last fifty years, chemists and others have looked for a cheap and easy method of separating it from its inert and practically useless companion, nitrogen, in order that it might be used for metallurgical processes where high temperatures are needed; for illuminating purposes, where a powerful and portable light is required; and for revivifying air in diving apparatus, as well as in underground workings. Tessié du Motay's method of obtaining oxygen from the atmosphere consists, to put it briefly, in absorbing it by means of a mixture of oxide of manganese and soda at a high temperature, and recovering it in the free state by the action of superheated steam, leaving the manganese and soda in a condition to be used again and again. That process has been actually worked in connection with illumination in Paris and Brussels; but probably with the advance of the electric light it has retired into the background. In New York, too, where its distinguished inventor settled, the process was employed for illuminating purposes—notably in the subaqueous workings at the East River Bridge, the quantity of oxygen "manufactured" being as much as 30,000 cubic feet per day, which was sold at fifty cents the foot. The gas was stored in iron cylinders, at a pressure of from 20 to 30 atmospheres, and was supplied to the theatres and to private persons who required either the oxyhydrogen light or the oxyhydrogen blowpipe flame. St. Claire-Deville and Debray devised a method by which sulphuric acid was decomposed into sulphurous acid and oxygen by the aid of heat; and Bousisingault proposed to obtain oxygen by converting baryta into the dioxide by heating in a current of air, and then decomposing the dioxide by a still higher temperature, using the baryta over and over again. This process is generally mentioned in the text-

* *Celestial Objects for Common Telescopes.* By the Rev. T. W. Webb, M.A., F.R.A.S. Fourth Edition. Longmans, Green and Co.

books with an addendum to some such effect as the following—hitherto difficulties pertaining to this method have presented its application in the arts. It is not a little singular that after Tessié du Motay's successful process has been utilised for some years—though it has never come into any extended use—the method suggested by Boussingault has been worked out to a practical result; but it remains to be seen whether the modification known as the Brin process will ultimately prove to be commercially valuable. We do not know why the price of the oxygen as made in New York was so high as 50 cents for a cubic foot; but it was stated, and there is no reason to doubt the statement, that in France the actual cost of production did not exceed 3d. for a cubic metre (a little more than 35 cubic feet). A lower sum than that was given at one time (see p. 86, Vol. XXIII.), but we prefer to take the higher estimate as the standard; so that if by the Brin process metallurgists can produce oxygen at less cost than by the Tessié du Motay method, it might be sold at much less than 50 cents a cubic foot, even allowing a large percentage for the cost of compressing it into the iron cylinders. Whether it is practicable to use oxygen in the furnace instead of atmospheric air with its 79 per cent. of nitrogen to be got rid of at a loss, remains to be proved; but it seems clear that, in the case of the blast furnace, as it is advantageous to use a hot blast instead of a cold one, it would be still more profitable to at least add a considerable percentage of oxygen to the blast, if it is found impossible to use oxygen alone to the exclusion of atmospheric air. According to Favre and Silbermann, taking as thermal unit the quantity of heat necessary to raise the temperature of a pound of water one degree centigrade (1.8 Fahr.), a pound of coke consumed by oxygen yields 7,000 thermal units, and a pound of hydrogen 34,462. A pound of hydrogen combines with 8 pounds of oxygen, but a pound of carbon needs only .27 pounds of oxygen for its complete combustion, so that if the oxygen is obtained from atmospheric air, not less than 36 pounds will be required in the case of hydrogen and 12 pounds in the case of carbon, simply because with each part by weight of oxygen in the air there are 3½ parts of nitrogen. In practice much larger quantities of air are admitted in the case of ordinary steam-boiler furnaces, owing to the condition of the fuel, the temperature of the furnace, and other circumstances, so that it is generally estimated that for every pound of fairly good coal from 15 to 25 pounds of air must be admitted, the furnaces with sluggish draught requiring the larger quantity. It will be seen then that an enormous loss of heat takes place simply in consequence of the 79 per cent. of useless nitrogen being heated up to the temperature of the furnace. In the case of the smelting furnace, it is obvious that the same principles apply, with the further possibility that the nitrogen is not without injurious action on the metal: hence there is much inducement to try the effect of a blast of oxygen, or, at least, the addition of a considerable percentage of that gas, to the ordinary atmospheric blast. The question naturally arises, What effect will the oxygen have on the refractory materials of the furnaces, on the crucibles, and on the other objects and substances which will be subjected to the intense heat? That remains to be ascertained; but it may be readily imagined that the cast-iron bars of an ordinary steam-boiler furnace would be speedily burnt. Still, when oxygen is used instead of air, the ordinary furnace will be modified and iron firebars will form no part of it. In metallurgy and other arts requiring high temperatures the use of oxygen or of oxy-

genised air has probably an important future, especially where from the nature of the processes carried on the requisite plant for the production of the oxygen will form only an additional apparatus. The cost of compressing it into iron bottles, carriage, delivery, and collection of empties will necessarily materially increase the selling price; but where the production can be carried on close to the place at which the gas is to be utilised, the Brin process promises to place cheap oxygen at the service of those who can find a use for it. In chemical factories, possibly in bleaching works, the process may be adopted with advantage, while there is always the steady demand for small quantities which are now supplied in bags and bottles. The process of preparing the baryta, as carried on by Brin Brothers at Passy, consists in calcining sulphate of baryta by mixing it with powdered charcoal and subjecting the mixture to a white heat, thus obtaining sulphide of barium. The contents of the crucibles are then emptied into water and dissolved. The solution is then transferred to iron vessels, in which it is treated with nitric acid, the hydro-sulphuric acid (sulphuretted hydrogen) which escapes from the apertures in the lids being burnt as it issues, in order to avoid inconvenience from its presence or its escape. The nitrate of baryta thus obtained is crystallised in the open air and dried. The crystals are then placed in covered crucibles and slowly calcined, the nitrous vapours being collected where the process is worked economically. When the calcination is finished, the result is caustic baryta, the substance which is employed in producing oxygen. Owing to its property of rapidly absorbing moisture and carbonic anhydride, the caustic baryta prepared as above is at once transferred to the retorts, or is placed in well-stoppered bottles for use as required. The cost of manufacture ranges from £4 to £5 per cwt.; but on a large scale it could no doubt be produced for much less. The substance above called caustic baryta is baric oxide, and it is claimed as the point of novelty in the Brin process; for, although Boussingault proposed to use it in the production of oxygen by first converting it into baric dioxide by passing a current of atmospheric air over it when at a dull red heat, and then expelling the absorbed oxygen by subjecting it to a much higher heat, it is asserted that he never made the baric oxide as obtained in the Brin process. That substance possesses the property of retaining the molecular state which enables it to absorb and afterwards to give up oxygen for a very long time—a condition, in fact, which facilitates peroxidation, and which, after four hundred successive reactions, exhibits no appreciable change in structure when examined under the microscope. On that fact rests the chief value of the process. As carried on at the Passy Works, the production of oxygen may be briefly described as follows:—The baric oxide is placed in metallic retorts—two nests of fifteen—heated by gaseous fuel, the temperature of the furnace being regulated and kept uniform by means of a metallic pyrometer, which, acting by expansion on a lever, controls the admission of air. Blowers are employed to drive air into the retorts when peroxidising the baryta, and vacuum pumps for assisting in the extraction of the oxygen when the preliminary process is completed. As is generally stated in the textbooks, the presence of a small quantity of aqueous vapour greatly assists the expulsion of the oxygen, and a saturator has accordingly been introduced into the plant to bring the entering air to the proper hygrometrical state; but in this case it will be understood that the aqueous vapour is introduced during the peroxidising stage. Only estimates are at present available as to cost,

but, judging by experience at Passy, 35,000 cubic feet can be produced in twenty-four hours at an expense of about 4s. per 1,000 cubic feet, which gives 62 cubic feet for 3d. as compared with the 35ft. obtained at the same cost in the case of Tessié du Motay's binoxide of manganese process mentioned above. If the gas can be sold, then, at prices which approximate to say, double the cost of production, an extensive demand would arise, and in cases where the oxygen could be used direct from the holder, its manufacture being carried on as part of the "works," it would appear to have a promising future. The question that will be asked, however, is, What effect has the gas on the metallic retorts, and on this point we have no information, probably because sufficient time has not elapsed to give a proper idea of the amount of repairs to the plant that will be needed.

THE ORGAN AND HOW TO MAKE IT.—XIII.

By J. DRESSEK.

Mutation Stops (continued).

ECHO Dulciana Cornet—is a mixture stop, generally of five ranks, the largest of which is 5½ ft. long, giving the fifth above the Diapason. Like all other mixture stops, the composition varies, and it may be of either the following intervals—viz., 5th, 8th, 10th, 12th, 15th, or 5th, 8th, 12th, 15th, 17th. In the first arrangement the third tone is an octave lower than in the second, where the third is a Tierce. Where such a stop as this is used there must be at least one 16ft. stop on the same manual.

In the following stops I shall merely give the intervals, as all the pipes are open metal, voiced like the Diapasons, and only the scale and power varied; thus the third sounding ranks are the smallest and weakest, the fifths next largest, and the unisons largest and strongest; there is, however, this peculiarity—viz., the various ranks do not begin on the lowest note and end on the highest, each rank as a rule breaks—i.e., begins to repeat itself—at some part of the compass, the reason for which is to give sufficient brilliancy in the bass and in the treble—first, to leave sufficient body of tone, and secondly, if some of the small ranks were attempted to be carried to the top all sound would be lost; as an instance, the FURNITURE is generally a two-rank stop sounding the 33rd and 36th above the Diapason; that is, three octaves above the 12th and 15th respectively; it usually, however, repeats itself every octave, and its only use is to give brilliancy to the general tone of the organ.

The following arrangements of mixture-stops are taken from "Hopkins and Rimbault," and so far as I have been able to examine some of the organs mentioned in that work, I find I may depend on their description.

Temple Church, London.

BUILT BY FATHER SMITH.

	Sesquialtera, III ranks.	Mixture, II and III ranks.
CC	17 19 22	22 26 29
Tenor C sharp	17 19 22	19 22
Mid C ¹ sharp	15 17 19	12 15
Treble C ² sharp	12 15 17	12 15
Treble F ² sharp	8 12 15	12 15

Rochester Cathedral.

BUILT BY GREEN.

	Sesquialtera, III ranks.	Mixture, II ranks.
CC	17 19 22	15 19
Tenor C	17 19 22	12 15
Fiddle G	15 17 19	12 15
Mid C ¹	12 15 17	8 12

Halifax Old Church Organ.

BY SNETZLER.

	Sesquialtera, IV ranks.	Furniture, III ranks.
CC	15 17 19 22	22 26 29
Tenor C	15 17 19 22	15 19 22
Mid C ¹	8 12 15 17	15 19 22
Mid G ¹	8 12 15 17	8 12 15
G ² in alt.	1 8 12 15	8 12 15

It will be seen from the foregoing arrangements, that all the mixture stops depend on the arrangement of the unisons, thirds, and fifths of the ground tone, and on the skill of the designer depends very much the effect of the completed instrument; as a general rule, mixtures are useless for chamber organs, although they are necessary to large Church or Concert Hall organs.

Reed Stops.

The pipes of this class of stops are entirely different to the preceding, as the sound is produced by a vibrating tongue of metal, instead of the wind passing through a narrow slit and striking against the upper lip of the pipe. The different shaped reeds were given in my paper of February 4th last, and fully explain the difference between open and closed reeds; but as to the exact advantage of either class I confess I am in considerable doubt. The closed reed is at the present time most in favour and is, certainly the easiest to voice; but those stops which should produce the full clang of the Trumpet are most successful if made with the open reed and those of the more quiet tone are better with the closed reed. At the same time very few rules can be given, if indeed any at all can really be given; the following can, however, be given as general rules.

Coronet—a stop of 8ft. pitch and of a full but smooth tone; the CC 8ft. tone should be 7in. diameter at the top, and the reed a closed one; the tongue should be nearly straight, so as to give a smooth full tone.

Horn has a tube similar to the above, but the tongue is rather bent outwards towards the vibrating end, which causes the clang peculiar to this class of stops.

Trumpet—the most popular of all the 8ft. reed stops. The diameter of the CC at the top is 5½in., although this varies from 6½in. to 5in. according to the size of the organ and the place it is to occupy. The reed is sometimes open, but now more generally closed; the tongue always is bent outwards, to get as much of the clang as possible. The clang is the ringing tone which is so remarkable in some stops; but if I am asked the why and wherefore of that tone, I must say I cannot tell: I can only say it is there; but no two voices go to work in the same way to produce the same tone; experience alone teaches, and that is the worst of it.

Oboe—a soft and sweet-toned 8ft. reed pipe. The tube is very thin for two-thirds of its length, and then finishes with a bell-mouth; the top of the pipe is two pipes less diameter than the Trumpet, and the tongue of the reed is nearly straight; the tone consequently is quiet and thin, and rather wailing in character. A plate of metal is usually fitted to the top of each pipe and soldered on half-way round, the other half is raised more or less for the purpose of equalising the power of each pipe. Occasionally the Oboe is made with a straight tube, and the top closed with a plate of metal; a slot is made in the side of the pipe and the metal turned down as in the Gamba.

Clarinet—Cremona—Corno-di-Bassetto: a stop of 8ft. pitch voiced to imitate the Clarinet. The peculiar tone is caused by the shape of the pipe, which is cylindrical and short, the CC pipe being only 3ft. long and 1½in. diameter.

THE ST. PANCRAS INDUSTRIAL EXHIBITION.

THE industrial exhibitions, of which there have been many of late, afford to a large number of artists, mechanicians, manufacturers, and their apprentices a field for the exercise and display of much talent and ingenuity that would otherwise remain unnoticed. Among the more important of these yearly displays, the St. Pancras Exhibition, in Drummond-street, holds a high position, and we have this time to record many new inventions or appliances connected with building, engineering, electrical and other lighting, machinery, and models. Sanitary plumbing is one of the directions in which the ingenious artificer may turn his ingenuity to useful account. Mr. S. Fairchild, of West Kensington, exhibits a plan for making our large mansions, at least, independent of the sewers. All the apparatus in the house is placed in a separate building or tower; there is a tube conveying fresh air from the top of the house to the drains, and another for the escape

of the gases, so that circulation of air is maintained, while all closets and waste-pipes are disconnected from the sewers. Valveless water-waste apparatus for flushing is exhibited by C. Maynard Walker, of High-street, Poplar, and we particularly dwell on an improved house sink-trap, by Dougald Leah, a tin-plate worker, of Kentish Town, which reduces to a minimum the disadvantages attending the ordinary scullery sink-trap. But Mr. Leah has several other very ingenious inventions which claim our notice. One of these is an improved kettle for spirit and gas stoves. This kettle, which in shape resembles the ordinary form, consists really of two bodies, an inner and an outer, the space or cavity between them being made to convey the heat and flame round the side of the vessel instead of only to the bottom, as in ordinary kettles of this kind. The heating-surface is thereby increased, and the time taken to produce boiling is reduced considerably. The circular cavity appears at the bottom as an annular opening about an inch from the outer edge all round, and it continues to the upper part of the kettle, just below the top, where a series of perforations allow free draught. Thus the kettle is an inverted cone. Another article of domestic utility is the same inventor's wine and beer tap. The object of the improvement is to keep an equilibrium of pressure on the liquid. A small indiarubber tube connects the tap with the vent, so that when the tap is turned on the vent is also opened, and the beer can be drawn. In this manner any vacuum is prevented, and no air passes through the tap, causing a gurgling noise as occasionally experienced with the ordinary tap. Both the tap and vent are also closed at the same time.

The improved ball-caster, by T. W. Barker, engineer, Brightlingsea, Essex, is a novel application of the universal ball principle; the weight is sustained centrally, and for heavy tables and other furniture is a far more scientific form of castor than the ordinary roller. In another part of the room we notice improvements in pianoforte construction, in which iron fronts are screwed to the wood framework. The exhibitor is W. G. Thomas, of Medburn-street, Oakley-square. A model of a revolving musical diagram, exhibiting the various keys and intervals with system of transposition, is shown by T. Blewett Pearce, of Hampstead-road; and T. W. Barker, engineer, of Brightlingsea, has a parlour pipe-organ of novel design. Among models of naval apparatus, we must call attention to Dougald Leah's invention for preventing collisions at sea. Extra "port" and "star-board" lights are attached near the ordinary lights, and these are made to turn to by cords connected with the steering apparatus, so that the act of steering opens the light on the particular side. Another apparatus is exhibited for steering vessels by G. Knowling, the object of which is to prevent "kicking." Mr. Leah also shows a clever method for launching boats, and a lifeboat and deck-seat for river steamers, which can be used when there is no time to lower the boat. We think the latter a useful and reliable mode of preventing accidents of the kind of which we have had many of late. T. W. Dalton's "passenger life-box" is a simple plan of making a passenger's luggage-box useful in saving life at sea, as it can be used either as a box or a lifeboat; while for a similar purpose we notice a luminous hood and whistle appliance which can be worn, by F. Dixon.

Inventions in connection with railway travelling are worth notice: One of these is an improved box for wheels by F. W. Dalton. T. W. Barker contributes a drawing of an improved brake, which is acted upon by chains and levers. According to this plan there are eight points of friction, but we refrain from expressing an opinion upon the merits of an invention which can only be judged by a practical trial. E. Paik's railway-carriage door substitutes a sliding for the ordinary hinged door, and we see a small model of an audible railway signal for use in fogs by Ernest A. Sullivan. A large model is also shown by D. Williams of a gas annihilator for coaling vessels, the object of which is to prevent spontaneous combustion. There are numerous other exhibits, including improvements in galvanic pendants for medicinal use, an alarum till for shopkeepers, a thermogenic incubator, water-heater, gas-fire and lighting stoves, but we pass on to some other objects.

Among the work contributed by skilled or professional hands we see some excellent responses in a clock-dial by W. J. Allard, also in iron by G. H. Hardiman, and embossed dessert-plate by W. Noel. Wood-turning is soantly represented, but wood-carving is a branch of art which never flags in exhibitions of this sort. The wood panels in carved oak and pine by W. Aumonier are masterpieces. E. T. Grove sends a walnut cabinet relieved by satin-wood, and we notice some excellent examples, especially the carving of birds by W. F. Jenkins, and some frames by T. Perrier, G. H. Bull, and a clock-case in oak by J. Burron. Of cabinet work there are a few good specimens. In the class of working models, we see a few painstaking and ingenious attempts: one a model of a two-ton steam hammer by E. F. Lacey, and another a working model of a high-pressure horizontal steam-engine by R. Venner, an interlocking apparatus for railway points and signals by G. G. Mackmurdie. Fret-work inlaid with porcelain and glass-painting, photography, oil, and water-colour drawings adorn the rooms. Among mechanical exhibits a 52in. nickel-plated bicycle, fitted with ball bearings and made of steel, by J. Stasman, must be noticed for excellent workmanship and finish. A safety gas-filter, for purifying and regulating gas-burners, is exhibited by W. J. B. Symes. An improved drill for making holes in sheet iron and other metals, made by Mr. G. Clutterbuck, of Clayton-road, Peckham, is well worth the attention of fitters and amateurs. The amateur exhibits are much too numerous to mention, and we can only draw the visitor's attention to the drawings in pen-and-ink; the mechanical designs, a few clever models, and the specimens of wood-carving, cabinet-work, and models contributed by pupils and others under the age of eighteen, which will be found in the upper room of the Institute.

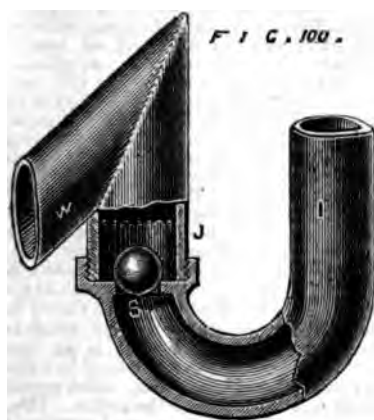
THE HOLLY SYSTEM OF SUPPLYING STEAM TO TOWNS.

THE system of supplying steam to towns for heating, cooking, and for engines, has been recently patented, so far as certain apparatus is concerned, by Mr. B. Holly, of Lockport, New York. In carrying out the object the method adopted is to use in a central part of the town a battery of boilers, from which steam mains are carried underground. Where the steam is used for power purposes in connection with steam-engines the exhaust can be readily utilised for warming, and in that manner the most economical results will be obtained. The object of the present improvements is to apply that principle of economy in connection with the whole system of steam mains, for which purpose double mains are employed, one for high pressure and the other for low pressure, and in connection therewith are automatic regulating valves, one form of which is shown in the figure. The mains consist of pipes, protected in any suitable manner to prevent condensation, and fitted at suitable intervals with service boxes to allow expansion and contraction. The high-pressure main takes steam directly from the boilers at a pressure of, say, 60 pounds; and the low-pressure main returns it to the boiler house at a pressure of, say, fifteen pounds. From the service boxes in the main, service pipes will pass to the buildings for supply of steam at high pressure to the engine. The exhaust steam is delivered to the low pressure main by a return pipe, and in connection with these supply and exhaust pipes is the automatic regulator valve shown in the diagram. The low-pressure pipe, D, connects with the high-pressure pipe, C, by a short section fitted with a screw valve at its connection with pipe C. At the upper end of pipe D is a valve, F, hung from a lever that is weighted to balance the valve. This valve F is between the pipe D and connection, so that when open steam may pass from the high to the low pressure pipe. It is a cylinder containing a piston connected with the lever; a pipe leads from the low-pressure pipe, D, to cylinder H, I is a pipe connected to the low-pressure pipe D, and provided with a valve hung from a weighted lever that retains the valve closed; L is a diaphragm in a chamber connected with pipes I and D. In case the exhaust steam from the engine does not supply the requisite pressure in the pipe D and main, such decrease of pressure will allow the valve F to be partially

with the most simple methods of making them:—

Fig. 99 represents one of these traps as I made them many years ago, and is very easy of construction. A is a piece of 2in. lead-pipe, worked over so as to receive the pipe I, which may be the inlet or outlet. This pipe is first shaved clean, then dropped through the flanged part F, and, with a turn-pin, opened a little, as shown at E, to receive the ball about one-third. This forms the seating, which *must*, of course, be true. Solder the joint at F. Put in an indiarubber ball (hollow if you choose, but if you can get a *pure rubber solid ball* it is better, as pure indiarubber always floats), wrap the ball in four or five thicknesses of tissue-paper, or even more; then work over the bottom flange G and fix the pipe W, which can afterwards be bent to the trap, as per dotted lines. If you wish the ball to float, you must take the pipe up high enough accordingly; on the other hand, if you require the ball to be at all times independent of floating action, you must turn the trap upside down and load the ball. In this case, you will have to form your trap in the pipe I, and can take the outgo off the side at H. In fact, this ball-trap can be worked in almost every conceivable way.

Fig. 100 is a simple ball-trap, as shown in



one of my patents of 1876, attached to the overflow of a valve-closet. This trap, which is shown upside down, is made as follows:—It was cast in one piece, as also the pipe I, but straight; this had the seating S cast upon it. It was cast in a mould something like a Couburge mould, the ball dropped in, and the trap sometimes soldered at J with a copper bit, &c. If the ball were required to float, a light ball was used, the pipe, I, left straight and the other way up; but on the other hand, if the ball is too heavy to float, the trap is formed in the pipe I.

In any case I is always the inlet.

To understand the action of these traps, suppose the pipe W, Fig. 99, to be bent up as shown by the dotted line D; that is above the ball-seating. It will be seen that water would lie in the bend and form a trap; consequently, if the ball is lighter than the water it will float, and as a further consequence, be forced up against the seating E, according to its buoyancy, and thereby cutting off all chance of sewer gases passing through this pipe. When the water is set running down the pipe I on top of the ball, it will send it whirling away from the seating, but when released from this pressure, it naturally again rises to its original position.

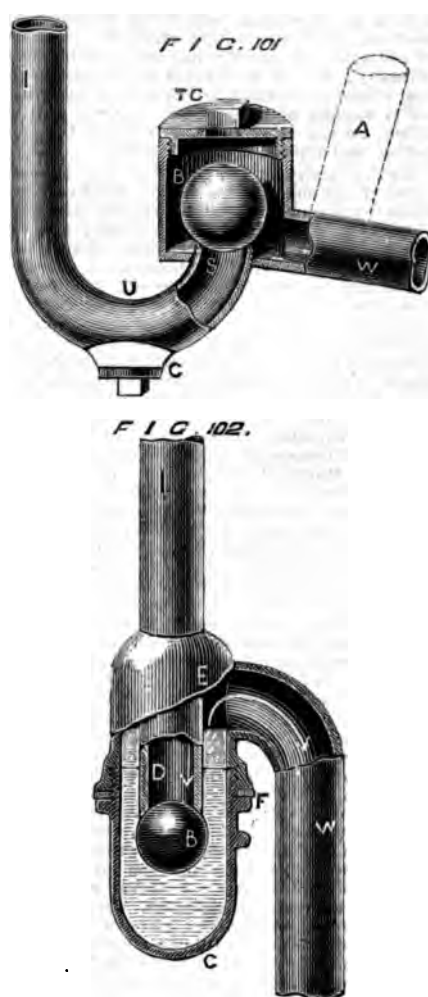
Now turn the trap upside down and bend the pipe I, as you did W, so as to form a trap, and wipe in the stump out-go H, so that the ball will be above the water-line. Now the action of the ball will be reversed, inasmuch as the ball will of its own gravity close the seating, and thus cut off all gas from passing between I and H.

Mr. Buchan's Ball-Trap.

This trap in principle is the same as the last described; but, as shown at T O, has a cap and screw, also at O and the vent-pipe A. The manner of making this trap is the same as described in reference to Figs. 99 and 100.

Bower Trap (Fig. 102).

The Bower-trap has lately had some little run upon it, which I imagine is owing to it having



been "pushed" into the market; but, be that as it may, the following is the description of it.

The top part, I E and W, is cast in one piece of lead, and the bottom O is made to screw on at F. O is generally made of glass, which I venture to suggest is very much against the efficacy of the trap, as under extreme temperature of either heat or cold (for instance, careless persons throwing down hot water in very cold weather) glass is very apt to break, and the glass once broken the trap no longer exists.

The shell of this trap possesses no advantages over Fig. 96; neither is there any superiority in the trap, if a small, solid india-rubber floating-ball is dropped through the cap and screw, and the overflow-pipe O branched into the pipe I.

(To be continued.)

COLOUR BLINDNESS.—I.*

By R. BEUDENELL CARTER, F.R.C.S.

Nature of Colour Vision generally—Solar Light—its Composition—The Prismatic Spectrum—Invisibility of Certain Elements of the Spectrum to the Colour-blind—Appearance of the Combinations of the Remaining Elements—Varieties and Definitions of the Resulting Colour Blindness.

IT is my intention, in this preliminary lecture, to speak chiefly of the nature of colour blindness; and, for this purpose, it will be necessary to pave the way by speaking of the nature of colour vision. The quality to which we give the name of colour depends entirely upon the kind of light which is transmitted through a coloured medium, or reflected from the surface of a coloured opaque substance. In order to make this clear, we must remember that we see surrounding objects only by virtue of the light proceeding from them, and that this light is derived, either directly or indirectly,

* The substance of a series of Cantor Lectures delivered before the Society of Arts.

from the sun. If we carry the matter a step farther, we find that what we describe as light is merely an impression made upon our eyes by vibration or wave movement; and that this wave movement occurs in an infinitely subtle fluid medium, called luminiferous ether, which pervades space, and fills the intervals between the molecules of all transparent substances. Just as water is a more mobile and subtle fluid than mercury, or air than water, or hydrogen gas than air, so this hypothetical ether is more subtle than hydrogen; and it is indeed so subtle that it transcends our knowledge entirely, except by its effects in the propagation of the waves of light. A study of the phenomena of light shows these phenomena to be of a kind which only wave movement can explain, and which bear a striking analogy to those produced by the visible waves of water, or by the invisible waves of air which we recognise under the name of sound. In the propagation of wave movement, it must be remembered, the particles which form the wave do not themselves travel, but only oscillate.

Now the light of the sun—and for the sake of simplicity we will exclude artificial sources of light from our consideration—produces wave movement of the luminiferous ether; and this wave movement, when it is interrupted by an obstacle, is turned back or reflected from this obstacle in a certain definite manner, dependent upon the nature and position of its surface. The human eye contains a mechanism by means of which the light waves which enter it are rearranged upon the nerve tissue subservient to vision, in a reduced reproduction of the pattern in which they left the obstacle, and so we are said to see the objects around us. What is meant by seeing, is that the vibratory movement of the luminiferous ether, being first rearranged within the eye according to the way in which it was reflected from the visible object, produces corresponding molecular movement in the nerve tissue, and this movement becomes the subject of consciousness. All vision depends upon the nerve tissue being made to vibrate in unison with the vibrations which constitute light. The light which we receive from the sun is white or colourless; and hence, if this light were pure and unmixed, so that it was reflected from all surfaces precisely as it fell upon them, subject only to more or less diminution of quantity from absorption or in transmission, the effect would be that the pattern or picture formed within the eye would exhibit differences of light and shade alone. The visible world would be deprived of colour, and would be reduced to the level of a "black and white" exhibition. In reality, however, the solar light is a mixture produced by the blending together of three different rates and magnitudes of vibration. The waves of largest size and of the slowest oscillation, when we receive them alone, produce a nerve movement which excites the sensation that we call red. The waves of intermediate size and quickness, when we receive them alone, produce a nerve movement which excites the sensation that we call green, and the smallest and most rapid waves produce a nerve movement which excites the sensation that we call violet. For the foundation of this discovery the world was indebted to the genius of Newton.

Material substances may be roughly divided in respect of light, into two classes; those which permit it to pass through them, and which are termed transparent, and those which obstruct its passage, and are termed opaque. We may probably assume that the interstices in the structure of the former are more fully charged with luminiferous ether, and are more favourable to its freedom of movement, than in the latter; but there is probably no solid, however transparent, in which the freedom of light vibration is so great as in air. We may assume, therefore, that light, in passing from air into any transparent substance, is retarded as regards the rapidity of the wave propagation; but whether it is modified in any other manner will depend upon circumstances, to which I shall now have to call your attention. Mr. Ladd will be good enough to throw a beam from the electric lamp upon the screen; and you will see that the other waves pass through the air unchecked, in a straight line, and make a luminous band, corresponding in shape to the slit of the lamp, upon the screen. He will now interpose a plate of glass, holding it at right angles to the course of the ray; and you will perceive that the luminous wave movement is continued through the glass almost as if it were not there. As soon, however, as he turns the glass obliquely to the ray, you will see a difference. The light waves no longer strike the surface of the glass fairly and fully, at right angles to their course, but obliquely, so that one end of each wave reaches the surface before the other. The consequence of this is that one end is more retarded than the other, and that the course of the wave is bent or turned. This is called refraction, and you will observe that, whereas the plate of glass held at right angles leaves the position of the bright line on the screen unchanged, the plate held obliquely bends the beam of light, and alters the position of the line.

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AYRTON'S METHOD OF COVERING WIRE FOR ELECTRICAL PURPOSES.

AN improved method of covering wire used for electrical purposes, has been patented by Prof. W. E. Ayrtton, of Cowper-street, E.C., which is of especial value where several wires are arranged alongside one another. In many industrial applications of electricity it is desirable to lay a large number of wires, either covered or uncovered, on a narrow space alongside of each other, and much inconvenience is experienced by reason of the difficulty in discriminating the different wires, and of the mutual induction caused by the several electric currents. In other cases, as in resistance coils, it is desirable to lay several convolutions of the same wire side by side in such a way that the whole has no external magnetic action and no self-induction. Professor Ayrtton's invention insures the easy recognition of any individual wire at any point by its distinctive position in the web or ribbon, provides an easy and certain means of destroying mutual induction when there are several conductors, as well as a simple method of constructing a coil of a single continuous conductor which has no external magnetic action nor self-induction. He finds that the relative insulation of the several wires from one another, or of the different layers of the same wire from one another, as well as of the whole from any metallic surface laid down on the web, to be as good as when the ordinary method of covering with silk, cotton, or other similar insulating material is employed. Further, the fixed arrangement of the conducting wires obviates crossing or twisting, thus rendering induction currents controllable, and therefore avoidable. This fixed arrangement also offers exceptional facilities for destroying external induction by surrounding a sending wire with the return wires of the same circuit, the simplest form being that in which the sending wire has one return wire on each side of it in the ribbon or web. The web, whether composed of a warp of wires and a weft of insulating material, or a warp of threads of insulating material and a weft of wire, may, if desired, be steeped in or passed through a bath of bitumen or melted paraffin-wax or of other similar liquid, and an extra security of insulation and solidity is thus secured. It may be rolled or twisted up sideways to be placed in the bath. The web or ribbon, in the flat state as woven, can be very easily painted with any fluid compound if desired, an ordinary paint brush being employed for the purpose, or the web or ribbon may be covered with gutta-percha, or with some similar substance, by being passed through a die where the compound is under pressure.

The practical applications of the invention are numerous and advantageous for simplicity and economy, as for instance:—In the present methods employed for communication by telegraph or telephone, the use of the ribbon will be extremely advantageous for enabling each wire to be easily discriminated at any part of the circuit, and for improving the working by enabling the mutual induction of wire on wire to be totally destroyed. Again, it is extremely important at the present time to be able to manufacture cheap and accurate resistance coils for schools and general laboratory purposes, which can be done thus:—The wire, which may be German silver, platinum, silver, &c., or simply copper or iron, if great cheapness of construction be desired, is wound bare on the shuttle and used as the weft, being woven backwards and forwards between parallel fibres of silk, cotton, or any suitable material employed as the warp. A sufficient length of such a ribbon having been cut off to give the resistance required, it is first brushed over with a flat brush dipped in melted paraffin wax or other suitable liquid, and then placed flat between a strip of paraffined paper, silk, or cloth rather longer than the ribbon, and of such a width that after having been folded double along its length it is a little wider. The whole is then placed in a strip of thin copper, brass, or other metal, a little longer than the paraffined paper, silk, or cloth, and of such a width that after having been folded double along its length it is a little wider than the paraffined paper, silk or cloth. Two short pieces of ordinary gutta-percha or indiarubber-covered wire having been soldered to the two ends of the wire contained in the woven ribbon, the edges of the doubled strip of metal are then soldered up all round, except just where the two leading wires protrude, at which places, by means of gutta-percha, indiarubber, or some adherent cement, the openings are closed up watertight. The whole strip may now be rolled up into any convenient shape without the employment of any bobbin, and from the mode of construction above described it will have practically no self-induction nor magnetic action. The whole or a portion of the apparatus thus made is now immersed in water of a known temperature, which temperature is rapidly acquired by the wire from the mode of construction employed. The resistance, whatever it may be, of the wire is accurately tested, and both the temperature and

the resistance scratched or otherwise marked on the thin metal case of the instrument above referred to. If then, whenever the coil is used, it be always put into a water bath of known temperature, and which, as above explained, is from the mode of construction rapidly acquired by the wire itself, its resistance, even when tolerably strong currents are passing through it, will be more accurately known than that of resistance coils as hitherto constructed, and its cost will be very much less. When the resistance coil is used for approximate measurements, or with not very strong currents, it will not be necessary to place it in a water-bath, since the temperature of the air will be sufficiently nearly that of the wire to enable the temperature of the air near it being employed in any estimate of the resistance of the wire. Or for the manufacture of resistance coils the wire may be used as the warp, and after a sufficient length of the ribbon has been cut off to give the required resistance, the ends of the first and second wires are joined together, also the ends of the third and fourth wires respectively, and the ends of the fifth and sixth, and so on, while at the other end of the ribbon it is the ends of the second and third, the ends of the fourth and fifth, &c., that are respectively joined together, so that all the separate wires forming the warp now constitute one continuous conductor. The strip of ribbon is then treated as before, in both cases no bobbin being necessary to wind the ribbon on.

When the ribbon is employed in the construction of the coils of galvanometers, electromagnets, &c., where the direction of the electric current in every convolution must be the same, the wire is used as the warp, and the ribbon may be so woven that at one end it turns at right angles to itself in the plane of the ribbon without discontinuity of any wire. This right angle piece is placed with one end slightly projecting, parallel to the axis of the bobbin if one be used, or parallel to the axis of the coil about to be formed, if no bobbin be employed, and the slightly stiff ribbon wound over it. After sufficient length of the ribbon has been wound on, the two ends of the ribbon are brought together, and a joint is made between the first wire at one end of the ribbon and the second at the other end, and between the second wire at the first end of the ribbon and the third wire at the second end, also between the third wire at the first end and the fourth wire at the second end, and so on. In making such a set of joints, Prof. Ayrtton has found it convenient, after slightly solidifying each end of the ribbon with melted paraffin wax, or other solidifying adherent, to cut each end of the ribbon obliquely, using a templet, so that the ends of the ribbon are cut symmetrically. He then scrapes off a small portion of the insulated silk or cotton, also obliquely and parallel to the direction in which the ribbon was cut, so that at each end of the ribbon there are a number of short ends of bare wire each of the same length; these bends at right angles to the direction in which the ribbon was cut, in order, as the length of the cut is longer than the breadth of the ribbon, to separate somewhat the bare ends, and make the subsequent jointing easy to perform. The joints are then made in the order described above. When in the construction of galvanometer, electromagnet, or other similar coils, he uses a strip of ribbon which has not been woven so as to turn at the end at right angles to the length, he merely folds the end (which would otherwise be straight) at right angles to the length, and proceeds as before.

In induction coils the wooden or ebonite separating discs or checks may be dispensed with, each section of the secondary coil being narrow and rolled on from a narrow tape containing a comparatively small number of wires, and each such section being separated from the next by a thin disc only of some thin insulating material, such as paraffined paper. In all telegraph instruments in which coils are used the application of the woven ribbon, instead of the ordinary covered wire, will greatly economise cost of construction, and facilitate after unwinding for examination or repair, since, even when the tape is quite narrow, the additional strength introduced by the group of wires composing it will prevent any one of them, even when they are quite fine, being broken in the winding or unwinding, whereas at present such breakage not unfrequently occurs from the strain in winding or unwinding being only on one wire. Again, when a break is found (from a flaw in the metallic wire or otherwise) to have occurred in a finished coil, the coil need not be unwound, but only the single wire in the ribbon in which the break has occurred, disconnected at its two ends, and cut out of the electric circuit. The invention is equally applicable to electrical condensers, whether interspersed with tin-foil or paraffined paper or not, and if the wire or wires be used as the weft in the weaving, or if used as the warp joined together end to end, exactly as in the manufacture of resistance coils described above, and a layer of tin-foil placed on the ribbon and rolled up with it so as to be everywhere close to the wire or wires, but actually insulated from them, then the

arrangement makes an excellent artificial submarine cable when the tin-foil is connected electrically with the earth. For the winding of the armatures of dynamo-electric machines and of the inducing electro-magnets, the ribbon may advantageously be employed.

CHILLING CAST IRON CASTINGS.*

THE surface part of a casting that is wanted to retain a certain shape, size, and smoothness, and to withstand a constant wear and tear, can, in most cases, be chilled when cast by having iron to form the shape instead of sand. The iron mould or chill when made of cast iron, should be of the best strong iron, having very little contraction, as the sudden heating of the surfaces by the melted iron is liable to crack it, so that in a short time the face will be full of small cracks or raised blisters. When melted grey iron is poured around or against the surface of solid iron, it is chilled from $\frac{1}{2}$ in. to 1 in. in depth, depending on the hardness and closeness of the iron the mould is poured with. In order to chill this iron as deep as 1 $\frac{1}{2}$ in. and upward, there must be some cast steel melted in the cupola. The proportion will depend on the quality of the iron and steel used. Steel borings can be put into the ladles and let the hot iron mix with them; but the best plan is to have some old steel castings or pieces of steel rails, and melt them in the cupola, and when the iron is in the ladle, mix or stir the metal with a large rod. With strong, close iron, about one part of steel to five parts of iron will cause a chill of 1 $\frac{1}{2}$ in. Iron for making chilled castings should be strong, as chilling iron impairs its strength. An iron that contracts very little in cooling is of the greatest importance in keeping chilled castings from checking or cracking.

I had reason at one time for studying the cause of chilled casting being bad. I was working in a shop where they made some small chilled rolls, about 10 in. in diameter and 14 in. long. The thickness of chill for chilling the roll was $\frac{3}{4}$ in. The top and bottom necks and webbers were moulded in dry sand. The job was given to me, and I moulded and cast three at a heat. Out of the first three there was only one good one, and I was told that I was lucky at that, and that the proprietors would give a good deal if they could make their own rolls, as they had to send away and pay a heavy price for them. These rolls had to be chilled 1 $\frac{1}{2}$ in. deep, as there were grooves turned in them for rolling bar iron, and when the grooves got worn out of true they were turned again. After studying the trouble over, I cast three more with good results, and from that on there was no more trouble with them.

Melted iron, when poured inside of a chill, similar to a roll or car-wheel chill, cools and forms a shell in a very short time, the thickness of which will depend on the hardness and temperature of the iron. It is during the course of the first two or three minutes that the checking or cracking takes place; for as soon as melted iron commences to cool or freeze, it starts to contract more or less, and as the shell thus formed becomes cool, or half-molten, it contracts and leaves the surface of the chill, so that the contracting shell stands, or holds in the pressure of the liquid iron inside. Should the mould not be dead level, the inside liquid metal will have the most pressure at the lowest point of the shell, and will cause this part to burst open. A check or crack never starts at the top part of a mould, but always at the bottom, and if you look closely at one of these cracks you will see it is the largest at the bottom, and running up to nothing. In some cases you can see where the inside liquid iron has flowed out, and partly filled up the crack.

I have often asked car-wheel moulders why it was they cooled their iron to a certain temperature, and they would answer: Because it keeps the wheels from cracking. Some days when they would have three or four wheels cracked, when asked what was the matter, they would say that the melter did not mix his iron right. So far as mixing the iron is concerned, it will stand a deal of variation, and it is a poor excuse for a moulder to put the blame on the melter for three or four bad wheels out of a heat of sixteen. If he would make a straight edge that would reach across the top and come down on to the turned level face of the chill, and then level his flasks instead of dumping them in any shape, I think the poor melter would not get blamed so much as he does for cracked wheels.

In making chilled rolls the temperature of the iron is as important a point as it is in the manufacture of car wheels. The iron should be poured as dull as possible, for the duller the iron the quicker and thicker is the outside shell formed, thereby offering a stronger resistance to the pressure of the inside liquid iron. Of course, the moulder must use his judgment in cooling off the iron, for if too dull the face of the chilled part will be cold shut, and look dirty. The rolls should be

* By THOS. D. WEST, in *American Machinist*.

poured quickly at the neck, and the gases cut, so as to whirl the iron and keep all dirt in the centre and away from the face of the chill.

When the mould is full, do not put in the feeding-rod until the neck is about to freeze up. When you do put it in, don't ram it down suddenly, so as to cause a pressure on the contracting shell, which would be liable to crack it. When feeding, work the rod slowly. It is better to make the chills as hot as possible, by heating them in the even, as the iron will lie closer and make a smoother casting against a hot chill than when poured against a cold one. By having the mould dead level, the pressure will be equal all around. Whenever there is a check or crack, you may depend that it is caused by unequal pressure of the confined liquid metal against the contracting shell.

THE DE MERITENS SECONDARY BATTERY.

AMONGST the interesting exhibits at Paris is a secondary battery or accumulator, devised by M. A. de Meritens, which is said to be superior to the Faure. In its first form it consists of a sheet of lead 2mm. (.08in. nearly) thick, folded and refolded on itself in such a way that the sheet at each fold is in contact, and a series of troughs are made. These troughs are entirely filled by sheets of lead 2mm. (.08in. nearly) thick, and placed in contact with each other and the inclosing sides. The leaves of lead foil are soldered together on one side, and a tongue is left to form a "pole." Two sections are placed in an ebonite box, separated from each other by a space of .5 cm. (.20in.) and form one element. Those forming a battery at the Exhibition are each 9 cm. wide (3.54in.), 10cm. (3.94in.) high, and 2cm. (.79in.) thick. The bath consists of dilute sulphuric acid. The battery is entirely of lead, and requires no protection in the form of cloth or felt envelopes, while the peroxide formed between the leaves by the current, is very firmly adherent, and is, moreover, from the arrangement of the battery, not liable to become detached. M. de Meritens has observed that the folded plate is of very little use in the battery, and is scarcely more than a dead weight, the thin leaves, 2mm. thick, doing nearly all the useful work. Each pole of an element will now be made simply of small strips of lead 2mm. thick, and 1.5cm. wide. Several thousands of the thin leaves (.08in. thick) will be placed upon one another in such a way as to form a rectangular parallelepipedon, one of the wider faces of which will be covered with the solder, and the strips forming the pole will be placed on it. In this way the weight will be considerably reduced, and the efficient surface largely increased. When once properly formed this battery is said to have a very large storage capacity compared with its weight, and it must be acknowledged that it is the simplest form of secondary that has yet been devised.

DRIED GELATINE FOAM.

AMETHOD of preparing gelatine in the state of foam—a state in which it can be indefinitely preserved, or be quickly dissolved—has been devised by Mr. R. Brooks, of Rockford, Mass.

The process consists in two essential steps: first, in subjecting a solution of gelatine in water to violent agitation, or to the action of air-currents under pressure, whereby air is mingled with the solution, and it becomes foamy; and, second, in evaporating the water from or dehydrating the foam by subjecting it to the action of cold, dry air. The first step, consisting in the introduction of air in a finely-communited state into a liquid solution of gelatine, may be accomplished in many ways. The solution may be subjected to stirring, beating, or any violent agitation which will mingle air with it and cause it to foam—a result due to its increased bulk, owing to the presence in physical combination of an infinite number of minute air-globules. In lieu of stirring, beating, or other agitation, the solution of gelatine may be subjected to the action of air-currents passed through it under pressure. The second essential step of the process consists in subjecting the foam resulting from the treatment of the solution during the first step to the evaporating or dehydrating action of currents of cold, dry air, whereby the water combined with the gelatine in solution is completely eliminated therefrom, leaving the pure gelatine in a very finely-divided state. In this condition it may be compressed and packed for transportation as the necessities of the trade may demand. In subjecting the gelatine foam to the action of dry air care should be taken not to burst or break the bubbles until the film of gelatine which incloses each minute subdivision of air is dehydrated and hardened. Therefore it will not do to allow air currents of much strength to strike the foam, as they would cause it to collapse and resume its

liquid form. The temperature of the air to be the action of which the foam is subjected should be only low enough to chill the gelatine film of each bubble and assist it in retaining its shape until dehydrated. It is obvious that, by simply subjecting the foam to still dry air, the desired results would be effected, only more slowly than when the air is in motion.

Dried foam of gelatine, thus prepared, dissolves with great readiness in water. At the completion of the process the gelatine is so completely dehydrated that it may be preserved unaltered for an indefinite period. The presence of water in gelatine, as is well known, is always attended with danger, as it is then more readily decomposed, and chemical treatment, to avoid such consequences, renders it unfit for dietetic uses and greatly impairs its value in the arts. One of the greatest difficulties in evaporating or dehydrating gelatine solutions lies in the fact that the gelatine is very sensitive to the changes in the temperature and hygroscopic condition of the atmosphere, and often large quantities are rendered valueless by such sudden and uncontrollable changes. This process of dehydration is entirely independent of atmospheric conditions, and they in no wise effect its successful prosecution. The chemical purity of the product has already been adverted to. Of its physical purity it is only necessary to state that, as the process is very rapidly carried on, and as the solution is not exposed to such an extent as it is when the old methods of evaporation are employed, there is no opportunity for dust and foreign substances to become incorporated with the gelatine product. While my process is adapted to be used in dehydrating all gelatine solutions, from whatever source they may be derived, it is peculiarly fitted to be employed in preparing for the market gelatine or ichthyocolla obtained from fish-skins, salted or fresh, and also from other fish tissues.

SCIENTIFIC NEWS.

ANOTHER comet is announced, this time by Mr. Denning, who first saw it on October 4, at about 3.15 a.m., while examining the region of Leo and Cancer with a 10in. reflector. Its approximate position on October 4, 15h., was R.A. 9h. 22m., N. Dec. 16°. Daily motion, 30 minutes east. Bright central condensation. Dun Eght Circular, No. 32, says that an identical telegram has been received from the Astronomer Royal; but it is not clear whether that was a repeat of Denning's, or whether the comet was also discovered at Greenwich.

Mr. Wesley, of 28, Essex-street, Strand, sends us Plate I. and the Handbook of Harrison's "Telescopic Pictures of the Moon." Mr. Harrison has, we understand, painted six pictures of the Moon at different phases, which are being reproduced in chromo-lithography. The plate before us shows the Moon 18in. in diameter, with the terminator at the crater Messier. The Earth-shine on the surface in shadow is well depicted. The handbook contains an outline-drawing, on which the objects are numbered, and descriptions given in the text. We understand that the other pictures will respectively be the Moon at five days old, first quarter, last quarter, Sunset at Copernicus, and "the last three days of the old Moon," terminator at Aristarchus. The paintings themselves have received high commendation from many American astronomers; and the coloured reproductions will doubtless meet with a favourable reception in the class-room.

The scientific lecturers this winter at the London Institution, Finsbury-circus, will be Mr. Grant Allen, Prof. H. E. Armstrong, F.R.S., Prof. W. E. Ayrton, F.R.S., Prof. R. S. Ball, F.R.S., Dr. Lionel S. Beale, F.R.S., Prof. R. Bentley, Mr. James Geikie, F.R.S., Prof. J. W. Judd, F.R.S., Prof. E. Ray Lankester, F.R.S., Prof. O. J. Lodge, Mr. John Perry, Dr. W. H. Stone, Mr. James Sully, and the Rev. J. G. Wood. Prof. Armstrong's subject will be "The Economical Use of Coal-Gas for Lighting and Heating"; Prof. Ayrton's, "The Storage of Power"; Prof. Judd's, "Are there Coal-Fields under London?" and Prof. Lodge's, "Electricity versus Smoke."

At the Warrington School of Science last week, Mr. C. M. Percy referred to perpetual motion in the course of his address on applied mechanics. No machine, he said, could create work. A steam-engine received power from steam and gave out work on the tram or the ship. A windmill received upon its sails power from the wind, and utilised this power in grind-

ing corn. A water-wheel by the power of falling water could turn machinery. But beyond this, the great obstacle to perpetual motion was that no machine could ever give out as useful work all the power which it received. There was a threefold loss if some work were expended in putting the machine in motion and overcoming its motion. All machines worked in some medium, such as air or water, and the opposition of this medium had to be overcome. Parts of machinery moving upon other parts generated a resistance called friction, and this friction required an expenditure of useful work to overcome it. For these reasons it was clear that not only could no machine continue at work without the addition of fresh force, but in all machines a considerable portion was exerted in the machine itself and was not available for transmission.

Rev. H. L. Maud, of Milverton, Leamington, writing to the *Times*, says that he has lifted 560lb. of fine table potatoes and a bushel of seed from a patch nine yards square planted in October last year. The sets were planted 9in. deep, and the tops made their appearance later than those of the spring planting, which in similar ground yielded only one-fourth the quantity.

The evening science lectures at Anderson's College, Glasgow, were commenced last week by Prof. Blyth, who in the course of his remarks said:—"But the electric light had so dazzled our eyes and filled our heads that there seemed to be little room left for seeing or considering other methods of converting mechanical work into heat and light through the agency of the electrical current. One such method in particular had been very strangely ignored—the method of lighting by the oxy-hydrogen light, where the gases are supplied by electrolysis. There seems to be no reason why our waterfalls and sources of power should not be used to fill gasometers with the separate or mixed gases oxygen and hydrogen, and then these led, like ordinary gas, to produce the brilliant oxy-hydrogen lime-light, or in some cases to produce for useful purposes the intensely hot oxy-hydrogen flame. Lighting by this method did not labour under the great disadvantage of being difficult to subdivide, and from some rough calculations which he had made, he considered that when the source of power was running to waste at any rate, it would be economical.

A series of trials with the Eames patent automatic duplex brake were made last week on the Barnby Don branch of the Great Northern Railway. The train consisted of a light tank engine, four coaches, and a van, and had a length, exclusive of the locomotive, of 147ft. The results of the trials were considered successful, one trial on the level showing a distance run of 218½ yards in a time of 12½ seconds, from a speed of 54 miles an hour, the rails being dry; but in another trial, at a speed of 49 miles, the time occupied was 19½ seconds, and the distance run 280½ yards, the conditions being the same. With wet rails one stop was from 44 miles an hour in 21 seconds, and a distance of 324½ yards. The brakes were drawn completely back with a vacuum of 16in.; when running a vacuum of 21in. was recorded, but on the application of the brakes it fell to 10 in. The train has been working with the brake-gear for two years.

The International Geological Congress meeting at Bologna, adopted on the 29th ult., a resolution in favour of confiding the elaboration of a general geological map of the world to a committee of seven geologists, the reporter and president to be Germans, and the other five to be selected from England, France, Italy, Austria, and Russia severally. The scale of the map is to be 1:1,500,000th of the natural size, the work to be performed in Berlin.

Some experiments have been made in St. Petersburg with electrically-driven pumps. One pump was for raising water into a fire-engine cistern; in ten seconds it could, says the *Times*, fill a cistern of 50 hectolitres (1,100 gallons), or give 800 to 1,800 (!) hectolitres of water in an hour. The other was a force-pump, giving 480 to 800 hectolitres of water in an hour, in a powerful jet. Though the dynamos were not worked to their maximum effect, there was an evident gain, an apparatus contained in a case which measured only about one cubic metre

furnishing the same amount of water as the strongest steam pumps. By simply turning the handle of a commutator, the circuit was closed for the actuating current. It is suggested that there should be a central generator of electricity furnishing a current at any time in case of fire, as well as for lighting purposes; and facilities should be given to connect promptly the conveyed machine with the conducting machine. [It will be noticed that the figures are rather remarkable, and it would be interesting to know how much the pump really did lift.]

Celluloid is being used in Paris for making stereotypes. The mould is taken with a special cement, which receives the impression and rapidly hardens. The celluloid sheet is then used to obtain the impression to be employed in printing. Celluloid has also been used for giving typographical representations of lace, the impressions being taken from the lace itself.

An alleged improvement by a Dresden chemist, Herr Nieske, in the new method of heating with acetate of soda, consists in mixing hyposulphate of soda with the acetate. The former melts more quickly than the latter, and retards crystallisation in cooling. Herr Nieske uses one volume of acetate with ten of hyposulphate. The cases are filled to the extent of three-fourths, hermetically closed, and kept in hot water, till one no longer hears a sound from crystals within, on shaking. The cases will then give an equable heat from ten to fifteen hours, according to size. A room-stove, acting on this principle, is described by Herr Nieske in the *Deutsche Ind. Zeitung*. It consists of an inner and an outer cylinder, the latter having numerous small holes. In the space between the two stand three of the heating cases. These can be easily lifted out by handles, and put into water in the central cylinder, which can be heated in position by means of a burner below (or removed to be heated elsewhere). This done, the cases are lifted into their places in the annular space. The stove runs on castors, and has a cover. The water in the inner cylinder furnishes, by evaporation, a wholesome degree of moisture. These stoves, and other apparatus of the kind, are supplied at a moderate price by Ederstein Brothers, in Dresden, and have already found considerable favour.

The publishing house of J. Springer, in Berlin, has offered a prize of about £50 for the best critical comparison of electric transport of force with the most common mechanical modes of transport. Memoirs may be written in French and English, as well as in German, but in that case translation must be authorised. The right of publication belongs exclusively to Springer. A jury, nominated by the Berlin Electrotechnical Society, will decide the award. Memoirs to be sent, in the usual way, to the President of this society, before Oct. 1, 1882.

The Russian military authorities lately decided to supply the cavalry with gun-cotton cartridges, instead of the old dynamite ones, for destruction of railways and telegraphs. Two kinds are used, moist and dry; the former constituting the greater part, and the latter being used as priming and inflamed with fulminate of mercury. The moist cartridges are kept and carried in wooden cases; the dry in zinc within wood and sheet-iron. Once a year, at least, the cartridges must be weighed and examined to see if there is deterioration. When a moist cartridge presents a brown-violet colour, it is necessary to use it without delay. When the dry kind show more than 3 per cent. of moisture, they are put aside.

A work on the Gymnotus, or electric eel, was presented to the Paris Academy the other day by M. Du Bois-Reymond. It gives the results of recent researches in Venezuela by Dr. Sachs, who went out some five years ago, at the suggestion of the Berlin physiologist, to study the creature in its habitat. Dr. Sachs had not completed the working up of his material for publication when, unhappily, he lost his life on a glacier in the Tyrol, in 1878. His work has been extended by M. Fritsch, with the aid of numerous specimens and preparations of the fish brought home. Among other things, M. Fritsch has succeeded in proving, with all but certainty, the development of the electric organs from striated muscles by metamorphosis. Various obscure points have been elucidated.

A strong and comfortable easy-chair may be easily made, as the *Scientific American* shows, from a barrel. This is cut off above the second hoop, so as to leave a complete back with half arms at the side. The barrel so cut is mounted on two strips of wood having castors under their ends, and brackets above to form the legs and add to the appearance of the chair. A head is fitted to the circular portion, and the whole is neatly upholstered.

Dr. Ceccharelli, we learn from the *Union Medicate*, has lately made an analysis of all the recorded cases of extirpation (complete and partial) of the larynx, and the results obtained. These operations number 30, and in 25 of them the extirpation was total. Eighteen times the reason of the operation was carcinoma (cancer); in the twelve other cases there was either no malignant tumour, or the nature of the lesion was unknown. The operation succeeded in 20 out of the 30 cases, being followed by cure; but nine of the individuals succumbed afterwards (at greater or less intervals), nearly always from recurrence of the disease. The author concludes that (1) extirpation of the larynx may now be regarded as a quite feasible surgical operation. (2) It should be done with the thermocautery. (3) It should be reserved for grave cases, where the lesion is not so extensive that the surgeon's knife is inadequate. (4) It should not be resorted to for malignant tumours. (5) It may be performed for carcinoma, but only when this is limited, when there is no soft cancer, and the disease has not yet brought general infection.

The Turkish Government is at present studying the question of electric lighting of the lighthouses along Turkish Coasts. A Frenchman, M. Michel, has been charged with the erection of the new lighthouses projected on the shores of the Red Sea. An International commission has met at Constantinople to fix the tariff of those lighthouses, which are greatly required for navigation.

An improvement of the Bunsen burner, by Herr Müncke, giving a large non-retiring flame of faint blue colour, and uniform high temperature, is described in *Dingler's Polytechnisches Journal*. A sliding tube is added which opens out funnelwise at the top, and has its mouth covered with a convex (paraboloid) piece of wire gauze, which divides the flame into a large number of small flames. On sliding this burner tube upwards, the inner cone of flames, at first fluttering and little coloured, becomes gradually smaller and more intense in colour, and at length disappears. In this state, the numerous little hemispherical bright blue flames burn on the surface of the convex head, while the large weakly luminous flame develops a very high temperature equally distributed. (The tube round the internal gas orifice has three longitudinal slits.)

In a note to the Paris Academy, M. La-roque describes an instrument for observing meteors, which may simultaneously appear in different parts of the heavens. It consists of a mirror having the form of a double pyramid.

The Municipal Council of Lyons has adopted the project of a tunnel traversing Lyons through-out its length, from the Pont Saint Clair to the Pont de la Gare, 2,200 metres. It is to be lit by electricity.

An interesting paper on carrier pigeons, by M. Tissandier, appears in a recent issue of *La Nature*. It gives sketches of a pigeon-house, and instructions for treatment of the birds, according to M. Van Roosebecke, who, a plain shoemaker in the Rue St. Martin, has given much attention to pigeon-keeping, and was one of the first to offer carrier-pigeons to the Government of National Defence, during the siege of Paris. He is President of the Columbo-ophile (pigeon-loving) Federation of the Seine (Department), which numbers 140 members, possessing some 3,000 to 4,000 carrier-pigeons. Since 1870 the Minister of War has encouraged such societies, offering as prizes for long flights valuable Sevres vases, and gold and silver medals. The City of Paris till lately gave an annual subvention of 1,000 francs to the Federation, and M. Tissandier regrets its withdrawal. Among remarkable instances of flight given by M. Van Roosebecke, it is stated that with a S.W. wind blowing, pigeons released at Bordeaux at 5 a.m. have often reached Paris at midday.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 81, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

* * * In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physics: a vice from whence great inconveniences derive their original." — *Montaigne's Essays*.

P XXIII. 100, 101 CASSIOPEIÆ.

[19299].—MUCH has been written in your pages touching this multiple star by Messrs. Sadler, Knott, and Perry (letters 16940, 17036, and 17088). In the *Observatory* for October, 1880, Mr. Burnham writes thus:—"In 1845, Otto Struve suspected the existence of a close companion to the principal star of this group, and in 1851 measured it with the 15in. refractor. Subsequently it was not seen when looked for, and, so far as I am aware, has never been seen since by anyone, until measured by me a few nights ago with the 18in. refractor of the Dearborn Observatory. It was very plain and easy of measurement, and, under favourable circumstances, ought to be seen with a much smaller aperture, perhaps 8in."

Mr. Burnham gives the following measure:—Pos. 342° 6'; Dis. 1° 26' — 1880-82 — mags. 6.0 — 10.5.

On the 1st of this month, the air being very steady, I carefully examined this star with high powers up to 750, but utterly failed to see Otto Struve's comes with my 8in. refractor. I distinctly and easily separated Dawes 2, and, not knowing the position angle, estimated it at 230°; Burnham, 225° 30' — Dis. 1° 36". Burnham's *d* (= Sadler's C, letter 16940) was rather difficult to see steadily. Perhaps some of your correspondents, with sufficient apertures, will kindly examine this star, and report, as I am not aware that Otto Struve's companion has been seen in England. The group is No. 18 of Burnham's "Quadruple and Multiple Stars." ENGLISH MECHANIC, Nos. 513, 514, 1875, in which there is a diagram of the principal stars. George Hunt.

Hopefield, West Dulwich, Oct. 8.

BRASHEAR'S SILVERING PROCESS.

[19300].—As one of those who have tried this process, I beg to record my experience. I have silvered successfully with several different formulas, including the sugar-of-milk, Rochelle's salt, Martin's and its modifications; but I like Brashear's best of all, because I have found it simple, easy, effective, and certain in result, and economical.

A few days ago I silvered a small mirror, and got a brilliant and firm film in twelve minutes without warming anything. The reducing solution improves by keeping. The potash keeps well in a stoppered bottle; it should be dissolved in the proper quantity of distilled water as soon as purchased. Pure potassa by alcohol should be semi-transparent; at any rate not opaque or powdery. The silver solution is best made fresh, and the silver nitrate should be weighed in glass pans, not metal. The mirror must be carefully and scrupulously cleaned, and all measures, silvering vessel, &c., washed out with distilled water, and not wiped before use. Excess of ammonia must be carefully guarded against, sufficient silver solution being added after all the ammonia is in to cause the bath to turn a clear yellowish brown liquid; this is important.

I find with Brashear's process that the solution turns black directly the reducing fluid is added. With Martin's, the change is more gradual, but only occupies a few seconds. Mr. Holmes has too much ammonia in his solution, which is doubtless the principal cause of his failure; as is shown by his finding it necessary to warm the solution, thus driving off a portion of the excess of ammonia. The ammonia dissolves the oxide of silver which has been produced by the action of the potassa, but if too much is present the reducing solution will fail in its object—that of reducing the silver to the metallic state. The speculum should be removed from the bath before quite all the silver is thrown down, as then the film is much brighter and requires scarcely any polishing.

The use of the acid is to convert the cane-sugar, or sucrose, to grape sugar or glucose; almost any acid will serve, but nitric seems the most effective.

known bicycle-maker) mentions a new arrangement of brake; but I may mention that I have recently applied a dodge to the driving-wheel rim or spoon-brake, that entirely takes the wind out of the sails of the objectors of the spoon-brake. It is so arranged that if the wheel is true or not the spoon equally presses on the tires, and is able to perfectly accommodate itself to the motion of the wheel if it wobbles a little, and hence does not tend to destroy the tires, as a rigid spoon-brake would if the wheel was out of truth. I think this plan will be of considerable practical benefit.

I have carefully re-read my letter at page 65, but I really cannot find the statement that I am stated to have made, "that the velocity of the rim of a small wheel is greater than that of a large one at the same speed." Surely "T. F." will not tell us that a smaller wheel does not make more turns to the mile than a large one, and that therefore its rim—i.e., the rim of the small wheel—is not revolving faster, the machine in both cases travelling the same distance in the same period of time. A 40in. wheel has a circumference of 125.66in., whilst the 56in. wheel has a circumference of 176.12in., or a difference of 50.46in. Therefore an equal point on the rim of the 40in. wheel must be revolving faster than a similar point on a 56in. wheel by the proportion shown; the machines both travelling the same distance in the same time. "T. F." will, therefore, see I am quite correct so far.

To "D. H. G." I would say that if the chain of a machine be engaging a given number of teeth in the pitch-wheel, and a given power transmitted from the treadles, if by enlarging the diameter of the pitch-wheel, and therefore enabling us to increase the number of teeth in contact with the chain, there must certainly be less strain per tooth than if fewer teeth were engaging; to say nothing of other questions of extra leverage proportionate to the ratio of the length of the arms of the pitch-wheel and the length of spoke of the drivers.

Referring to the question of the "Cheylesmore," the machine in question was bought but about six months since. It is a very fine machine in many respects, but I can easily heat it on my steel roadster, especially if it comes to a question of up and down hill riding.

Where our friend deals with the question of gearing, and in which he quotes my statement of "theory not being proved by practice," is he not getting a little "mixed"? I really cannot see that the quotation has any direct bearing on the "Cheylesmore," to which it would apply. If theory is disproved by practice, then so much the worse for theory. But whilst giving the "Cheylesmore" and other good machines their due, and though from the proportions of certain parts they are amply strong enough to withstand the working strain put on them, still, if the same amount of metal could be so distributed that the liability of fracture be lessened, and a gain on other points attained, then theory would not only be justified by practice, but a real benefit gained by the reduction of wear and tear and mention one item of benefit only. Sunlight.

[19307.]—MAY I suggest to C. F. Steel (p. 65), that his gearing (neat as it is both in design and drawing) might be made even more compact by substituting for the levers a cam action similar to that used in a screw-cutting lathe for throwing the split-nut into gear?

I fully agree with "T. F." on the spring questions. The designers of the springs at present in use seem to take into account only the vertical jolting, and to disregard the side "joggling," a form of motion not only distressing to the rider, but very destructive by its "racking" effects to the machine. "Joggling," too, is aggravated by the height of the seat above the axle-line, which, by the bye, is a point in favour of big wheels. If the seat is suspended from three points, they should be at the angles of a triangle, similar to that described by the points at which the wheels touch the ground. The following addition to the ordinary spring would, I think, be of service. To the centre of the upper plate of the spring rivet a disc, say, 3in. by 3in., through both bore a 3in. hole, and fit to it a turned bolt with lock nuts and a spherical head. Let into the under side of the seat a brass-plate with hemispherical recess to receive the bolt head, which would be held there by a 3in. washer round its neck screwed to the plate. Between the disc and washer place a thick round ring of soft rubber, and screw up with the nuts. These should be tightened when the rider is seated, and the rubber ring therefore compressed, and there should be a rubber washer between the nuts and under side of spring. I should be glad to hear if "Sunlight" has tested the tricycles referred to by him some time back, and particularly his opinion of big wheels speeded down. A few weeks ago one of "ours" inquired about left-hand steering. I should like to know why steering should not always be effected by the left-hand. Besides the analogy of horse-riding and driving, I think it would be pre-

ferable, as it would leave the right-hand free for those offices more naturally effected by the right hand than the left. It would also enable the rider, when pushing his machine, to walk on the near side of the road, and retain hold of the steering-handle, an obvious advantage with machines that have a single large driver. Faber.

MEDICAL REPLIES.

[19308.]—PALPITATION.—"Sufferer" (44941) asks me what to do in a case of permanent palpitation for a patient not yet out of her teens. I conclude that the patient is a female. If so and she is very pale, she will probably find cure in a bottle of "Wyeth's Dialysed Iron," which she can get at any good chemist's, and of which she should take ten drops on loaf-sugar twice a day for some weeks. Should aperient medicine also be required, take every morning, directly on waking, a breakfast-cupful of hot water with a pinch of ginger and a salt-spoonful of Epsom Salts. The Epsom salts may be increased or diminished according to the effect produced. Plenty of green fresh vegetables and of fruit should be taken, and some of "Fellot's Speciality Lime Juice Cordial" will be better as a drink than beer. It is very cheap, and one tablespoonful in a tumblerful of water makes a delicious and wholesome drink. If the Epsom salts cannot be borne, a compound rhubarb pill may be taken every night at bedtime; but the other is preferable in most cases.

Palpitation of the heart is a very frequent symptom, and often a very distressing one. It is due to one or more of three causes:—1st, Extreme nervous irritability, a condition which may cause it even in perfectly sound and healthy, but highly-strung, men. This is remedied by cultivating the habit of taking things easily and deliberately. 2nd, Disease of the heart, rendering its action inefficient, and therefore, laboured. For this cause the only remedy is reduction of the call made upon the heart, and the avoidance of all hurry, bustle, extreme fatigue, and excitement. 3rd, Disease of the blood. If the blood is watery (anemia), as is often the case with growing girls, the watery blood imperfectly nourishes the body, and carries an inadequate quantity of oxygen. The result is that in order to supply these things to the tissues, a very rapid circulation has to go on, and this amounts often to distressing palpitation. The measures I have suggested will cure most of these cases, and meanwhile the patient should adopt the measures suitable for an inadequate heart as described already, so that the heart may not be overtaxed and permanently strained during this temporary condition of anemia or diseased blood. James Edmunds, M.D., &c.

Grafton-street, Bond-street.

ON BLEEDING.

[19309.]—IN my last week's note on bleeding (19293) two typographical obscurities have crept in, which, if the article be kept for directions in workshops, should be corrected. In the second column "the tips of the wound brought accurately together" should have read—"the tips of the wound, &c." End of next paragraph should read—"the ends of the ligatures should be left to hang out of the wound." I might have added that in bleeding from the nose the blood often runs backwards into the throat, and is unknowingly swallowed and passes through the bowels as a tarlike evacuation. This occurs if the patient lies on his back while bleeding goes on. For nose-bleeding take the turpentine, apply ice-bladder over the bridge of the nose, keep the arms up over the head, and the head and shoulders well elevated.

Ice water might be injected into the nostrils as a last resort before plugging with sponge or cotton wool. The plugging should never be left in more than twenty-four or thirty-six hours, and syringing with carbolic acid water is the best corrective for the putrefying blood, which, with plugging, soon accumulates in the nostrils. J. E., M.D.

OBLONG BALLOONS.

[19310.]—MR. S. E. PEAL, in letter 19295, reveals the operation of his thoughts in arriving at the mistaken conclusion that an "oblong balloon is simply a means of increasing resistance." I will endeavour to set him right. He has confusedly joined together the questions of resistance, and the shifting of the centre of pressure. I will take the latter first. I read a paper upon the subject of the shifting of the centre of pressure on planes before the Aeronautical Society on the 23rd June, 1879, and my paper was published in the "E. M." in July of that year. My experiments proved that when a plane was moved at a good speed (in this case 20 miles an hour) at angles from 10 to 30 degrees, the centre of pressure occurred at a distance of 35 per cent. from the front edge, or 0.35 of the length of the plane, and when the plane was mounted on centres at this distance the pressure was balanced.

If Mr. Peal will refer back, he will see that my remarks are in entire accord with his as to the

centre of pressure. But this has nothing whatever to do with resistance to forward motion. There is no necessity for the oblong balloon to "broach to" as though it were a shot out of a cannon.

Suppose that a "globe" balloon of 40ft. diameter could be propelled at 20 miles an hour, say 30ft. per second. Its resistance would be 900lb., and it would require 120 effective horses' power to propel it at that speed. Its capacity would be 33,500 cubic feet. This would not "broach to," because it is all round alike; but its course would be very erratic.

Suppose, again, that an oblong balloon of 20ft. diameter were substituted for the above with hemispherical ends. The two hemispheres would require a cylinder 93ft. long between them to make the displacement 33,500 cubic feet. Now 30 effective horses' power would drive this at the same speed, 30ft. per second. We have thus by change of form reduced the resistance to one-fourth, but slightly increased the skin resistance, for which two or three additional horse-power would probably suffice. If this oblong balloon received its impulse from a similar source as an elongated shot, it would certainly "broach to" and go "broad-side on," as Mr. Peal says. But if its propelling power is in itself, with a rigid screw-shaft fitted in the exact centre of resistance, it will then keep its end-on course as well as an Atlantic steamer.

At page 66, No. 861, of the "E. M." the balloon now on view at the Paris Exhibition is described. There is no tendency in that to turn broadside to its course, and if the screw were placed right astern it would still keep its course. It would be better if the axle of the screw were in the line A-A, but it would be difficult to mount in so small a balloon; it being merely a scientific toy.

I take this opportunity of thanking Mr. Peal for the many results of observations made by him of birds in flight. The account of the bald-headed adjutant is very interesting. We could manage to make a model soar, if we could provide a steersman; but the want of this brings it down either head first or tail first. And to make a large soaring-machine, to carry an intelligent steersman, requires time, money, and private grounds—neither of which are very plentiful, as far as this problem is concerned.

Even if soaring were much resorted to, driving power must always be at hand for starting, stopping, or alighting, and other emergencies. No power whatever is required in soaring, except to very slightly elevate and depress the tail, as it becomes necessary, and it is constantly in requisition. Thomas Moy.

37, Farringdon-street, Oct. 7.

DIAGRAM FOR CALCULATING THE EFFICIENCY OF BRAKES IN STOPPING TRAINS.

[19311.]—THE very interesting diagram, published as a supplement to the *Engineer* of the 16th Sept., is another instance of the valuable method of representing graphically long and, in many cases, wearisome calculations.

Having received letters from several of your readers asking for information upon the subject, I think it will be an advantage to them if I give an idea of this diagram which was designed by the Westinghouse Brake Company, and, at the same time, explain how such a diagram is obtained so as to enable any person to construct similar diagrams for special purposes when they are required.

The best plan to compare the stops of railway trains, made with the help of continuous brakes, is to express, in pounds, the average resistance which the brakes create to the movement of the train, or, in other words, to express, in pounds, a constant force which would bring the train to a stand in the same distance in which the stops actually took place; but this force may be much more conveniently expressed in percentages of the weight of the train so as to eliminate this factor and establish thereby a common measure between stops with trains of different weights.

After these preliminaries it is easy to establish algebraically that which the diagram gives graphically. The momentum of a train at a speed of v feet per second, and of a weight P is $\frac{Pv^2}{2g}$, this momentum is destroyed by the action of a brake-force F acting over the distance of stop d , or $\frac{Pv^2}{2g} = Fd$.

To express F in percentages, x of the weight, P of the train, substitute $F = \frac{x}{100}P$, and the equation becomes $\frac{Pv^2}{2g} = \frac{x}{100}Pd$, or if transformed so as to express v in miles per hour, $x = 3.34 \frac{v^2}{d}$.

This formula enables the average brake-force exerted in making any given "stop" to be calculated, thus:—Suppose a train to be stopped from v

= 50 miles an hour in $d = 1,200$ ft. on the level.

We then find $x = 3.34 \frac{50^2}{1,200} = 6.95$, which means that the average brake force was 6.95 per cent., or nearly 7 tons for every 100 tons of the total weight of the train. To make a diagram of this formula is very simple, when we observe that it is of the form $y^2 = cx$, which is the equation of a parabola, when y and x are considered as variable.

If now, instead of putting y as the vertical distance, we put heights proportional to y^2 , or, in other words, if $y^2 = m$ is substituted, the equation becomes $m = cx$, which represents a number of straight lines if m and x are considered variable, and c a constant.

I will now refer to the practical use of the diagram. The horizontal lines are for speed; the ver-

at c for that purpose. The second b consists of a button, which can be shifted in a slot below the swell keys, in which it is fixed (see Fig. 2). The third consists of a movable back to the organ-seat; when the player leans back the swell is opened.

The first and third of these must be spring-swells; the second a balance-swell. All methods ought to have pneumatic action.

(2) "That the swell be adjustable." This arrangement is shown at Fig. 3. a is the pedal, c is a metal segment of a circle, the centre of which corresponds with the pivot of pedal. The edge of this segment is considerably roughened; b is a secondary pedal, hinged to the principal pedal, as shown in the cut, which is forced against the edge of c by means of a spring. To open the swell it is only necessary to press the pedal (a), and the friction between b and c will be sufficient to prevent pedal rising. To close the swell lightly, touch the

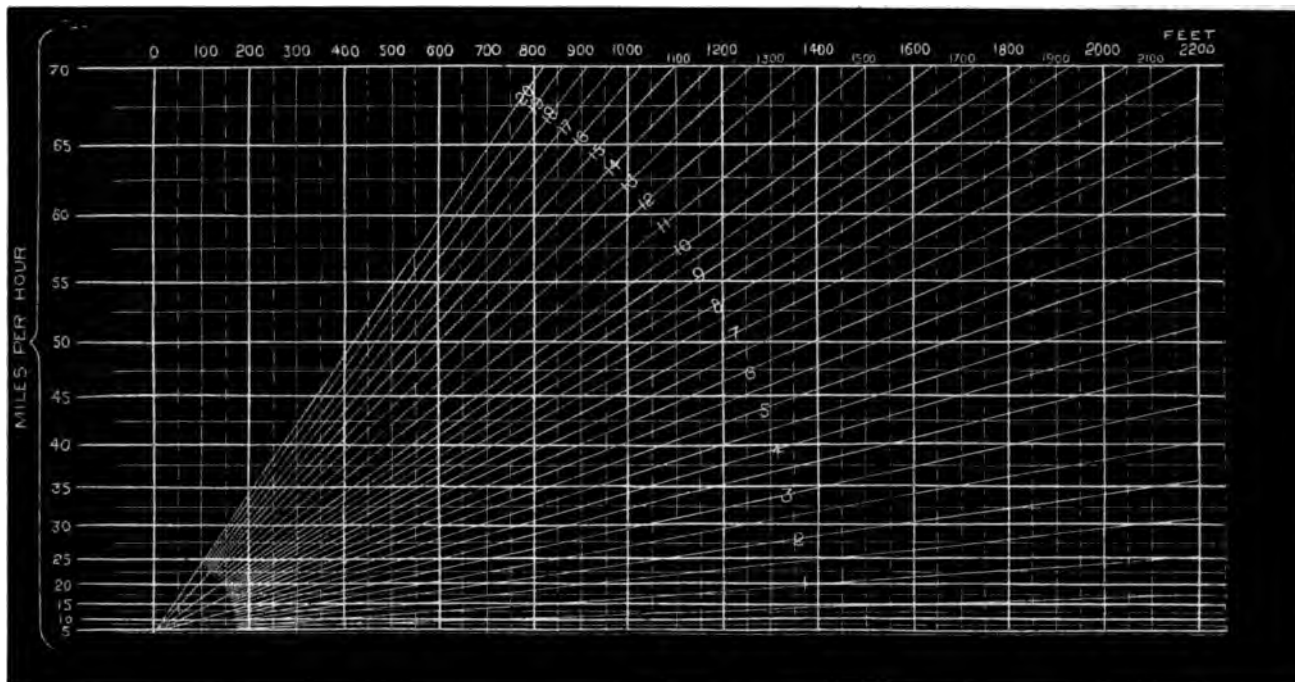
presses the pedal key. This method has the advantage of insuring a lighter touch.

I do not for an instant pretend that these arrangements are perfect, or even original; but I consider that, with perhaps a little alteration, they will all be found to answer their purpose well.

L. R. D.

A COMMON PARAFFIN-LAMP AS A SOURCE OF HEAT IN CHEMICAL MANIPULATION.

[1913.]—In pursuing a course of practical chemistry, it is highly essential that a source of heat of sufficient power and durability be at hand, and it is also a matter of considerable importance that it should be supplied at the lowest possible expenditure—both of money and material. To those, of course, who have gas at their command, the matter is simple enough; but to a large number of students



tical lines for distance, and the diagonal lines give the percentage of brake-force.

Taking the example given above of stopping a train from 50 miles an hour in 1,200ft., all calculations are rendered unnecessary, as, at the point of intersection of the horizontal speed-line 50, and the vertical distance line 1,200 we find that the nearest percentage-line is 7, which gives the brake-force required.

When stops are made at different speeds, it is usual to reduce them all to a standard speed of usually 50 miles an hour, in order to compare the distances run, and for this purpose the diagram is especially useful.

If a train running at a speed of 62 miles an hour is stopped in 940ft., the average retarding force will be found to be 13.6 per cent.; but to compare the efficiency of the "stop" it is necessary to know in what distance the train would have come to rest from a speed of 50 miles an hour under similar conditions. Upon referring to the diagram it will be found that the percentage line 13.6 intersects the 50 miles an hour speed line at a point which gives the distance required as 613ft.

A small diagram is also used, showing the influence of gradients in percentages. I need not, however, occupy your space further to-day, as in my letter, Vol. XXXII., page 244, I gave the required rules.

Clement E. Stretton.

Saxe-Coburg-street, Leicester, October 7.

THE ORGAN.

[1912.]—I inclose a few suggestions adapted to meet the requirements of the "Recommendations" of the College of Organists (v. letter 19105.)

(1) "That some method be devised to operate the swell by some means independent of the swell-pedal." There are three methods of managing this: (a) by the wrists, (b) by the thumbs, (c) by the body. The first (a) is accomplished by having an iron rod (a , Fig. 1), extending across the keyboard; this is supported at each end, by a brass or iron lever b , which is pivoted at d .

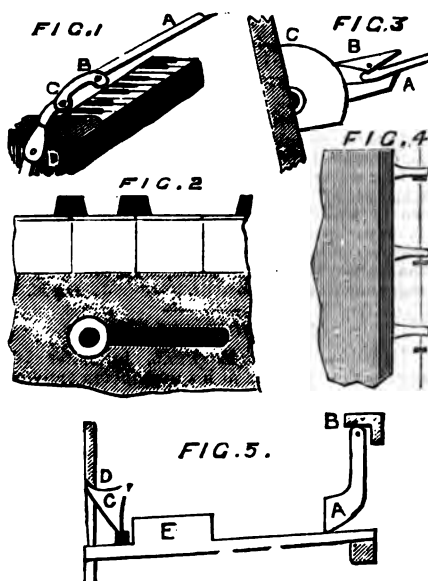
The player's wrists rest on this bar, and on pressing them down the swell is opened. This movement can (if desired) be thrown out of action by throwing back the rod a , the lever, b , being hinged

front end of b , and the pedal will immediately rise.

(3) "That some plan be devised to improve the crescendo."

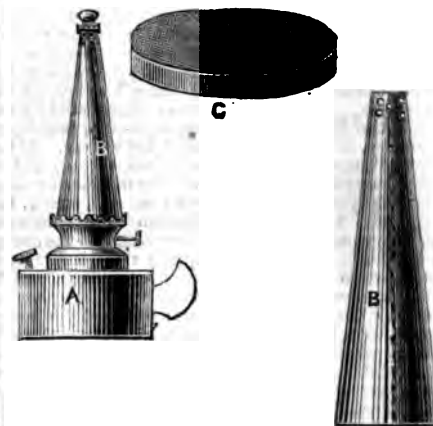
Fig. 4 will, I think, explain itself; by this means the louvres are opened gradually.

(4) "That pedal shafts be lengthened or raised at back, in order to facilitate legato playing." This



is in order to allow the player to change his feet on a short key. Fig. 5 shows two methods; c is the pedal, a is the second key, centred at b ; where it touches the key it is leathered and blackleaded. This key is played by the back of the heel; by the other method the key c , which is centred at d , de-

who follow a course of practical chemistry, the difficulty and expense is greater, to say nothing of unsatisfactory results. Spirit is the only, or almost only, substance that the generality of students can use, who have not gas, and the cost at least is 1s. per quart. Now, the heat generated by a common paraffin-lamp is very great, and, if utilised at the top of the chimney, no smoke is given off, and this is of immense importance, as all chemists know. The ordinary glass chimneys are useless for this purpose, as they invariably crack; but, by substituting a sheet-iron (or common tin) chimney, the heat seems to be intensified, and flasks, cruci-



bles, test-tubes, and other chemical apparatus may be readily heated without being smoked. I cannot say that this mode of obtaining and utilising the heat of ordinary paraffin-lamps is anything new, as some of "ours" may be already acquainted with it. It occurred to me, however, as being a powerful and economical source of heat, and I have made a chimney like the one figured in the annexed drawing. A is a tin container, to which an ordi-

nary paraffin burner is soldered, *b* is a conical tin chimney riveted together; *c* is a small piece of iron-wire gauze, that fits at the top of the chimney; a few holes should be made round the top, as they prevent any undue attraction of the flame towards the vessel being heated, which should not be allowed to approach the top nearer than half an inch. Paraffin-oil in Liverpool is only 2½d. per quart; it lasts longer than spirits. The flame can be regulated, and, for the distillation of water, the heating of drying-ovens, and various other purposes, has immense advantages over ordinary oil-lamps, and, in point of expense, over spirit-lamps.

G. H. Wilkinson.

IMPROVED COMBINATION LATHE. —II.

[19314.]—In continuation of my description in last week's issue of the new combination lathe in

block at one end in which two large holes are drilled, crossing each other vertically and horizontally. The upper slide is mounted on a spindle to fit these holes, and can be quickly set in either position (see Figs. 5 and 6) and held firm by the pinching-screw *D*. The hand T-rest and fret-saw table are held in the same manner; a hinge-block *E* to carry the tool is let into the upper plate of the slide, and works on the pin *F* with a clamping-screw *G*. A rack, *H*, is cast on the upper surface of the main slide, which is actuated by the toothed sector, *J*, of the rocking-bar. When used as a shaping-machine, the work-table *L.L.* is mounted on a stout spindle, and is held at any desired height by a set screw in the bracket *K*. *M* represents a piece of work that has to be shaped circular; it is mounted on an arbor, which is rotated by the worm-wheel *N*, actuated by the leading screw, and which is also the quick hand-traversing gear of the slide-rest; *O* is a back-centre for the

Fig. 8 shows an adapter, *c*, consisting of a tangent-screw, *d*, with a worm-wheel and arbor to fit into the socket *K*, and carrying the upper slide of the sliderest fixed by the set-screw *e*. If the tangent-screw be produced and connected to the leading screw by gearing, as shown in dotted outline in Fig. 7, then all sorts of annular and eccentric circles or arcs can be moulded under the drill; the arrangement of a pair of bevel wheels, as shown round *K* in Fig. 7, is somewhat similar in effect.

If, now, an eccentric cutter-holder, *g*, be placed on the drill-spindle, and the requisite adjustment for the pattern be given to the graving-point, and the drill-spindle be also moved to one side of the centre of rotation of the work as may be required, by the aid of the change-wheels, various relations of speed of rotation between the drill-spindle and the work can be arranged, and the eccentric cutter and work be driven at different speeds in the same

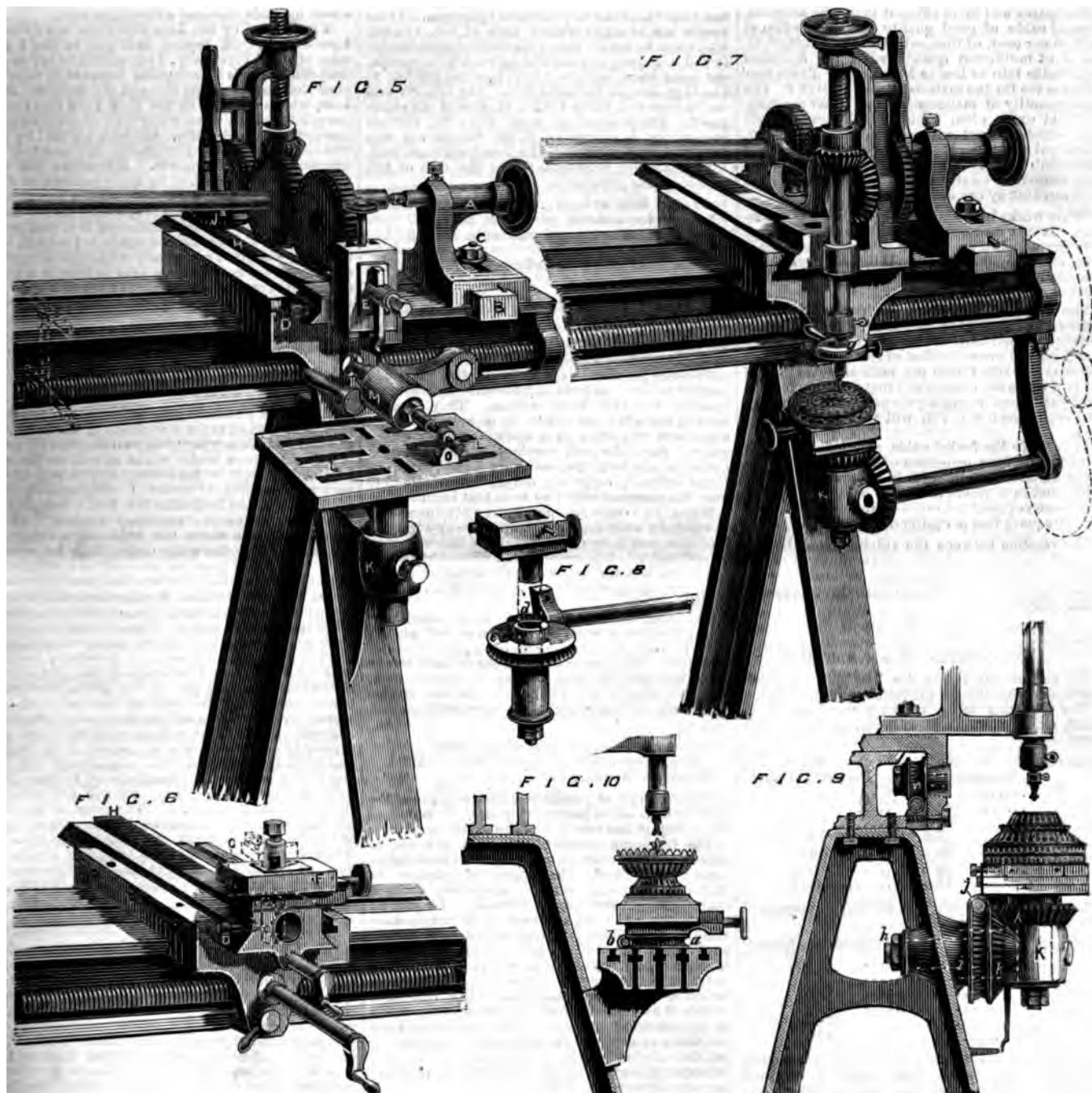


Fig. 6, I now illustrate a modification designed for cheap production and for the smaller class of lathes. In this pattern the bed is shown in single I-section; it may be with a gap, and have the headstock cast along with it. The back-centre *A* is clamped to the bed by a block *B* neatly fitted to its under-surface, which grasps the edges of the bed. This block has a vertical stem which slides in a cross-slot in the foot of the back-centre, so that the back-centre may be shifted or slid sideways on the block for taper-turning; the whole is firmly clamped together by the nut *C*. The slide-rest is designed with a long lower slide, and has a

arbor. In Fig. 7 the drill is shown brought to the front, and Figs. 8, 9, 10 illustrate various adaptations for the production of ornamental work. If the upper slide of the slide-rest (see Fig. 10) be provided with a worm-wheel *a* to the quadrant-plate, with a tangent-screw *b* (or some graduated arrangement may be substituted), and the work be fixed to the top of the slide-rest, a great variety of ornamental work can be done by cutters and suitable drills on the drill-spindle. The work can be shifted from the centre of rotation by the slide, and the drill itself be traversed for straight-line work or eccentricity.

or opposite directions. The graving-point will then produce the ovals, triangles, inside and outside loop patterns, &c., produced by the geometric chuck. Fig. 9 shows a further modification, which will enable work to be ornamented round the edges or at any angle by the drill, and within certain limits by the eccentric cutter. In this case the bracket *K* can be set to any angle, and hold the work in any position under the drill-spindle, and is clamped by the nut *H*; the work is rotated by the pair of bevel wheels *kk*. The bevel on the collar of the bracket *K* is driven by the tangent-screw *j*. It will also be possible to cut volutes and

spirals by traversing the drill by the leading screw with a requisite speeding between the leading screw and the rotation of the work.

Next week will be described some simple arrangements for shaping with small plain lathes.

J. A. Armstrong.

ON THE PURIFICATION OF COAL-GAS.

(Concluded from p. 117.)

SULPHURETTED HYDROGEN.

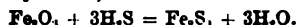
[19315.]—THE next part of the process is the removal of the bulk of the sulphuretted hydrogen, which is effected by some convenient form of hydrated ferric oxide—preferably that which is termed "natural oxide." There is also another form in use called "artificial oxide." For economical and practical considerations good natural oxide is the best, being both cheaper and more efficient than the artificial. Natural oxide of good quality should contain at least 65 per cent. of iron, calculated as $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$, and is of indifferent quality when the hydrated ferric oxide falls as low as 50 per cent. These percentages are for the material dried at 212°F . The usual quantity of moisture at 212° is 50 per cent. Artificial oxide often contains anhydrous ferric oxide which is inert with sulphuretted hydrogen. It is usual to lighten the natural oxide with about one-fourth part, by measure, of sawdust or refuse from tanneries. Artificial oxide is already mixed with sawdust by the manufacturers.

Oxide works best when in a tolerably dry condition. It may be necessary at times when it gets very dry and dusty to water it down and turn it over, but no more water should be employed than is needed to prevent the oxide running through the sieves.

The depth of material in each vessel is 36in., disposed in six tiers of 6in. each. This will give a capacity equal to 42 cubic yards of oxide for each vessel per million cubic feet of gas per diem. The quantity of oxide fouled per million cubic feet of gas is a variable quantity, ranging from four to eight yards, and averaging six yards. The average time each vessel will run will therefore be seven days.

To revivify the fouled oxide, as it is termed, it is spread on a floor composed of old slates (pinned about a foot off the ground) in a layer about 9in. thick, and in 48 hours it will be ready for reuse. The space required for revivification will therefore be 1620 square feet per million cubic feet of gas.

The reaction between the sulphuretted hydrogen and the hydrated ferric oxide is variously represented by different authorities, as occurring by either of the two following equations (neglecting water of hydration).



or,



The author has reason for believing that both reactions occur, though the former predominates.

The following table, showing the manner in which oxide accumulates sulphur, may be of interest:—

Times used.	No. 1. Per cent. sulphur.	No. 2. Per cent. sulphur.
2	15.8	19.7
4	24.6	32.6
6	31.2	40.1
8	35.4	45.7
10	39.5	49.8
12	42.4	52.3
14	45.6	55.6

A case in which oxide was worked on unwashed gas, gave following results:—

Times used.	Per cent. sulphur.
2	15.1
3	24.3
4	28.8
5	31.7
7	31.8
10	32.

It will be seen that after the 5th time of working the oxide became inert. The cause is to be found in the formation of compounds of iron with cyanogen. These cyanogen compounds are smaller in amount where the gas has previously been passed through lime.

The following estimate for the cost of purifying gas from sulphuretted hydrogen takes labour only into account, for the value of the spent oxide is generally considered as being equal to the cost of the new:—

Charging and emptying 6 yards at 1s. 3d. 90d.

Turning over and preparing for re-use

6 yards at 2d. 15d.

Per million cubic feet 105d.

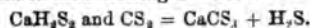
Per thousand cubic feet, say 1d.

CARBON DISULPHIDE.

This impurity is now extracted by means of calcium sulphhydrate (CaH_2S_2), which is prepared by means of the reaction between the sulphuretted hydrogen in the gas and lime, according to the following equation.



The sulphhydrate combines with the carbon disulphide in the following manner:—



Since carbonic acid attacks both the calcium sulphocarbonate and sulphhydrate, it is necessary that the gas be well freed from that impurity before entering the third pair of vessels. The same remark applies, with even more force, to oxygen. However, if one of the oxide vessels be well fouled, the iron sulphides therein will be sufficient to arrest the further progress of oxygen. For this purpose it is well to so work the oxide purifiers that there is as much foul oxide in action as is consistent with the due removal of the sulphuretted hydrogen. These vessels are charged with 6 tiers of 5in. of lime, which can be fouled at any convenient opportunity. It will not always be needful to work both vessels, one being amply sufficient to reduce the sulphur to 8 to 10 grains per 100 cubic feet. The other vessel can be reserved, ready fouled, in case of an emergency. The amount of work done by calcium sulphhydrate is enormous, if the vessels are well protected from the action of air and carbonic acid. The following is an estimate of the cost of this portion of the process:—

305 yard lime at 8s. 48d.

Labour for slaking, preparing, charging, and emptying 1 yard at 1s. 9d. 21d.

Per million cubic feet of gas 69d.

Per thousand " " say 007d.

THE LAST TRACE OF SULPHURETTED HYDROGEN.

The fourth and last pair of vessels should be worked with clean lime, six tiers, with 4in. on each tier, making a capacity of about 28 yards for each vessel per million cubic feet of gas. It is important to allow as little sulphuretted hydrogen as possible to enter these vessels. They can be worked one after the other, or separately, or one alone with the other as a spare vessel for emergency. Since the tests employed for sulphuretted hydrogen are, in most cases, very severe, it will be found difficult, especially during hot weather, to keep the gas absolutely free from that impurity.

When the vessels are emptied, it will be necessary to carefully wash them out to remove any trace of foul lime, and dirty sieves should be thrown out to be replaced by clean spare sieves. The dirty sieves can be washed and exposed to the action of the air for a little time, when they will be clean enough for reuse.

The exact manner in which these vessels are worked will vary with circumstances not always to be foretold, but always requiring great care and solicitude. The lime that comes out of these vessels is put into the first pair for use on carbonic acid. The following is an estimate of the cost of this final stage in the purification per million cubic feet:—

Labour for slaking, preparing, charging, emptying, &c., 1.4 yards at 2s. 33.6d.

Or say per thousand feet 03d.

The total cost of purification for gas made in the metropolis is about one penny per 1,000 cubic feet of gas, but in one case it is as low as 6d. per 1,000.

The foregoing process is effective, and can be depended upon if care be used to protect the sulphhydrate vessels from the action of oxygen or carbonic acid, and can be conducted without causing any great degree of nuisance. Of course, there must be a certain amount of unpleasant smell in a gas factory, though with care it can be kept from extending beyond the immediate neighbourhood. There are certainly some factories, such as manure-works, causing much greater nuisance than any gasworks. The carbonate vessels, if well driven off, are not offensive, especially in the absence of ammonia. The oxide vessels are not likely at any time to cause unpleasant smells, but the sulphur vessels are certainly always very offensive, though fortunately they require recharging only at very long intervals.

It is not at all doubtful that this rather complicated process may one day be substituted by one simpler, cheaper, and more efficient. There is such a process now being introduced, which promises to revolutionise gas-purification. It is the invention of two American gentlemen, Messrs. Lugo and Lees, and may be described in very few words. Its aims are—the removal of all ammonia, sulphuretted hydrogen, and carbon disulphide, and the practical removal of the other obscure forms of sulphur which the present process leaves untouched. It consists in adding about 1 per cent. of air to the crude gas at some convenient point on the inlet of the exhausting apparatus, and then heating the gas in a special vessel to a moderate temperature of

about 450°F . The gas is then passed through the purifying boxes, which are charged simply with animal charcoal. The gas will then contain no ammonia, sulphuretted hydrogen, or carbon disulphide, and merely a nominal amount of sulphur amounting to 2 or 4 grains per 100 cubic feet. Of course, when the removal of the carbonic acid is desirable, the gas can be afterwards passed through lime in the ordinary way.

The following are the advantages claimed for this process:—

There is no washing required, which is a troublesome operation, and is detrimental to the illuminating power.

The process is continuous; the labour being but nominal, since the vessels containing the charcoal require cleaning out at very long intervals.

As a means of sulphur-purification, it is superior to the process at present in use, as it easily reduces the obscure forms of sulphur one half.

Freedom from nuisance; the spent charcoal having but a very faint smell, similar to that possessed by oxide material a few times used.

It is asserted by Mr. Lees that there is a gain of 4 per cent. in bulk beyond that due to the 1 per cent. of air. Personally, I am unable to say more than that there is a perceptible increase in volume after the gas has passed through the charcoal. Mr. Lees, who is engineer to the New York Gas Company, informs me, when water-gas, which is largely charged with naphthalene, has been purified by his process, that the objectionable hydrocarbon is conspicuous by its absence. Altogether, the invention, which is covered by many patents, is full of promise, and will, no doubt, take a prominent place in gas-manufacture; especially where sulphur purification without nuisance is a desideratum. The whole of the ammonia is found in the charcoal, combined principally with sulphuric acid, and can be washed out from time to time in a concentrated form. The charcoal accumulates in course of time a large percentage of sulphur, which is recovered by a process that also revivifies the charcoal so as to admit of its re-use.

Beckton, London, E. Lewis T. Wright.

CONTINUOUS BRAKES RETURNS.

[19316.]—I NOTICE in your article, p. 77, you say that, with regard to the statements of the Brighton and Midland Co.s, you "fail to understand" how the Westinghouse brake works so well on the one line, and so badly on the other. If you will allow me a small portion of space, I will explain. On the Brighton they look after the brake, but on the Midland it is indeed "carelessly treated." You mention one case where the triple valve froze on the tender; now the water ought to be let out of the bottom cup of these valves every now and then: in this instance it had not been done, the water then froze; hence the failure. Another case, on January 29th, I can also explain. The express was made up of two engines, and equal to 19 vehicles; there were no brake-blocks on either engine-wheels, and the five front vehicles were all fish-vans, having brake-pipes only, and no brake-blocks; the driver of the second engine put on his brake very suddenly, and before the leading man had shut off steam. Now, Sir, you will see that as the fish-vans had only pipes, all the brake-power, with the exception of one tender, was at the rear of the train, and when I tell you that the couplings of the G. and S.W. vans were afterwards found to have had flaws half through the iron, you will not wonder that the train broke loose. The great delay was not caused through the brake, but in consequence of the "signalman" not allowing the engines to return into the tunnel to fetch the train. No doubt he acted for what he thought safety, but he caused a very great unnecessary delay. A Driver.

SIX-COUPLED TANK ENGINES.

[19317.]—I NOTICE in your issue of this week a letter on the subject of Metropolitan District engines, from "E. L. P.," in which he suggests a type of engine for working that line having six-coupled wheels, and a pair of trailing wheels with radial motion.

It may interest your correspondent "E. L. P.," and your readers generally, to know that on the L. and Y. Railway engines of the above type have been used since the early part of 1880. The first were four rebuilt goods-engines, Nos. 22, 26, 30, and 333, each having six wheels coupled, 4ft. 10in. diam., and cylinders 15in., 15in., 16in., and 16in. diam. respectively, and 24in. stroke. They have had new boilers and a pair of trailing wheels added, which are fitted with Mr. Webb's radial motion. The tanks are at the sides and the back. In proof of the satisfaction these engines have given, new engines of the same type have been built in two classes—one for local passenger service with driving wheels 5ft. 1in. diam., and another for shunting with smaller coupled wheels. The cylinders and wheel-bearings are inside. One of the three engines sent by the L. and Y. to the Stephenson Centenary Exhibition was of this type.

With your permission, I hope to have something further to say with respect to the L. and Y. engines at a future time.

Oct. 8.

R. N. H.

STATICAL PROBLEM.

[19318].—No algebraic solution of the general problem (18838) is possible, as it depends on an equation of the sixth degree: for any particular case, however, the coefficients occurring in this equation can be calculated and the solution then obtained by any of the known methods of approximating to the roots of an equation: but the necessary calculations are very long and tedious.

The mechanical condition is

$$W_1 \cos. \beta \sin. \delta = W_2 \cos. \gamma \sin. \alpha,$$

when A, D are the points from which the weights W_1 , W_2 hang, B, C the points (in a horizontal plane) to which the string is attached, and α , β , γ , δ the internal angles at A, B, C, D.

If $BC = a$, $CD = b$, $DA = c$, $AB = d$, we have the geometrical conditions—

$$a^2 + b^2 - 2ab \cos. \gamma = c^2 + d^2 - 2cd \cos. \alpha$$

$$a^2 + d^2 - 2ad \cos. \beta = b^2 + c^2 - 2bc \cos. \delta,$$

so that the mechanical condition becomes

$$bW_1 \sin. \delta (a^2 - b^2 - c^2 + d^2 + 2bc \cos. \delta) =$$

$$dW_2 \sin. \alpha (a^2 + b^2 - c^2 - d^2 + 2cd \cos. \alpha).$$

Now we have by projections

$$BD \sin. \delta = BO \cos. \alpha, BDC + DO \sin. BDC$$

$$BD \cos. \delta = DO \cos. BDC - BO \sin. BDC,$$

when BO is drawn perpendicular to DA; hence we can express $\sin. \delta$ and $\cos. \delta$ directly in terms of α , since $BO = d \sin. \alpha$, $DO = c - d \cos. \alpha$, $BD^2 = c^2 + d^2 - 2cd \cos. \alpha$, $2bBD \cos. BDC = b^2 - a^2 + BD^2 \sin. BDC = 1 - \cos. BDC$.

If we put these values in the above condition and take $c^2 + d^2 - 2cd \cos. \alpha \equiv e$, instead of simply $\cos. \alpha$, as the quantity to be directly determined, we get the equation

$$(BD^2 - AD^2 - KA^2 + K^2) \sqrt{-D^2 + 2Ce - e^2} = (BD^2 - BC^2 + C^2 - e^2) \sqrt{-B^2 + 2Ae - e^2},$$

wherein $A = a^2 + b^2$, $B = a^2 - b^2$, $C = c^2 + d^2$, $D = c^2 - d^2$, $K = 2 \frac{W_2}{W_1} + 1$, and on squaring

and reducing it takes the form

$$e^4 + pe^3 + qe^2 + re^2 + se + t = 0,$$

where p, q, r, s, t are known functions of a, b, c, d . A real value of e , and so of α , can then be obtained by Newton's method of approximation, and β, γ, δ are then given by the geometrical conditions.

Long as this exact calculation is, it is not really longer than that required by "M.I.C.E.'s" method of solution (19041); for in the latter the magnitude of one of the angles has first to be approximately determined by a tentative graphic process, then the magnitude of another has to be approximately found by a method of approximation which is long if a certain quantity H is not large compared with another quantity 2Δ which may range between 0 and $\frac{1}{2}$, and then a series of nearer approximations, alternately to the two angles, is to be made.

R. E. B.

PRODUCTION OF ELECTRICITY IN THE BATTERY.

[19319].—The difficulty which "W. T. R." (19231, p. 66, and 19292, p. 116) finds in explaining the source of electricity from a gas-coated plate arises from a very common cause: it arises from observing without measuring. Whatever debate may exist as to the theoretical source of electricity, contact or chemical, one thing is certain, current—that is, motion of electricity, can occur only with expenditure of energy, and that energy must be derived either from chemical action, which gives up energy, or from surrounding space by means of a lowering of temperature in the liquids themselves. Now, when we insert in a liquid a platinum plate coated with a gas opposed to another plate considered neutral, we have many phenomena to consider. The liquids inevitably contain dissolved gases; if sulphuric acid is employed, it is pretty certain to contain either sulphurous or nitrous acid: in fact, there are numerous chemical actions possible to be set up under the conditions created by an electric circuit. When "W. T. R." says, "The gas seems to be transferred, thereby producing electricity," has he examined whether this is the fact? Is the new coating of the same nature as the first? Above all, is it equal in quantity? This last would be the case, if it were a transfer only, whereas a chemical action might very possibly absorb half and transfer half, or other proportions. Such examinations are extremely difficult, because the action is so infinitesimal. The oxidation of one-hundredth of a grain of hydrogen would maintain a current for hours, or even for years, which our instruments would easily make manifest, and even measure. Therefore, the observation that no fresh chemical products appear, amounts to nothing. No test would indicate the presence of products resulting from what would be considered a large current. It is useless to attempt to base theoretical ideas upon infinitesimal actions. We must

work upon such a scale as permits exact measurement of all the conditions. Till "W. T. R." can produce a measurable current, set up without accompanying chemical action, it is really very venturesome of him to "doubt" what all experience shows, viz., that no current is ever produced in any battery without an equivalent chemical action, which sets free energy equivalent to the electro-motive force developed.

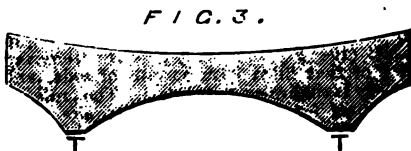
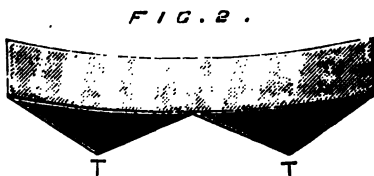
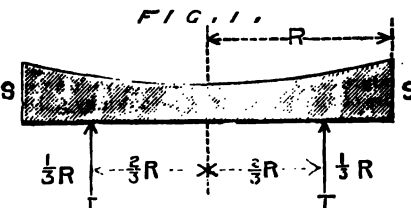
Sigma.

FORMS OF SPECULA.

[19320].—MR. H. A. WASSELL'S letter (pages 66 and 67) greatly interests me, as I have myself been working in the same direction, my idea being to try and devise a form of speculum that should be rigid by reason of its own form, and not by reason of any extraneous support it receives in the cell.

Before dealing with the form required, I must have a word on the usual cell-arrangement. Am I not right in considering it a mistake to support the speculum during grinding and polishing (the latter more particularly) in a different manner from that in which it will eventually be supported in the telescope? It seems to me that the speculum ought to be polished (at least) in the identical cell in which it is to be used, in order to insure (as far as possible) that it shall retain the figure given to it by the polisher.

Next, we come to the question of the best form to resist flexure. Suppose we assume the speculum to be divided into a number of sectors—say, a dozen, then each of them will be nearly triangular in shape, and therefore the centre of gravity of each sector will be nearly at one-third the radius from the outer edge. Consider the centres of gravity to be connected by a ring, then the radius of this ring will be two-thirds the radius of the sector or of the speculum. In Fig. 1 let SS be the



section of the speculum, then the position of this ring will be that marked by the arrows T T. Again, we may consider each sector as a beam balanced at its centre of gravity, and tending to deflect at each end, and to counteract this tendency we must introduce the stiffening-rib, as in a bracket or corbel. We thus arrive at a speculum of this form (see Fig. 2), where the speculum is shaded by elliptical lines and the brackets by vertical ones, T T being, as before, the supporting-ring. As a final step, we may assume the brackets to become so numerous that they are continuous round the speculum; the latter then assumes the form of Fig. 3, which is that suggested as the stiffest obtainable with a given weight of material.

If made of glass, the speculum might, I suppose, be cast of this form; but if of metal, I think it would be necessary to cast the speculum of equal thickness, and to solder on the extra backing, so as to avoid the porosity which (I am informed by "A. J. S.") always shows itself in such cases if the back differs much in section from the face. I have observed the same thing in cast-iron work, such as in pipes with bands cast on them. Whether the form of speculum now proposed should rest continuously on this ring, or whether the latter should itself be cut away so as to leave merely a certain number of equidistant points of support, is a matter for trial rather than theory. My letter is too long to allow me to touch on the effect of edge support (as when telescope body is horizontal, or approaching that position), but I hope to refer to this in another letter.

To save myself from criticism, I suppose I ought to say that the ring might, under another

form of deduction, be placed nearer the edge, also that the centres of gravity of the assumed sectors would be differently placed in Figs. 1, 2, and 3; but I only wish to give the simplest idea without going into any nicety, as the ring would not need to be mathematically exact in position.

A. S. L.

REPLIES TO QUERIES.

* * In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[44266].—Kites (U. Q.).—The principles involved in the flight of the paper kite were the subject of investigation by the mathematician Euler, who published his investigations in a memoir inserted in the *Transactions of the Academy of Berlin* for the year 1756. The subject involves several questions, which for the most part cannot be treated without the aid of the higher analysis; suffice it for the present to state, that the angle which the face of the kite must make with the wind, supposing that to be blowing horizontally, in order that it shall rise with the greatest facility, must be $54^\circ 44'$. M. Euler also found, from his calculations, that the tail contributed essentially to the elevation of the kite. There are some chapters on the subject of the construction of kites in Cassell's "Popular Recreator," Parts 4 and 5, which might afford "Ventosus" some of the information he requires. A kite may be made of almost any form provided it be made to balance, that is, not only of equal weight on each side of the points to which the cord is attached, but also to have an equal area of surface. China is the great land of kites; they are a source of great interest to that ingenious people, who have (I have somewhere read) a sort of kite-flying festival, when the sky will be peopled with all manner of strange forms of animals, men, birds, fish, dragons, &c., for a Chinaman will make a kite of any form, and having made it, will make it fly. I recollect a friend making a kite many years ago, of hexagonal form, about 6ft. across, which flew remarkably well. As good a form as any, and perhaps as convenient for taking to the scene of operation, is made by taking two light strips of wood, of lengths in the proportion of about 10 to 7, pivot the shorter in its centre to the longer one at a distance slightly more than half the length of the shorter from one end of the longer; the short lath turning round on the long one, the calico covering rolled round them makes the kite in a convenient form for carriage. The calico is attached permanently at the head and foot of the kite, and at the extremities of the cross lath by tapes to tie and untie. As to practical uses, kites have been employed to lead a line over otherwise inaccessible places, to ships in distress, over the tops of high buildings, &c. Pompey's Pillar was once ascended by a party of sailors by help of a kite, and I believe the vane on the spire of Salisbury Cathedral was once reached in like manner, and repaired. A kite in the form of a hawk is sometimes employed by sportsmen when birds are too wild to be approached; they will not take wing while it is hovering over them. Everyone has read of Benjamin Franklin and his electric kite.—W. W.

[44460].—Eosema.—I would very strongly recommend hydropathic treatment for this complaint. I have been a sufferer from it from childhood, and got little permanent relief till about ten years since, when almost as bad as I could be, with my face in a perfectly frightful state, I placed myself under hydropathic treatment at Mallock. As mine was so severe a case it took some time to put right, but in four months I left perfectly free from the disease. I have had several relapses since—indeed, I do not think it likely anything will get the tendency to the disease out of the system, but I find a few vapour-baths taken at home, without much trouble, ward off or cure an attack. In the winter of 1879-80, I had a severe attack in both arms, but the vapour-baths soon began to take effect, and in a very short time I was all right again. If "An Old Sufferer" will advertise his address, I shall have pleasure in sending particulars of the simple arrangements I have for getting a vapour-bath at home without special apparatus.—T. W. W.

[44493].—Nominal Horse-Power.—Does not "Arithmetical Ignoramus" see that I cannot give the definite meaning of N.H.P. inside the shops without being acquainted with the special rule worked to; and I assure him I have not that knowledge of the trade. The so-called Admiralty rule is to multiply the square of the diameter in inches by the velocity in feet per minute, divide by 6,000, and the product is N.H.P.; but, as I said, it is utterly useless, and is not used by engineers. The construction of an engine does make all the difference in the world. For instance, in the case in question—a spinning-mill—it is of

the first importance that the engine should run with the utmost steadiness, the governor being sensitive enough to keep it down to one regular pace. I think the querist will find a beam-engine best adapted for the work, or a horizontal with heavy flywheel and Corliss valves—not one of those verticals, which are excellently adapted for contractor's work.—SAUL RYMER.

[44600].—Huntsman and Cast Steel (U.Q.).—The following is the story of how this inventor's secret was stolen:—About the year 1770 a large manufactory of this peculiar steel was established at Attercliffe. The process was wrapped in secrecy by every means which the inventor could command. None but workmen of credit and character were employed, and they were forbidden to disclose the secrets of the process by a stringent form of oath. At last Huntsman's secret was stolen in the following manner:—One night in winter a traveller, to whom the desire of placing himself close to a roaring fire seemed a reasonable request, knocked at the door of the factory. A workman presented himself, whom the wayfarer addressed humbly, begged admission. "No admission here, except on business," was the reply; but on scanning him over, and discovering nothing suspicious about him, granted the request, and let him in. Feigning to be worn out with cold and fatigue, the wayfarer sank upon the floor, and soon appeared to have gone to sleep. To sleep, however, was far from his intention. He closed his eyes all but two little chinks, and through these little chinks he saw all he cared to. He saw the workmen cut the steel in pieces, and put them in a crucible, and through the entire process, which of course was easily remembered, and poor Mr. Huntsman's secret was no more.—JACK.

[44614].—Dirt-Stains in Wood.—It cannot be done. You can try washing with chloride of lime solution and a small brush, but it is doubtful if you will succeed.—T. P.

[44616].—Home Binding.—Most probably the statement is only a puff—especially as it is said that each number can be added in a moment, and that "no back is needed."—J. T. M.

[44618].—Shelling Wheat.—I believe it is run through rollers which just crack the shell. The process is somewhat similar to that adopted in the case of pearl barley.—OVERHOF.

[44620].—Lifting Machine.—"Country Millwright" will find it advantageous to give his sieves a combined movement—that is, sharp movement lengthwise with a slower shift sideways.—T. P.

[44626].—Staining White Pine Floors.—Would "Furnishing Salesman" kindly make his reply on page 22 a little more definite by saying what the "bit of brown umber" is to be rubbed into, the floor or the cloth? Also what "stiffing" with polisher's glaze means?—W. B.

[44628].—Marking Paper without Ink.—This querist requires something like Bain's chemical telegraph, a description of which he will find on p. 214, last volume.—E. G. M.

[44643].—Scavenging Machines.—There are plenty of road-sweeping machines in use in London. They have a revolving brush, which delivers the mud, dust, &c., into a trough that is emptied here and there for the heavy carts to take away.—S. M.

[44660].—Organ-Bellows.—Cut out the ribs in paper, and you will soon see what shape they ought to be. The lines showing the gusset corners should diverge. Shown many times in back numbers.—S. R.

[44664].—Greenhouse.—This question was fully answered in an article on p. 175, last volume. The best angle for latitude of London is 37°.—ONE WHO LOOKS IN THE INDICES.

[44631].—Waterproof Cloth.—In this case it is most likely the cloth was prepared by one of the processes the principle of which consists in rubbing the wrong side of the cloth with a substance such as beeswax, which is then drawn on to the fibres by ironing the cloth on the right side. The alum and sugar of lead process is objectionable on account of the smell when wetted.—J. O.

[44640].—Size for Orange Lead.—It would be interesting if "L. E. J." would say what he means. Size of all kinds is simply gelatine, and he can surely try whether isinglass, glue, parchment, or the so-called patent size answers best. He might add a little bichromate of potash with advantage.—T. J. M.

[44672].—Midland Engines.—To "METEOR."—A few corrections require to be made in reply on p. 95. Engines 5 and 21 are double-framed, of what we call the 890 design. No. 610 was built by Sharp, Stewart, and Co., 1867, not by Kitson. No. 444 is a straight-framed goods engine, built in 1860. No. 770 was built by Dübs and Co., 1870, and is a goods engine. No. 920 is the same class and maker, but built in 1871. No. 990 is the same

class, built by the Vulcan Foundry Company, 1872.—A DRIVER.

[44694].—Faulty Common Pump.—I read your paper regularly, but never venture to answer queries unless I know the advice I have to offer is sound. I shall not argue with "Working Tom" as to the usefulness of an air-vessel, but merely tell him that I have cured several cases exactly like his by ordering the use of such vessels, and one, no longer ago than last week. Of course, a portion of the air is pumped out. The vessel would be of no use unless it were so. His assertion that a good suction-pump will draw easily 27ft. may be accepted with a grain of salt. A single reciprocating pump, at that height, requires to be worked very slowly and carefully. If a quick stroke is given, the result is a jerk and a smaller quantity of water than is due to the stroke. I should evidently be wasting your space by offering him further arguments as to my simile of the iron or wood rod.—W. WYATT.

[44698].—Novelty.—I am exceedingly obliged to F. H. Wenham for his information on the subject of tuning steam-whistles. "Sunlight" promised me, on page 47 of our present volume, that if I would decide as to the number of whistles or pipes, he would put me in the way of carrying out the necessary arrangements. Will "Sunlight" kindly fulfil his promise, and oblige?—G. FRYER, Swansea.

[44724].—Heating Railway Carriages with Acetate of Soda.—In reply to "Old Mechanic," the following, translated from *Il Giornale del Genio Civile*, of December, 1880, may be useful. A plan for heating railway carriages with acetate of soda, invented by Mr. A. Ancelin, is now being tried on the railway from Paris to Havre, and on that between Orleans to Chalons. This system is based upon the fact that solid bodies, in passing to a liquid state, absorb an amount of heat which is rendered latent as the body is dissolved, and on reversing the process and passing back to a solid state this heat is rendered sensible. The crystallised acetate of soda, $C^2H^3O^2NaO + 6HO$ melts at a temperature of 59° cent. (139° Fahr.), with an expenditure of about 94 calories, as shown by following formula:—

$l = (160 + t)(C - c)$
 l = latent heat.
 t = temperature at melting point.
 C = specific heat of acetate soda in its liquid state.
 c = " " " " solid state.
 A foot-warmer of the capacity of 11 litres (2.42 gallons) would contain about 15 kilograms (33lb.) of acetate of soda, and supposing its initial temperature to be 80° cent. (176° Fahr.) or that of the ordinary hot-water heater, in cooling from 80° to 60° cent. (176° to 140° Fahr.) gives..... 225 calories.
 Latent heat 1,410 "
 Further in cooling from 60° to 40° cent. (140° to 104°) 96 "

1,731 calories.
 An ordinary foot-warmer of equal capacity filled with water at 80° cent. (176° Fahr.) in cooling to 40° cent. (104° F.) would only give 440 calories or about $\frac{1}{4}$ of that filled with acetate of soda, and this theory is confirmed in practice. The ordinary foot-warmer for railway carriages require to be refilled every 2½ hours, whilst those containing the acetate of soda would not require changing oftener than every 10 hours, and besides creating less disturbance to railway travellers, has the advantage of making a considerable saving in the labour required. An economy in fuel also would be effected, as ordinary foot-warmer, after being removed from the carriages, and before they can be refilled with hot water, generally remain exposed to the air, and the temperature is further reduced to 10° cent. (50° Fahr.) To heat them to 90° cent. (194° Fahr.), 80 calories are required per litre, of which only 40—viz., from 80° to 40°, are utilised for heating the carriage, so that for heating a foot-warmer of 11 litres, 1,760 calories are lost and 1,760 only are available. On the other hand, by using acetate of soda, a foot-warmer containing 15 kilograms of heat substance at a temperature of 10° cent. (50° Fahr.) would require—

From: 10° to 40° cent. (50° to 104° Fahr.) — $30 \times 0.32 \times 15 = 144$ calories
 " 40° to 60° cent. (104° to 140° Fahr.) — $20 \times 0.32 \times 15 = 96$ "
 Heat expended for melting (latent) .. 1,410 "
 From 60° to 90° (140° to 194° Fahr.) — $30 \times 0.75 \times 15 = 337$ "

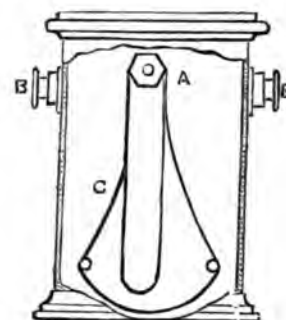
Total..... 1,987 calories
 Of which only 144 in cooling from 40° to 10° and 112 from 90° to 80°, or 256 calories, would not be utilised. The heating by water on the ordinary plan requires 3,520 calories, whilst heat by acetate of soda only 1,987. The melted acetate of soda is introduced into the warmers at a temperature of 100° cent. (212° Fahr.), and is then closed hermetically, and to be reheated only requires to be immersed in a bath of boiling water for about 1½

hour. I understand that a trial on a large scale will be made this winter on some of the lines in Northern Italy.—P. LE NEVE FOSTER.

[44730].—Electro-Magnet.—An electro-magnet to pull 10lb. a distance of 1in. will have to be a strong one—the distance is great; for instance, an electro-magnet to pull 10lb. at 1in. will pull 610lb. For this you would require an electro-magnet having a 1½in. core, 20in. long, bent into a horse-shoe, and having 24 layers on each leg of No. 20 silk or cotton-covered wire; the length of each layer should be 6in. With this magnet and three quart Bunsen cells, you will do what you wish easily.—W. J. LANCASTER.

[44734].—Lecture Experiments.—Get the "Intensity Coil," written by "Dyer"; this costs 1s., and contains a lot of experiments that may be easily performed. Then you should get a recent edition of Lardner's "Electricity and Magnetism." The descriptions in Lardner's are very easily followed.—W. J. LANCASTER.

[44738].—Exhibiting Photos.—To "SUNLIGHT."—You can utilise your present case if you follow the plan I now propose. Across the centre you would require a wood roller of such a size that either four or six flats can be formed on it, as shown in the sketch. These must be the width of



the pictures, and the views must be cut to one standard size. Cut out as many pieces of cardboard as you have views, and carefully paste a view on each. Next get a band of linen, the length to pass round both the roller A and the two bottom ones, also allowing it to hang, as shown, very loosely. The band then will be wound round by the roller holding the band by the cardboard, resting on the flats. So far, you will need little expense. Next comes the question of the lenses. To get anything like a good effect you will need good lenses, and these should be the regular achromatics, and carried in mounts similar to an opera-glass, B. If that be too expensive, then they may be mounted in an inferior way by a sort of drawer arrangement. The roller must be of such a size that the views must be about 6in. from lenses, as that is the standard distance of the focal length of the required lenses. You will, if you wish to allow six persons to look on at the time, require six distinct bands and sets of lenses, and the bands and lenses must be so arranged that each set of lenses has its own band of views. The achromatic lenses can be bought cheaply enough. Small ones can be got at about 3s. 6d. per pair by buying from the makers direct on the Continent; and if it would be of any help to you, I would be very happy to put you in the way of obtaining them.—SUNLIGHT.

[44739].—Vernier.—Full instructions to make a vernier, and how to read it, would occupy a great deal of space, and it is doubtful if they would prove intelligible to one who had no knowledge of the subject. "T. B." will find all the information he wants in "Heather on Mathematical Instruments," published in Weale's series, to be had for 1s. from any bookseller.—X.

[44741].—The Sun's Longitude.—Mr. Herschel having given me the clue, I notice—what I ought to have seen before—that the Sun's latitude depends upon the position of the Moon, and therefore that any irregularity of longitude would probably arise from the same cause. I am inclined to think that "A Fellow of the Royal Astronomical Society" was indulging in a little mild chaff at my ignorance. Well, we old sailors have sometimes had our laugh at the astronomers. I remember, between forty and fifty years ago, being in a flag-ship on her way to a distant station. On her stopping at a southern port, where was a famous observatory, our navigating officers visited the astronomer, when the conversation naturally turned upon ascertaining the longitude at sea. A young astronomical attaché remarked, "Ah, why not take the mean of a hundred lunars?" You may be sure that the hundred lunars afforded a standing joke for many a day. I am still perplexed at the discrepancy between the Sun's longi-

respect to the time of apheion as given in *Almagest*, and that from the period given by Dr. Ball and all other writers. No perturbation would account for it. H. K.

[44780.]—**Painting on Terra-Cotta.**—To oil-colours on the red or Leukos (creamy) for sketching the design in pencil, as on oil or canvas, mix the oil-colours with a little like flake-white, but use Roberson's in place of much turpentine. Lay this on thick, and let it dry for some hours; then finish with the colours needed, without flake-white, but still use Roberson's medium. Quite dry and finished apply a slight coat of oil varnish. Sable brushes are best. When any pencil-marks can be rubbed out with a finger. If wanted to remove any spots of mistakes, spirits of turpentine will do this. Black (black) were the painting is to be exactly as painting on canvas, and needs, as, no explanation, every stroke of the brush perfectly. Spots of paint or mis-mixing be rubbed off with a piece of wool; as the colours are moist. To paint china colours on the red or Leukos for use underglaze colours, and proceed painting on biscuit china. On enamelled terra for firing, use underglaze colours, proceed as in ordinary china painting. Melas (black) china colours are not applicable; the black colour does not stand firing. A black enamel is a charming novelty for use on china colours. The using of china in a layer of white enamel laid over the design, and which requires to be fired in a proper furnace, is, of the three the most "lasting," at the same time the most expensive. There was an article on terra-cotta in a recent number (I forget which) of *Illustrated Carpenter and Builder* which might interest to "J." to read. Terra-cotta burnt or baked clay, and the art of using it was known at Rome in the time of the kings. Mosaic history gives us instances of its use; in China the potteries have existed 2,000 years, and in the Egyptian sarcophagi the Assyrian tablets we have proof that ears before Christ terra-cotta was used, as would be supposed at that remote the art of painting on it in oil, china, and colours, was not known.—MARGUERITE.

[44781.]—**Gyroscope.**—I have had gyroscopes given to fifteen minutes easily. You must friction to least possible unit, or it will not. The better way for you to hang wheel is to use steel pivots screwed through ring, and into two countersunk holes in centres of axle. This will reduce friction very much and you will find the gyroscope spin much longer than it does now with cone bearings.—W. J. LANCASTER.

[44782.]—**Faure's Condenser.**—You cannot urge this condenser; but by a little practice I soon find how to tell when it is charged; then for dividing the current you can use the plates into sections, and have a shunt; don't suppose you are going to light half a dozen lamps from one condenser. Faure, at present, has done but little in light; was altogether disappointed with it in Paris, and reading so much of the million under.—W. J. LANCASTER.

[44783.]—**Feed-Water Heater.**—To "Sun." Many thanks for replying to my query in the above, and forward further particulars as follows: We use a pair of vertical tubes fitted with Field's tubes; distance from boiler, 25ft.; exhaust-pipe at present 18ft., with a straight run of about 18ft. to the boiler. We have a space of about 5 sq. ft. at discharge boiler, and plenty of head room. If I recommend a heater of the annular form, all one would suit us best, as space is valuable. The part we wish to heat with exhaust, heating heater, is within a few feet of boiler, lower above.—STOKER.

[44784.]—**Telescopical.**—If your power of vision is good clear disc when used on a first-class star, then the o.g. is not bad, but if a trace of the irradiation only in a lesser than the o.g. is in fault. The o.g. should be easily. It is difficult to tell what a lens is doing it: if I had it here for five minutes, I tell you all about it. As to the circles, I give the information you ask for, I have no before you want it. Also I shall fully describe various forms of stands. The wires on a meter diaphragm should be all soldered to; first drill as many small holes in the glass on each side as you require wires, taking care to drill them true, then put one end of each through each hole, until all are in position, older the lot at once, put the other ends in the other holes on opposite side, draw all and solder at once.—W. J. LANCASTER.

[44780.]—**Stereoscope.**—You can make a stereoscope to fold up and go into your pocket. The base-board should be 8in. wide at one end, 5in. wide at the other, and 7in. long; to the larger end hinge another board to carry the stereo slides, and to the narrow end hinge a frame carrying the lenses; a small handle, to screw into base-board, will enable it to be held when in use.—W. J. LANCASTER.

[44794.]—**Induction Coil.**—The insulation will determine the quality of the coil; the better the insulation the longer the secondary spark, and vice versa. Your coil should give a good thick 1in. spark if well insulated. If the insulation is bad, you might remedy it by taking off any cover you have made for it, and backing the whole of primary and secondary in melted paraffin in the oven for a day; then the probability is it would give a longer and better spark than now.—W. J. LANCASTER.

[44803.]—**Firegrate for Lancashire Boiler.**—For a two-flued boiler 22ft. by 6ft., I should not advise a greater length of firebars than 4ft., and not less than 3ft. 6in. Firebars will do very well in one length up to 4ft. long, so you will have no need for two lengths. The dead-plate should be 10in. wide, and should rest on angle-iron brackets inside the flue; if your flues have no brackets, you can tap, say, four 1in. set-screws in, and let the dead-plate rest on them. The back-bearer will do made from a piece of 1 1/2in. square iron, either cast or wrought, and it should rest on brackets bolted inside the flue; room must be left for expansion in this bearer, as well as in the firebars. It is a most reprehensible practice to allow this bearer to rest on the flue, as they are apt to arch up with expansion if they do not damage the flue. I have known flues damaged through having middle-bearers wedged across them. Top of dead-plate should be 2in. below centre of flue, and 4ft. bars should fall 2in. at back end. "Sunlight" has given dimensions for a grate suitable for a boiler 30ft. by 7ft. 6in.—such, at any rate, is the usual practice here in Lancashire. In a 2ft. flue, you could not keep a 7ft. grate covered with fuel at the back-end, and thus you would have a current of cold air passing into the flues through the bars cooling the flues, thus wasting fuel or diminishing the evaporative power of the boiler.—SER.

[44807.]—**Lighting.**—One series of lights in a long room is not sufficient, especially as the lights are so low. The better plan would be to raise the pendant a couple of feet. Get six of Sugg's No. 6 burners, and arrange a reflector inside each light, so that the reflection can be carried to each end of the room; 6in. reflectors would answer every purpose. They should be a little nearer to jet than their focus to get best effect.—W. J. LANCASTER.

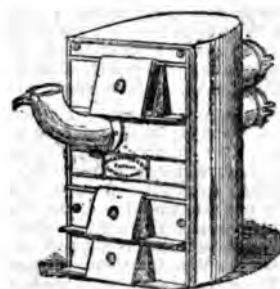
[44809.]—**Electricity.**—Your idea, supposing it feasible, would be a good one; as it is, it is an absolute impossibility. The time may come when something of the kind might be attempted, but 'tis not yet, and the only method of using up wind-power at present visible to me is to have a weight for the wind to raise the height of the house. This may be so heavy that it would take all day for the wind to raise it, then at night it could run down and drive a motor; but even this ponderous affair would have its difficulties, not at all easily overcome, and the power so obtained would be trivial compared to the work of a gas-engine of even one horse-power.—W. J. LANCASTER.

[44831.]—**Strength of Boiler-Plates.**—The following is the formula for cylindrical boilers:— $T = \frac{PD}{2K}$, thickness of plates in inches;

P pressure per square inch in lbs.; D diameter of boiler in inches; K tensile strength of material given in Molesworth's pocket-book as follows:—For best Yorkshire plates—7,800, 6,200. For best Staffordshire plates—6,200, 5,000. For ordinary plates—3,700, 3,000. The larger figures are for double riveting, and the smaller for single. For new boilers, Wilson gives 5 as a factor of safety, and for old ones 6 or 8. 5 is the number used in the above strengths.—C. E.

[44832.]—**Heating Small Greenhouse.**—I have just come across a description of a new boiler, which promises to be of considerable value to amateur florists, and I therefore ask for space in your columns to bring it under the notice of your readers. It is made by those well-known hot-water engineers, the Messrs. Messenger, of Loughborough. The advantages claimed are that no heat is wasted, the boiler standing in the house, the whole of the heat from the boiler itself is utilised; economy both in first cost and maintenance, there being no brick setting or iron casing required, and consequently none to get out of order. Not being set in brickwork, or attached to the freehold, it forms a "tenant's fixture." No stokehole is necessary; the front of the boiler being flush with the greenhouse, and on the level of the ground. It may be fixed either in the brick or boarded front of a greenhouse, and is absolutely safe from risk of fire. Being on the slow-combustion principle, it is very economical in fuel, and no

night-stoking is required. The joints to the pipes are put together with elastic rings, and the pipes are connected immediately to the sockets of the



boiler, and circulate through an open-feed siphon fitted with a lid, so that there is no need for any cistern and supply-pipe. The fuel consumed is stated to be 16lb. in 12 hours, and the apparatus is capable of heating, including the boiler itself, the equivalent of 80ft. of 4in. piping.—S. M.

[44832.]—**Heating Small Greenhouse.**—The best way to heat the greenhouse would be to take out the kitchen boiler and bore a hole through it at the back, 1 1/2in. from the bottom, to take in a piece of 1in. gas-pipe, then bore another hole the same size about 6 1/2in. or 7in. higher up the boiler, then screw the ends of the 1in. pipe, which should be long enough to go through the wall into the greenhouse, then put on a check-nut and put the pipe through the hole in the boiler; put another nut on in the inside of the boiler, using red-lead, and a small piece of hemp; then screw all up tight, and fit the boiler into its place again, then you have the flow and return pipes, to which fit cast-iron pipes in the greenhouse. If J. Sharratt will send me a plan of the greenhouse, I will send him a sketch to work to. The water will circulate from the kitchen boiler through the pipes in the greenhouse; but there should be a stop-cock to prevent the heat becoming too great through the day, as night is the time when it is most wanted. There would have to be a small fire kept up through the night in frosty weather.—JOE BLAIN, Albert-square, Carlisle.

[44832.]—**Heating Small Greenhouse.**—If your kitchen boiler is one that is fed from a cistern at the side of the fireplace, you might utilise it by connecting it by means of 1in. or 1 1/2in. iron or lead pipe with the cast-iron (2in. or 3in.) pipes in the greenhouse. If you use iron connecting-pipes they could be screwed into the boiler with a nut on each outside to keep them watertight, by means of a grummet and red-lead paint. One should go into the boiler at the top and be connected with the top line of pipes, called the flow, and the other should go in at the bottom and be connected with the bottom line of pipes, called the return. If lead pipes are used they could be connected with the boiler- and greenhouse-pipes by means of brass unions, to be purchased at any plumber's. The pipes should rise from the boiler to the furthest end about 1in. to the yard, and in the bend at that point should be screwed a 1in. gas-tap, and from it a small lead pipe should be carried up to the roof inside. This tap should always be open, to allow any steam to escape. If your kitchen boiler is supplied from the top of the house, you would find it more satisfactory to put up a small gas-boiler, as the pressure of the water would try the joints and prevent the vent-tap being kept open. The kitchen fire would, of course, be required to be kept in all night in frosty weather, and you would require taps on the connections between boiler and pipes, to shut off the heat when not required.—C. E.

[44833.]—**Logarithms.**—The querist should procure "A Rudimentary Treatise on Logarithms," by Henry Law, C.E. (Weale, 59, High Holborn), price 2s. 6d. The appendix contained in above work has a table of every prime number from 2 to 1,000—also a table, by the aid of which the number answering to any logarithm can be found to six places.—ACONITE.

[44839.]—**Electrical Contact, Motor, &c.**—Nickel would not answer for electrical contacts, because it does oxidise when subjected continually to a high temperature. Now, for simple contacts, with a weak current circulating, nickel will answer, but it will not do for currents that would heat a contact. Froment's engine is altogether too clumsy for you to make or use; but there are several good motors. When in Paris I ordered several motors, and when I have them I will report as to best one for general purposes.—W. J. LANCASTER.

[44840.]—**Swan's Electric Light.**—Swan's incandescent lamp is altogether unsuitable for working with Bunsen's cells. It is only satisfactory when used with a dynamo-machine; then

an equivalent can be got, but nothing like the arc lamp gives from same horse-power.—W. J. LANCASTER.

[44846].—Old Zinc Battery Rods.—I have tried all sorts of dodges to cast old zinc rods, &c., but have never done it to my liking. I have found the best thing to be done is to sell the old as scrap, and get new zinc; this at once ends all difficulty, and in the long run is the cheapest—that is, if time is worth anything.—W. J. LANCASTER.

[44849].—Raising Flour.—I should not attempt to elevate flour from silk reel to top of mill by a worm, the best plan would be to run up a leg of elevators; webbing 4½ in. wide, buckets 4 in. wide, running over 12 in. pulleys, making 40 revolutions per minute, would be of ample capacity for your requirements. Having no idea of how your silk is constructed, I could not at present advise the best position for them to receive and discharge. To make sketch intelligible to anything like a good scale would require too much space; but if you will advertise your address I will give you any information you require, as I am constantly erecting silks, elevators, &c.—MILLWRIGHT.

[44852].—Faure Battery.—You cannot charge this condenser with an induction coil; but you can charge it with a series of Bunsens. You ought to be able to construct one of Faure's from the description in the MECHANIC of July 15th. Let me know which part it is that you do not understand, and I will help you.—W. J. LANCASTER.

[44854].—Hot-Beds.—The plan you suggest, as it stands, would, in great part, fail. You want something like a plan I am acquainted with, where a petroleum-lamp was made to do just what you want. It consisted of a glass case placed on the incline, or, rather, with an inclined bottom, which was cased in. At the lower end was a tin heater cylinder, from which went a circuit of copper pipe round the inside of the glass case just above the level of the earth. This carried water, which circulated interruptedly; the waste heat from the lamp (which, by the bye, was, last year, supplanted by a gas-burner), was then led into the under side of the box, which was of metal, and after parting with its heat, the products of combustion were carried off by a suitable outlet. This had the effect of both warming the earth from the underside as well as the air in the case. And the arrangement described was also additionally good in that no products of combustion were able to penetrate the case in which were the plants. Happy to further describe it, if you think it likely to suit. The regulator of gas supply is entirely automatic, on a plan modified from the idea shown at page 161, Vol. XII.—SUNLIGHT.

[44856].—Coins.—I is most likely a 1s., Charles II., obv. leg. Carolvs II., Dei Gratia. Field, bust showing right cheek. Rev. leg. Mag. Br. Fra. et Hib. Rex., 1668. Field, arms. 2 C's in each angle. Edge milled with straight lines. Hawkins, p. 380–382; Henfrey, p. 109. Fourth issue, milled; 92½ gr.; generally common. Ruding, Vol. II., Pl. XXXIV., No. 12, p. 338. 92 gr. 2½ d. William III.; obv. leg. Gulielmus III., Dei Gra. Field, bust showing right cheek. N. under bust; rev. leg. Mag. Br. Fra. et Hib. Rex.; date. Field, a shield crowned. Arms of Nassau in centre. Edge milled with oblique lines. Hawkins, p. 392–394. Henfrey, p. 117; weight, 46½ gr.; mostly common. Pieces of the country mints are difficult to procure in a fine state of preservation. N. means it was coined at the Norwich mint. Ruding, Vol. II., Pl. XXXVI., No. 22, p. 340. 44 gr. 3 d. maundy money. Obv. leg. Jacobvs II., Dei Gratia. Field, bust showing left cheek, rev. leg. Mag. Br. Fra. et Hib. Rex.; date. Field III., crowned; edge plain. Hawkins, p. 384. Henfrey, p. 141; rare; 22½ gr. Ruding, Vol. II., Pl. XXXV., No. 6, p. 339; 23 gr. 4 and 5 I do not know. If "Blue Danube" is interested in Numismatics he cannot do better than procure "A Guide to the Study and Arrangement of English Coins, giving a Description of every Denomination of every Issue in Gold, Silver, and Copper, from the Conquest to the Present Time, with all the latest Discoveries." By Hy. Wm. Henfrey, Member of the Numismatic Society of London. John Russell Smith, 36, Soho-square, 1870." Plates and woodcuts, post 8vo., cloth, about 7s. 6d. "A very useful and compendious History of English Coins, and what will interest collectors—it gives the price the rarest coins have sold for in auctions of late years." Smith. In "An Introduction to the study of Ancient and Modern Coins, by John Yonge Akerman, Prof. Russell Smith, 4, Old Compton-street, Soho-square, 1848," is a "Table of prices at which English coins have been sold." It is taken from the sale catalogues of well-known collections of English coins, between the years 1802 and 1847. Foolscap, 8vo., with numerous wood engravings from the original coins (an excellent introductory book), cloth 6s. 6d. The table of prices extends only to Queen Elizabeth.—W. STAVENHAGEN JONES, 79, Carlton Hill, N.W.

[44857].—Electric Engine.—I am getting some electric engines over from Paris, of several different forms, and with others I am making I intend to thoroughly test them, one against another. I have a most decided preference, just now, to a modification of Froment's engine, but on a smaller and better principle. I will let you know how I succeed. Your plan is not at all satisfactory, and would be very expensive in working. I never yet used an engine of a similar form to yours that has been at all worth the cost of driving; they make pretty toys, but are useless as motors.—W. J. LANCASTER.

[44860].—Leak in Iron Flue.—Try rust-joint cement as follows: 1 (by weight) powdered sal-ammoniac, 2 flowers of sulphur, 80 cast-iron borings, made to a paste with water and hammered into the joint. The above is quick-setting, but is not so good as the following, which sets slower: 2 sal-ammoniac, 1 flower of sulphur, 200 cast-iron borings. If the joints are not very wide the borings should be fine.—C. E.

[44861].—London and N. W. Engines.—Whitworth, January, '65; Vampire, October, '74, are stationed at Stafford; Yakob Khan, May, '77, is at Crewe; Una, May, '62, at Camden; Trentham, February, '53, Pheasant, May, '63, are at Rugby; Theorem at Liverpool; Shark, November, '74, at Birmingham; Saddleback, May, '79, Phantom, May, '77, at Northampton; Zygia, January, '65. Sorry I know nothing about the new sheds. Thanks for your reply to my query last week.—HENRY T. ROBERTS.

[44861].—L. and N. W. Engines.—To "FORTUNA."—Yakob Khan is 859, I believe, though I have never seen it. If you look at "Egeria's" list of this week you will see that it comes in the middle of a batch of 1877. 839 is a pilot-engine. Perhaps that was the No. you saw. I will do my best to answer 44861 if "Egeria" does not. I hope he will, and will continue his lists, as he has resumed them. I do not quite agree with "Keraulophon" in what he says about "Cornwall," as however "noble-looking" it is, the cylinders are not large enough for the diam. of the wheels, and it has to be driven with the gear "full on." I fancy the "Wellington" would beat it for economy and even speed, with equal trains in a long run.—DROMED.

[44862].—Piano.—Unless it is the stock of some well-known dealer, an auction sale of new pianos should always be looked upon with suspicion. There is a class of instruments made especially for this purpose and for export to our colonies. As may be expected, they are put together in the most jerry manner, and of the cheapest materials, but as they are generally sold first cost something under £10, the wonder is that, bad as they are, they can be made at a profit. At one time the colonial trade in these instruments assumed comparatively large dimensions, and it is more owing to this fact than anything else that Continental makers obtained so firm a footing in our markets. If, as I am sorry to say seems likely, "Hecto's" piano is of this class, any attempt at repairing would be perfectly hopeless, and I should advise him to sell it on its merits for what it will fetch, unless, indeed—which is far from probable—it bears the name of any known maker, when, perhaps, a fair allowance would be made for it in exchange, though, from the circumstances of the sale, this arrangement would be perfectly optional on his part.—W. H. DAVIES.

[44865].—Air-pressure from Fall of Water.—I should be obliged to "Sunlight" for particulars of the two methods of working under low and high pressures. I could fit up either as far as water-power goes—having a 4 in. pipe with 160 lb. pressure at command—and only want about 20 cubic feet of air per hour.—DUNROD.

[44865].—Air-Pressure from Fall of Water.—If "Dunrod" will turn to p. 358 of Vol. XXVI., No. 665, of the "E. M.," he will find an illustration of the article he requires. I have one, which I made on the same principle for making air-gas, and which answers admirably, giving a pressure of 1 in. of water. He will hardly find this sufficient pressure for a blowpipe blast. When I do anything in that line I use a pair of ordinary bellows with an equalising reservoir submerged in water, for the air-blast, using the apparatus before mentioned to supply the gas. If I did much blowpipe work I should purchase a foot-blower of Mr. Fletcher, of Warrington. He supplies an article for supplying blowpipes with air by means of water, which, I believe, gives a higher pressure than that I have mentioned, but not much volume. Get his catalogue.—J. HEZMALHALGH, JUN., Fellscliffe, via Leeds.

[44878].—Microscopic.—1. Zeiss' glasses are the best made at present for histological work. 2. B = $\frac{4}{10}$, price 30s. D = $\frac{1}{6}$, price 42s. 3. Monocular. Messrs. R. and J. Beck's "Economic," with glass stage, is the best stand for the histologist. 4. Zeiss' objectives have a much greater

working distance, and are infinitely superior to Hartnack's.—PRACTICAL HISTOLOGIST, M.D., F.R.M.S.

[44873].—Steel Drops.—Solution of oxalic acid or salt of sorrel in warm water will remove all the stains. Wash well immediately afterwards in plenty of cold water.—DUNROD.

[44882].—Chemical Equation.—To draw out a chemical equation, write the formulæ of the bodies taking part in the reaction on one side, and the products of the reaction on the other, multiplying any of the formulæ (when necessary) so as to make the number of atoms of each element the same on both sides. For example: Mercury (Hg) and oxygen (O) unite to form mercuric oxide (HgO). Therefore, we have $Hg + O = HgO$. This is the simplest possible form of equation. Manganese dioxide (MnO₂) on being heated, splits up into an oxide having the formula Mn₂O₃, and free oxygen; so we first write $MnO_2 = Mn_2O_3 + O$. But as the number of atoms of each element must be the same on both sides of the equation, we multiply the left side by three, and get $3MnO_2 = Mn_2O_3 + O_2$. The first example shows combination, the second shows resolution of two elements. For two bodies reacting together, we may take the displacement of copper (Cu) from its sulphate (CuSO₄) by iron (Fe), $CuSO_4 + Fe = FeSO_4 + Cu$. The products being sulphate of iron and metallic copper. As an instance of the more complicated behaviour of three bodies, we may note the action of sulphuric acid (H₂SO₄) on bleaching powder. This latter is at all intents and purposes a mixture of calcium hypochlorite (CaCl₂O₂) and calcium chloride (CaCl₂). The products of the reaction are calcium sulphate (CaSO₄), chlorine (Cl), and water (H₂O). So we first write $CaCl_2O_2 + CaCl_2 + H_2SO_4 = CaSO_4 + Cl + H_2O$, and to make both sides balance, we must double the H₂SO₄, and make the equation:— $CaCl_2O_2 + CaCl_2 + 2H_2SO_4 = 2CaSO_4 + Cl_2 + 2H_2O$. There is really an intermediate stage where the Cl₂, 2H₂O exist as 2HClO + 2HCl, but the above is the simplest equation representing the action.—DUNROD.

[44885].—To Canoeists.—For sea-going purposes, a canoe on the "Nautilus" or "Pearl" pattern, with lug-sails and patent reefing-gear, is far the safest and best, but I cannot say they are light and easy to paddle. No canoe with good sailing and sea-going capabilities can be. The qualities are, to a great extent, incompatible. The reefing-gear is a great advantage, enabling a large sail-area to be carried, and reduced in an instant when required. These canoes are from 13 ft. to 16 ft. long, about 30 in. beam, and fitted with one or two centreboards. Sail area varies with the intention of the owner, whether he means racing with plenty of ballast, or cruising in light trim; also with his nerve and experience. Rig, usually big fore lug and mizen, and sometimes a jib as well. A long flat floor for stability, and a good sheer fore and aft to give power in a sea, are essential to a sea-going cruiser. But paddling any safe canoe in rough water is, at best, hard work, and unsatisfactory as to progress.—TREADLE.

[44884].—Problem.—In Todhunter's "Plane Trigonometry," edition 3, article 242, you will find your problem worked out at length.—C. E. F. N. ["H. V. C. V." and "A. L." have also replied to this query.—Ed.]

[44884].—Problem.—In the figure given by "Y. S.," let $ABD = \frac{B}{2} - X$, $CBD = \frac{B}{2} + X$.

From $\triangle ABD$, $BD = \frac{AB \sin. BAD}{\sin. ADB}$ = also

$\frac{BC \sin. CBD}{\sin. CDB}$, i.e., $BD =$

$$c \sin. \left(d + \frac{B}{2} - X \right) = a \sin. \left(d + \frac{B}{2} + X \right) \dots (1)$$

This gives $\tan. X =$

$$\frac{c \sin. d^1 \sin. \left(d + \frac{B}{2} \right) - a \sin. d \sin. \left(d + \frac{B}{2} \right)}{c \sin. d^1 \cos. \left(d + \frac{B}{2} \right) + a \sin. d \cos. \left(d + \frac{B}{2} \right)}$$

Hence we can find sines of $d + \frac{B}{2} - X$ and $d + \frac{B}{2} - X$. Whence BD is found from (1). Also, AD =

$$\frac{AB \sin. ABD}{\sin. ADB} = c \sin. \left(\frac{B}{2} - X \right)$$

$$BD = \frac{BC \sin. CBD}{\sin. CDB} = a \sin. \left(\frac{B}{2} + X \right)$$

and knowing $\tan. X$, we can also calculate the sines of $\frac{B}{2} - X$, and $\frac{B}{2} + X$, which are required here.—H. T. B.

[44884].—Problem.—Referring to the diagram, page 100, call the angle $ABD = v$, then $DBC =$,

$\delta - v$. If we can find v the problem is solved because in the triangle BAD we then have three angles and one side known, from which the other sides can be found. In any triangle any two sides are proportional to the sines of the opposite angles, therefore,

$$\frac{CD}{CB} = \frac{\sin. (\delta - v)}{\sin. \delta} \therefore CD = \frac{CB \sin. (\delta - v)}{\sin. \delta}$$

$$\text{and } \frac{AD}{AB} = \frac{\sin. v}{\sin. \delta} \therefore AD = \frac{AB \sin. v}{\sin. \delta}$$

$$\text{also, } \frac{BD}{AD} = \frac{\sin. (180 - (v + \delta))}{\sin. v} \therefore BD = \frac{AD \sin. (v + \delta)}{\sin. v}$$

$$\text{and } \frac{BD}{CD} = \frac{\sin. \{180 - ((\delta - v) + \delta)\}}{\sin. (\delta - v)} \therefore BD = \frac{CD \sin. \{((\delta - v) + \delta)\}}{\sin. (\delta - v)}$$

Equating these two values of BD, we get—

$$\frac{AD \sin. (v + \delta)}{\sin. v} = \frac{CD \sin. (\delta + \delta - v)}{\sin. (\delta - v)}$$

Substituting the values of AD and CD from the two first equations, we get—

$$\frac{AB \sin. (v + \delta)}{\sin. \delta} = \frac{CB \sin. \{(\delta + \delta) - v\}}{\sin. \delta}$$

In this equation the only unknown quantity is v , of which we must find the value. This can be done by expanding the numerators by the formula $\sin. (A + B) = \sin. A \cos. B + \cos. A \sin. B$; then if we call $\sin. v = x$, $\cos. v = \sqrt{1 - x^2}$, and substitute these values in the expansion, we get a quadratic equation from which the value of x or $\sin. v$ can be found. In some cases it will be found more practical to take the logarithms of both sides of the equation last found, so that we get $\log. AB + \log. \sin. (v + \delta) - \log. \sin. \delta = \log. CB + \log. \sin. \{(\delta + \delta) - v\} - \log. \sin. \delta$. By giving trial values to v , and substituting the known values of the other symbols, the value of v will be correct when the two sides of the equation balance. In the number of this Journal of August 5th, page 526, I described a method of solving these logarithmic equations with a few trials. — M. I. C. E.

[44888].—L.N.W. Engines.—In my reply last week, instead of "are all Trevithicks," &c., read are all Ramsbottoms &c. It was an error of mine. — FORTUNA.

[44888].—L. and N. W. Engines.—Scorpion (7), Atalanta (97), Tiger (117), Lily (222), Clive (723), Red Gaxtlet (802), Waverley (806), are Ramsbottom's 7ft. 6in. singles, with outside cylinders. Mastodon (479) is one of Ramsbottom's 6ft. couples; Etna (481), Emerald (626), are Webb's "Precursor" class; Duchess (1519), Frobiisher (1528), Talavera (1672), Airey (1678), are Ramsbottom's 6ft. 6in. couples. — HENRY T. ROBERTS.

[44891].—Turning Shafting.—I should proceed as follows:—Cut the bars into lengths to go between the lathe centres, and if they are not straight make them so by bending them in the required direction with a pinch-bar, using a block of hard wood resting on the lathe-bed as a fulcrum, at the same time hitting the rods some smart taps with a hand-hammer, about the part requiring straightening; having got them fairly straight, fix a stay on the lathe-bed, with hard wood pieces for the rods to run in, about two feet from the back centre (the part where the stay is fixed should run as nearly dead true as possible), then turn and finish to the required size, a length of about 4in. from back centre. Now fix in rest, on one side of the bolts that hold the tools down, a roughing tool, and on the other side of the bolts, a finishing tool, which latter must be adjusted to so touch the part already turned that it will finish the rod the whole length to the same size, and the roughing tool must be so adjusted that it will leave just enough metal for the finishing tool to make a clean job; tighten down the holding-plates on both tools, and see that they have a good hold of each, and immediately behind the finishing tool fix your travelling-stay, which should grip the finished part of the bar with a nice hold by means of iron, or, to my mind, more preferable, hard wood blocks, and prevent all spring; having adjusted the two tools and the stay properly, one cut up the bar will finish it; use an ordinary feed and speed, and run soapy water pretty freely on the roughing tool. I have, of course, assumed that one roughing and one finishing cut is sufficient to reduce the bars to the required size, as should be the case in all work of this kind. Before commencing the cut remove the fixed stay that was put on to turn the short piece at the end of the bar. — C. E.

[44893].—Water v. Gas.—I have an organ in my house of 8 stops, besides 30 notes 16ft. Bourdons and CCC, driven by a Bailey (of Salford, Manchester, patentee) water-motor; pressure of

water 43, placed out of doors. Supply of wind regulated by valve attached to bellows. It works satisfactory, cost 1½d. per hour. The charge by the water-works for water here through a meter is 6d. per 1,000 gallons. It is set going merely by drawing out a stop marked "Blow." Being out of doors, water is emptied and motor not used during frost. This might, however, be obviated by constructing a vault for it. Gas is objectionable except for very large organs; you cannot regulate the supply except by means of an overflow bellows. The machine itself is very costly. Must be lighted and started each time you sit down to play—if it is even only for a few minutes—and light extinguished when you have done. The objection to Bailey's motor is that if the water is of very hard quality the slider is apt to stick, and must be oiled constantly through an oil-hole. This is unfortunately the case with mine. If the water is soft this would not occur. To the best of my recollection the Bailey motor cost about £8. Before this I had an Empress rotary; it was very wasteful and very weak, and I had to abandon it. I shall be happy to afford you any further information in my power. I should not recommend it if your pressure is under 40. You will then require a larger machine and use more water. — J. BROOKE PECHLE.

[44900].—Induction Coil Brakes.—The point should be well down the spring, not opposite the armature. The object is to allow the armature to play over sufficient space, and yet not to set up violent hammering on the point. This is aided also by making the spring weaker beyond the point than behind the screw. Another object gained by this is the prolongation of contact so as to allow perfect magnetisation of the core. As the magnetisation rises it begins to act on the armature and draws it, but does not break the contact for some time; does it suddenly, but with small opening which diminishes the time of break and increases that of contact. Use a thick platinum, which is good economy, and arrange it so that it can move over the spring contact and so vary the actual surfaces touching. — SIGMA.

[44904].—Warming Church.—You will find nothing superior for this purpose to a large size "Tortoise" slow-combustion stove, which whilst moderate in first cost, is economical as to consumption of fuel, and requires very little attention. The largest size will efficiently warm 40,000 cubic feet; its cost is £8. You can probably obtain full particulars from your local ironmonger; if not, I shall be pleased to send them if you will advertise address in 6d. column. — R. T. LEWIS.

[44904].—Warming Church.—If you mean a heating apparatus, then for hot air I think that you will not do better than try Hayden's apparatus, of Frome; if hot water, there are many good systems; if a series of stoves only, then the radiating gill stove is the best, in my opinion, as most fully utilising the heat of the fire. — SUNLIGHT.

[44907].—Governors, Force-Pump, &c.—Do you wish to use the ordinary or high-speed governor? I should advise the latter. I shall want to know the position which you can affix the governor to—if on the steam-chest direct, or where? Also if you have a pulley on the crank-shaft or not? If you were to send me a sketch showing the general arrangement of the engine, I could do much better for you. To save extra cost you might either send the sketch through the editor, or by advertising your address I would send you my address, so that you could send the sketch direct to me. The pump must be according to whether it is a plunger or long-stroke one. If it was a hollow plunger one it should be ½in. diam., and say 1½in. stroke. If a long-stroke one, then it should be ½in. diam., and the same stroke as the piston of course. Fly-wheel should be not less than 18in. diam., and if room be available, even 24in. diam.; weight to be say 24 to 30 pounds. — SUNLIGHT.

[44910].—Universal Chuck.—I much regret not being able to give "El Capitán" information about the "Onesida" chuck. Business avocations have, alas! cut me off from all amateur work for nearly two years, and my workshop plant is all shut up, and doubtless deteriorating, in a London warehouse. But, as a general rule, all chucks working with a "scroll" are, from inherent vices of construction, bad grippers. To enable the jaws to work in all parts of the "scroll," whether close in to the centre or out at the edge, they are obliged to be made with a degree of looseness, or "play," which is fatal to their rigid holding powers, as the real bearing surface between the jaws and the scroll at any point is very slight. The only really reliable jaw-chucks are those in which the jaws are controlled by screws. Some of the American chucks I have seen on this principle, in which there were three or, better, four screws and jaws, and all made to work simultaneously by an open wheel gearing into pinions on the screw-heads, which were very good indeed, and very firm grippers. One, especially, has an arrangement by which the jaws can be disconnected, and set to any irregular-shaped object, and then, being again put

into gear, half a turn gripped all firm, struck me as very suited to general work. Scroll chucks answer admirably for light work, such as holding drills, or for work supported by the back centre or boring-head; but for rough work, and for anything of any length, to be held by one end only, they are a delusion and a snare. — TREADLE.

[44912].—Flute.—[Mr. A. Collard, 211, Oxford-street, W., sends us a circular about his new flute, and a letter, in which he says that the most satisfactory way for the querist will be to pay Mr. Collard a visit, and try the instrument for himself. The querist wrote from India, so he had better send for one of the circulars to the address given. — Ed.]

[44912].—Collard's Flutes.—In reply to "India," I may say that Mr. Collard's improvement is applicable to any system of fingering, and I recently saw one he has made for Mr. Nicholson with the old 8-key fingering; but the new fingerings, Boehm, Radcliff, or Carte '67, especially the latter, are preferable, and are very easily acquired. No one who has heard one of these flutes can doubt their superiority in the low notes; but the accuracy of mechanism required necessitates a high price, £35, I believe; but a note to Messrs. Collard, 349, Oxford-street, will obtain full particulars. — T. R. W.

[44913].—Defects in Pianos.—To MR. DAVIES.—The liability of piccolo pianos to go out of tune just at the junction of the steel and covered strings was noticed and explained in No. 718 ("How to Keep a Piano in Order"), but as it may not be convenient to refer so far back, I may say that it is caused by a want of length, and consequent deficiency of tension in the lowest steel notes. Under these circumstances, the strings not being tightened to their proper tension have no reserve of elasticity to draw upon, and are therefore extremely liable to get sharp or flat with the slightest changes of temperature. As this failing is local, rarely indeed extending to more than 4 or 5 notes above the covered strings, an iron frame would be powerless to correct it; but I have found it a great improvement to substitute music-brass, of the same gauge, instead of the steel-wire, or in cases where the belly-bridges are in one piece, to continue the covered strings a few notes higher up. — W. H. DAVIES.

[44915].—Electro-magnets.—Your fin. magnet is best with a bow and not flat, and should be in one piece of metal only and have 1½in. clear between the poles; you will require 2½ or 3lb. No. 15 or 16 wire, and two Bunsen batteries. Begin to wrap the wire at the top of one leg by tying the wire round the iron, leaving about 18in. of it projecting; twist this end round the bend so as to be out of the way; then hold the magnet on a table with the left hand, turn the poles upwards and keeping the wire very tight, wrap six or eight layers of wire on the leg by turning the magnet round, laying the wire even and close and preventing it getting loose at each half-turn with the finger and thumb of either hand alternately; then untwist the 18in. wire and go round the bend to the other leg, with which proceed in the same way, and you will finish by tying the wire as you did on the iron core. You can put the job aside at any time by winding the wire for a few turns round both legs. In unwinding, take care to keep the wire tight till you get back where you left off. — J. SUTCLIFFE.

[44917].—Strains on Crank-Pin.—To "SUNLIGHT."—I do not know if you desire the easily worked out formula or the mathematical exposition of this question, so, as far as possible, put the reply into terms that could be utilised by those who are not well up in mathematical science. I would say that, on the theory of the parallelogram of forces, we have an easy way of not only finding the strain on the crank-pin, but also on the connecting-rod. To do this, lay off a horizontal line to scale, representing the stroke of the piston, also the connecting-rod and crank. Next, continue the line of the piston-rod to the centre of the crank-shaft. Then set off on the continuation of the piston-rod the pressure to scale, and at the termination of such pressure erect a perpendicular. Then the distance from the point where the line representing the piston and connecting-rods joins the intersection of the vertical line, would represent, when scaled, the strain on the connecting-rod, and the vertical line to the intersection of the connecting-rod the strain on the crank-pin. That is, when the crank is at mid-stroke nearly. The strains, would, of course, vary in other positions. — SUNLIGHT.

[44918].—Lever of First Order.—15:12::11:137:8'903 very nearly, the error being .04 of a foot, very nearly half an inch. When it is considered that the centre of gravity of two logs would not be coincident in position with that of the man, probably solution to three places of decimals is near enough. — TREADLE.

[44919].—Induction-Coil Brake.—The proper place for the platinum contact on the spring is ½ the total length of the spring downwards from the

armature. Very much even then depends on the way the spring is made. It should be so made that when the current passes the portion between the contact and the armature should bend a little before breaking contact, and therefore the spring must be pretty stiff in the lower part and weaker in the upper part above the contact. With a perfectly fitted spring and contact I have never had any difficulty, no matter what the size of coil may be. The platinum surface should be made from stout wire, driven into and riveted into both spring and contact-screw. The great fault is want of surface in the contact, and, if this be too small, it will neither allow the coil to work to full power, nor will the platinum stand the wear. If of any service, I should be happy to send Mr. Brown a sketch of contact-breaker I made for my own use on a very powerful coil, and which, after four or five years' use, is in perfect order still.—SUNLIGHT.

[44920].—Injector Pumps.—The class of instruments you describe are really not of the injector, but the ejector, class. And, therefore, there are many points on which you would need to be acquainted to be able to at once deal with the subject. The suction and delivery should be ample in area, and the delivery should also be either made with an easy dip, or bend so that the issuing body of steam and water may not be projected into or be surrounded by air. The jet, in fact, should play directly on to a body of water or other fluid. Then, again, in my opinion, the jet is too far removed from the throat, and it, owing to the form of construction, is too far from the suction-inlet. If the jet also does not point fair at the centre of the throat, an ejector will frequently refuse to work. These are a few of the causes you may find at the base of your sometime failures, which necessitate adjustment.—SUNLIGHT.

[44921].—Tricycle.—I ride a Humber: it is certainly a beautiful machine, and the quickest goer. Hillier won the 50-mile amateur championship on one. It is, however, somewhat difficult to ride at first. If "Ex." intends buying one, I would advise "The Premier," which is also a double-driver, and which can be easily ridden after a few hours' practice. If "Ex." will advertise his address, I will write him where he can see my Humber and examine it at his leisure.—E. E. H.

[44921].—Tricycle.—The "Humber" has been some time before the public; is ridden by several of the crack riders amongst the professional class, as, from its large drivers, 52in., it makes good time on a racing path. But the size of wheel would be certainly against it for ordinary road riding. The price is very high, being £22. It is also heavy, and requires some little skill in riding; but it is a very good machine for racing or level riding, especially when the rider is an expert bicyclist. But it runs much heavier than a bicycle, and is nothing so easy to propel as many other tricycles of the usual pattern.—SUNLIGHT.

[44922].—Force-Pump.—I should say you require new leathers to the valves, as they do not hold water. Take your pump to pieces and examine each valve, and if you cannot put in new leathers, send the valves to the nearest plumber.—WORKING TOM.

[44922].—Force-Pump.—There is nothing at all required that would be difficult to do, necessary to prevent the pump requiring the trouble of priming each time of being used. The fact is, that the foot-valve does not hold, or else there is a leaky joint below the barrel—most probably the former. What you need to do is to take out the bottom valve, and either if it be worn fit a new one, or else see that the existing one is made to hold water, and the defect will at once disappear.—SUNLIGHT.

[44923].—Decolourising Agent.—Has the querist tried the effect of passing the liquor through a considerable depth of animal charcoal? If the liquid is in the nature of a syrup, it should be passed through whilst hot.—SAUL RYKER.

[44923].—Decolourising Agent.—Filtration through animal charcoal would probably remove all colour from the solution. If chlorine answers the purpose, and there is no objection to its use other than its poisonous properties, that may easily be got over by careful addition of sulphide or bisulphide of soda (brewers' material) which will form with any excess of chlorine the innocuous compound known as Glauber salt.—DUNBOD.

[44923].—Decolourising Agent.—Cannot you manage to obtain the liquid without the burnt sugar?—as it seems strange to add burnt sugar and then proceed to bleach it. If you do not yourself make the said liquid, perhaps the manufacturers, on your representations, would supply you with a quantity uncoloured. Have you tried peroxide of hydrogen? I should think that would be the safest.—Os.

[44924].—Telegraph Circuits.—A metallic return circuit, instead of earth, would be free from the effects of earth currents and of induction; it

would be in no way protected from those of lightning or such atmospheric disturbances as would set up a strong tension between the lines and earth. As to lightning, they might well prove more dangerous than a single line with earth connections, but this could be guarded against by any of the simple lightning protectors placed at intervals along the line. Earth currents setting up opposing forces in the two wires would be neutralised and not interfere with the working current, and the same with induction effects; but as to atmospheric actions, the wires would be simple collectors, receiving a strong charge and tending to discharge to the earth.—SIGMA.

[44925].—Valvaline.—If "P. M." will advertise his address in "ours," I will put him right for a safe and effective lubricant. Being a mechanical engineer, I have seen a great many instances of what you complain of.—EL SENOR DON JUAN.

[44926].—Photographic.—If the pinholes are only in the sky, or mostly there, and are on no other important part of the picture, varnish the negative on the glass side, and when the varnish is quite dry and hard, rub some powdered resin over the portion to be retouched (this is to give the pencil a bite on the varnish); now, with a good pencil, say a B, blacken the sky, or such parts as require it, then rub the blackened part over with a bit of flannel: this is to insure an even blacking. Print as usual. Should the pinholes be on some object in the foreground, rub a little resin on the film side of the negative, and touch each pinhole over with the pencil; now varnish again, taking care to prevent the lead running. On the print the retouched spots will be white instead of black; now mix the required colours with a little gum-arabic in water, and paint the white spots the shade of their surroundings, this is called "spotting out."—WILLIAM PECK, Hayward's Heath.

[44927].—Matt Varnish.—Try a little mastic in spirit of wine or ether. I think it will give the effect you want if used on cold glass.—Os.

[44927].—Matt Varnish.—A very fine varnish is that recommended by M. Léon Vidal. It is composed of sandarac, 18 parts; mastic, 4 parts; ether, 200 parts; benzol, 80 to 100 parts. I compounded a somewhat similar varnish some three or four years since, and it proved most successful. But see that the glass is perfectly clean.—SUNLIGHT.

[44928].—Artificial Leg.—I think that "One in a Fix" might get over one of his difficulties by fixing a piece of the same light tough wood of which the foot is made in the bottom of the leg, making a cup-shaped hollow in this and another in the foot opposite to it, and place in a good stiff indiarubber ball, like an ordinary tennis ball, of a suitable size between them. Those hollows should be a little wider than the segment of the ball contained in them, but their depth and the size of the ball should be found by experiment, and I think could be managed so as effectually to prevent both the "jerk" and the "flop." As to the other defect I think it could be remedied by cutting away the top of the leg at back as long gaiters are cut away, or if that would prevent the fastening of the steel at side from being stiffly enough supported, the top could be left a little wider, and not be brought in so much behind. If the bottom of the thigh-piece hurts, it should be eased in the same way as the top of the leg. I do not understand at all what the part F is, where it goes, or what is the use of it, or if it has anything to say to either or both of the defects. The ball should be well in front of the hinge, and caught between the hollows in the leg and foot, just as a lemon is caught in a lemon squeezer. If "One in a Fix" tries this plan, I would be glad to hear how it works. I have never seen it tried. It has just come into my head as a dodge likely to answer.—G. J. H.

[44929].—Rotary Steam-Engine.—I am not able to lay my hand on the copy of the *Scientific American* for the 10th of last month; but from what I recollect of the matter, I think it was a turbine motor in which the steam was ejected against vanes, and that there was no direct dead pressure, as in the reciprocating engine.—SUNLIGHT.

[44930].—Cosmorama.—The best thing that I could recommend the querist for this purpose would be a zoetrope or wheel of life. This ingenious toy is very amusing and instructive, and would, no doubt, answer all the requirements of "Cosmorama." If the querist does not know how to make a zoetrope, I will send all the necessary instructions if asked to do so. The cost of material is very trifling; but if "Cosmorama" does not like the idea of making it, he can obtain one at the cost of 2s. 6d. or 5s. of J. Clark, 2, Garrick-street, Covent Garden, London. The slides are sold in books containing three coloured diagrams, at 6d. per book.—G. FRYER, Swansea.

[44930].—Cosmorama.—Such an instrument would really be very similar to the requirement of

the querist under No. 44738 in many particulars. I quite see your idea, and it could be easily carried out. Imagine (for its simplest form) an octagonal box, say, about 20in. across the flat face, and about 24in. deep, similar to a section of an octagonal column. In the upper part of each of the faces there should be a lens or lenses, as the case may be, and facing each a picture. Whilst in the centre, as you suggest, may be a powerful lamp. The views might be photos, carried each by a glass plate inserted in a frame, which would thus surround the central lamp. The pictures themselves would be rendered transparent by soaking them either in paraffin-wax or a solution of Canada balsam and turpentine. This would also act as the adhesive medium to secure the pictures to the glass plates. If this frame with the pictures was made to revolve, then each person would be able to inspect the whole eight views without moving from his or her peep aperture. Additional effects could also be introduced by the aid of coloured glass or gelatine in sheets, to give the appearance of sunrise, storms, moonlight, and other effects. In fact, I could suggest a lot of diorama effects procurable. The only question is that of the lenses; to produce good effects they are most necessary. For other particulars of them, see the query already quoted and my reply. As an instrument to amuse more than one person at a time, you would find such very good, and I shall esteem it a pleasure to in any way help you.—SUNLIGHT.

[44931].—Battery to Recharge.—The Leclanché battery is recharged with ammonio-chloride, about 1oz. to a cell.—ALBERT SMITH.

[44936].—Milk Analysis.—You had better get Professor Wanklyn's book, published by Trübner, 59, Ludgate-hill.—ALBERT SMITH.

[44937].—Pianoforte.—The standard tension of the wires in a 6½ octave grand piano may vary from 40lb. to 1 cwt. Now, as between these two extremes there exists a difference of about 6 tons in the combined pull of the strings, "J. G. A." will see how impossible it is to answer this query in anything like a reliable manner without a fuller description of the instrument, maker, and probable age; but as there will be, most likely, a register of the numbers of the wires upon the worst-plank, he will be better able himself to ascertain the original sizes, beyond which it would hardly be safe to venture.—W. H. DAVIES.

[44939].—Brass Founding.—Let "Young Ireland" procure "Brass Founders' Manual," Weale's Series, price 2s. 6d.; it will help him out of some of his difficulties.—WORKING TOM.

[44939].—Brass Founding.—Your cores are not properly made; they should be of clay, and well baked in a core-oven before being put in the sand. The materials you have used for them might do if well baked to thoroughly dry them; but having never used anything but proper clay cores, I could not say definitely if they might be used as a substitute.—SUNLIGHT.

[44940].—Boat.—Both ribs and planking can easily be bent, as I have described repeatedly in this journal, by steaming or boiling. What class of boat are you proposing to make? Is it to be clinker or carvel built? You might, if you like, use two bulkheads right across, as you mention, and it would stiffen the boat greatly. For particulars of how to steam and bend the ribs, &c., see replies in back numbers of this journal.—SUNLIGHT.

[44943].—Tricycle.—(1) The gear described and illustrated by Mr. C. J. Steel would, as he states, be just the thing to affix to the "Salvo." (2) The lever shown is not to pull against in riding, but merely to alter the gear. The rider would, of course, have to use the usual steering and foot handles to take the pull of his arms against. (3) The idea of one wheel is all right, that is that B and C would be one casting. But it would be impossible to continue the teeth from the outer to the inner circle of teeth, because if it were so done, the pinion T would not gear at the lowest when made to do so at the highest point of the teeth. In fact, it would be impracticable on the question of the gearing.—SUNLIGHT.

[44946].—Harmonium Stop Ineffective.—The stop-lever is probably disconnected. Open the instrument, and examine that part, and no doubt you will soon see what is the matter. If only disconnected, you will have but little trouble to put it right.—G. FRYER, Swansea.

[44946].—Harmonium Stop Ineffective.—If "Mark" had taken the trouble to look inside his instrument and given us some idea of the arrangement, it might have been possible to reply. Dalciana Bass is a stop I do not know on a harmonium, and I suspect in the case in question it does exactly as much as it was intended to do. If it is a substitute for the Sourdine it should be so connected as to allow only a small hole to be open for the passage of the wind to the reeds; but without knowing anything of the internal arrangement of

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for six weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, W. W. has replied to 44268; Jack, 44600.

44358. Salicylic Acid, p. 532.
44363. Civil Service, 533.
44367. Drying Yarns, 533.
44368. Compound Engine, 533.
44370. Stiffening Malacca Cane, 533.
44380. Ejecting Water, 533.
44390. Hearing Trumpet, 533.
44396. Our Hats and Shoes, 533.

44611. Metropolitan Loos, p. 629.
44617. Vermilionette, 630.
44624. Lippman's Electrometer, 629.
44627. Thomson's Electrometer, 629.
44630. Tasmania, 629.
44632. Propane, 629.
44633. Barium Bichromate, 629.
44636. Boyle's Law, 629.
44637. Conic Sections, Puckle's, 629.
44647. Iron Foundry, 630.
44652. Naturalists' Dredge, 630.
44656. G. W. Engines, 630.
44662. Old G.W.R. Engines, 630.

QUERIES.

[44978].—Legal.—A. has an aunt living in Victoria, British Columbia, who wants to transfer her share of a property here in Scotland to A. How can this be done legally and with the least expense? A reply from "Sperans" will be much appreciated.—AN M.D.

[44979].—Brass Springs.—Will some of your readers kindly give me details of method of making brass spiral springs? Also, flat springs out of sheet brass.—M. B.

[44980].—Carpenter's Tool-Chest.—Will someone kindly inform me the best way to fit up a carpenter's tool-chest, as I am about to make one for myself? I want it to take nearly all kinds of carpenter's tools, with head planes, fillisters, and ploughs handy to get at, as very often in use. Please state the most convenient size of chest.—WOODENHEAD.

[44981].—Chemical Analysis.—I should feel obliged if Mr. Allen, or any of the chemical contributors to "ours," could help me out of some difficulties I meet with in the study of analysis. In making analyses of minerals, &c., containing SiO_2 , Fe_2O_3 , Al_2O_3 , CaO , MgO , &c., I fuse with KNaCO_3 if necessary, dissolve in dilute HCl , evaporate to dryness in presence of a little HNO_3 , redissolve, filter off, and weigh SiO_2 . Add to filtrate AmHO , and boil until NH_3 is expelled. Allow to stand an hour, and filter off Fe and Al. To the filtrate I add oxalate of ammonia to throw down Ca, and boil; filter off CaOx , and other ignites to CaCO_3 or determine by KMnO_4 . To the filtrate, after precipitating the Ca, I add excess HNO_3 , and evaporate to dryness; redissolve in dilute HCl , and add AmHO . Then add Na_2HPO_4 , and allow to stand in the cold for twelve hours or more. The precipitated magnesium phosphate (d) I collect, dry, and weigh. The following are my difficulties:—a. I cannot reduce the Al_2O_3 from its extreme gelatinous to a more granular condition. No amount of boiling that I have tried has effected this. How is it managed, so as to render the filtering easy and rapid? I use a filter pump. b. What is the best method of titrating the Ca oxalate. I find that the colour remains and disappears after a few seconds, during the addition of several c.c. of KMnO_4 , when near the finish? How am I to avoid this, and how tell the exact finish? Or if I ignite the oxalate to carbonate, is there any way of obtaining the precise heat to give CaCO_3 , only such as a metallic bath or any other way than merely by the visible red heat. c. On adding AmHO here I always get a little Fe and Al precipitated. How is this, and how may I avoid it? Of course I have added it to the other Al and Fe. d. I never get this precipitate crystalline. The magnesium phosphate I obtain is flocculent. How is this, and how may I avoid it? I shall be grateful for any help that can be given in this matter to—A SELF-TAUGHT COUNTRYMAN.

[44982].—Rope Driving.—I should be extremely obliged if any of "ours" could give me information about above. 1st. What is the advantage of ropes over gearing as regards friction? 2nd. Is it possible to drive with crossed instead of open ropes, in order to impart motion in any direction to shafting driven from the main shaft without injuring the rope? 3rd. What horse-power will a rope 1½ in. in diameter impart driving from and to a 3ft. pulley? Any information will oblige—ANXIOUS INQUIRER.

[44983].—Mineral—Oil Stoves.—Now that "strong necessity" is forcing many of us to study economy, our attention has been turned to mineral oil-stoves for the purpose of heating sitting-rooms and bedrooms,—particularly the latter,—but we are afraid that breathing the products of combustion might prove injurious to health, especially in the case of delicate or consumptive persons who wish to keep their rooms warm during the night, and, as no reliable information can be obtained from the sellers of the stoves, I venture to trespass on your space, feeling sure that we shall get the precise information we want.—X.

[44984].—Sulpho-Carbonate.—Recommended in the Times of 23rd September last as a remedy for the phylloxera. Will some kind reader give me information respecting this article, and say its probable wholesale price? Could it be manufactured abroad in moderate quantities, without an expensive plant? Any details as

to the mode of its manufacture, or a reference to any work where this information is to be obtained, will much oblige—ITALY.

[44985].—Gas-Fire in Bedroom.—I have a prospect of changing my residence this winter, and, having an invalid in the family, am desirous of arranging a gas-fire in his bedroom. Now, knowing that there are gas-fires and gas-fires, I want to have it done properly at the first; therefore, I seek advice and information from some of the knowing ones belonging to "ours" who have written on the subject, especially "The Gas Man," to whom, a month ago, I inserted an advertisement of my address, but, to my great disappointment, he has not taken any notice of it hitherto.—H. O'B.

[44986].—Pebble Spectacles.—In a well-known optician's window there is a notice to the effect that pebble lenses cut in the proper direction show coloured rings with the polariscope. On trying a pair which I know to be pebble, I saw no rings, but a change of colour only; on rotating the polariser, other lenses, supposed to be pebbles, produced no effect. The same with common spectacle lenses. Will someone kindly explain why I did not get the rings? Also, if the absence of colour is a certain proof that the lenses are only plain glass?—LAWIS ASUNDRI.

[44987].—Carbonic Acid Gas from Chalk and Vitriol.—What quantity of carbonic acid gas can be obtained from a pound of vitriol mixed with chalk? And, what is the best proportion of chalk? What is the expansion of this gas under heat for each degree? Is there any work which enlarges on this subject?—QUEENAN.

[44988].—Matriculation Fees.—Is there any society that advances the fees for those wishing to go in for the Matriculation Exam., London University? I know there is a society which advances fees for women, but is there one for men? The fees are repayable by quarterly instalments. Any information will oblige—HAND-OF-STUDENT.

[44989].—Gas.—Will any of our correspondents kindly inform me how many cubic feet of gas, of average quality, would be required to produce the same amount of heat as one ton of coal? Also, of average quality?—J. W. I.

[44990].—Exhaust.—A description of the exhaust used at gasworks, to relieve the retorts from pressure, would much oblige—J. W. I.

[44991].—Straw-Bleaching.—Will any correspondent kindly detail the methods of bleaching straw used by the Luton or other straw-weaving manufacturers? I believe that in some cases the straw is not dipped in chloride of lime solution, and should be glad to know the process adopted.—A. S.

[44992].—Fan for Planing-Machine.—Would any of your readers kindly give me some information?—What sort of fan or blower would be required to draw the shavings and dust from two or three planing-machines? They are fixed on a floor; the line of shafting and counter-shafts are under. Would it be possible to draw the dust downwards from the machines or not? They are large machines, and in a line on the floor, with a beam running directly over them, the lay shaft directly under. I should like to draw the dust down under. The machines are often driven all at one time. If I made the fan, what would be the best sort to make, and which would be the best way to fix it in the shutters or box?—L. S. D.

[44993].—Advanced Cookery.—I am fairly advanced in the art of cookery, but wish to obtain good standard works upon same to become chef. Will any person of experience assist me? I have attended schools in plenty until my means are nearly exhausted.—OUPHIN NELLY.

[44994].—To "Sperans."—Will you please say whether the statute of limitations bars a claim against the administratrix of a deceased shareholder for calls on shares held by him in a limited liability company?—STUDENT.

[44995].—Main Spring Winder.—Will any of our watch friends kindly describe how the machine is used? Is the outer end of the spring fixed to the barrel, and the barrel held until the spring is wound? And, what is the use of small lever above winder?—NO NAME.

[44996].—Tithes.—What official source or history will supply information of the period when the impost of tithes was first levied in England? the approximate amounts at various periods of British history? the relative amounts appropriated by the clergy and laity respectively at the present time? also, the amount collected in Ireland, if any? if the Tithe Commissioners have any control of the money? or judicial authority in its levy? Is there any audit of receipt and expenditure?—A MEMBER OF THE ANTI-TITHES LEAGUE.

[44997].—Chamfering Oxford Frames.—I have been much interested and assisted by the replies in "ours" as to chamfering Oxford frames; but, as I find most difficulty in cutting out the rebate, perhaps some of your valuable contributors will assist me as to the best and handiest way of doing so. I notice that "S. C. W." (19169, p. 14) refers to the use of the circular saw in forming the rebate; and, may I ask him if it is done in the lathe? And, if so, how is the operation performed?—STREATHAY.

[44998].—Railway Brakes.—To Mr. Miles.—I am very much obliged to Mr. Miles for giving us on p. 622 of last vol. an account of his brake. Will he be good enough to tell me upon what line it is or has been used? I don't see any difficulty in preventing the water from freezing, but at the end I do not understand how the brake becomes self-acting in case of accident. Suppose a train with Mr. Miles' brake runs off the line, or a pipe bursts, will the brake act of itself, or will it be rendered useless?—A DRIVER.

[44999].—Self-Feeding Fountain for Aquarium.—I am constructing an aquarium 3ft. 3in. by 1ft. 4in., and 1ft. 6in. deep. I should like to have in it a self-feeding fountain—that is, not fed from any outside source. My plan is to make a water-wheel 14in. diameter, with a 2in. face. This wheel I should work two pumps (quarter centre) ½ in. bore, and 2½ in. stroke, and

send water into a cistern on the top of the aquarium. This tank or cistern will be about 4in. clear of the top of the aquarium. A pipe from the tank conveys water to run the wheel, and a small pipe for the jet will also be taken from the tank. The pumps will be made similar to an engine cylinder, but with clacks. Do you think the plan will work if neatly carried out? Or, can you suggest another method for a self-feeding jet? It will not do to have an external supply. I want the thing to work itself.—O. F. C. O.

[45000].—Toning-Bath.—Would some able correspondent tell me how to rectify my toning-bath? It has turned black—not through the precipitate, which I allowed to settle and then filtered the clear liquid off. Also, could I strengthen it by evaporation instead of adding more AuCl_3 ? And, what is a good formula for a toning-bath?—W. E. K.

[45001].—Lantern Polariscope.—I have fitted a polarising apparatus to my lantern, and am now preparing crystals for the same; but, not being so successful as I wish, I should feel obliged if Mr. Wright would kindly give me information upon following points:—(1) About what time is required to satisfactorily evaporate a "salicine" solution to procure a slide covered with Newton's discs? All my slides crystallise round the edge only. (2) In order to prepare an Iceland spar slide, which angles should be ground away? I have tried all, but can get no coloured rings, though following as I suppose the directions usually given. (3) Can tops be cut by an amateur, or would it be more advisable to get the crystals cut by a lapidary? (4) Is an aperture of about 1½ in. a fair and useful size to cover well? (5) How can unannealed glass be prepared?—L. U.

[45002].—Darkening Oak.—I am about to darken the whole of the new oakwork of a large house with ammonia. I should be much obliged for any advice as to the best method, and the relative cost (1) of tanning it, (2) of painting the liquid on with a brush. I should also be glad to know if the two methods are equally durable.—ROSECRUIXIAN.

[45003].—Orguette.—Will some obliging correspondent furnish me with instructions for making music for above? What kind of paper is most suitable, and where it can be obtained? Also, in what keys can tunes be played on orguette? Information on these or any other points will be thankfully received by—JACK STAY.

[45004].—Phetometer.—I would thank "Gas-Manager," or any other correspondent, if they would explain the way to use the Lethby phetometer with Methven's standard. I wish to ascertain the cost of gas as compared with other means of lighting—say candles; and I wish to ascertain the number of grains the candles will consume per hour.—GAS-LIGHT.

[45005].—Microscope Slides.—Can any of your contributors inform me what material I ought to use to mount flattened buric acid beads upon glass slides for use with a microscope? In 1880 I mounted upwards of 100 beads on 25 slides with Canada balsam, and they remained unaltered during the summer, but soon after the usual winter dampness set in, the beads absorbed atmospheric moisture, became opaque and white; then a white efflorescence appeared over the surface, and they finally crumbled into powder, so that some six months' work has been nearly thrown away. I was thinking of trying white of egg.—W. A. B.

[45006].—Chemical.—Would Mr. Allen kindly give the atomic weights of the following elements according to the best authorities?—Cerium, Didymium, Erbium, Lanthanum, Thorium, and Yttrium. Also, any particulars with respect to the atomistics and combining weights of the recently-discovered metals—Lanthanum, Neodymium, Scandium, and Terbium, would be thankfully esteemed. And, further, is the balance of evidence in favour of the atomic weight of Uranium being considered as 120 or 240?—W. S. F.

[45007].—Erythema.—Will Dr. Edmunds, or some kind reader of "ours," kindly tell me a remedy for a kind of erysipelas (erythema)? My son, a lad of about 13, has had it now in his face for two or three years. It is principally under his eyes, red and swollen, and the skin shining; it gives him the appearance at times of having black eyes. I notice it is always worse in the evening, and after he has washed. I have had medicine for him from my doctor several times, but without any permanent good.—ANXIOUS.

[45008].—Violin Construction.—Will one of the gentlemen who have been lately writing in this magazine on the above subject kindly inform me as to the following:—Round the belly of a violin are traced two fine black lines. I want to know with what substance these are traced, and, are they made before the violin is varnished or afterwards? I am thinking of staining the violin with permanganate of potash or saffron. Can I use any better stain than either of these?—VIOLIN.

[45009].—Liquefaction of Oxygen and Hydrogen.—How, when, and by whom were these bodies first liquefied? Have they ever been solidified? If so, please give particulars. An early answer will oblige—T. W. ELLERKER.

[45010].—Erecting Small Engine.—To "SUS-LIGHT."—Thanks for your kind offers. The sizes are as follows:—Length of bore inside covers 3-16, through the cover and gland 1-4-32, valve face 1-6-32 + ½, ports 5-32 + 13-32, exhaust 1 + 13-32. I would like it to have four motion bars on with an inside crank. I have not seen the engine you mention.—CROSBYHEAD.

[45011].—Sulphate of Strontium.—Can any of the readers of the "E.M." inform me as to the use of this mineral? During the last few months a certain quantity of strontium has been shipped from the port of Gigenza (Sicily) chiefly, I believe, to Amsterdam. Several small mines of sulphate of strontium have been opened lately in Sicily. It is said to be used for refining sugar in Germany.—ETNA.

[45012].—To "Sperans."—Is it the law in Ireland that tar distillers have to take out a license from the Board of Inland Revenue to enable them to distil tar? Is there a similar law in England? Does the same thing apply to stills used for scientific purposes? as I have

English Mechanic

AND

OF SCIENCE AND ART.

4Y, OCTOBER 21, 1881.

A HAND-MIRROR IN
IVORY.

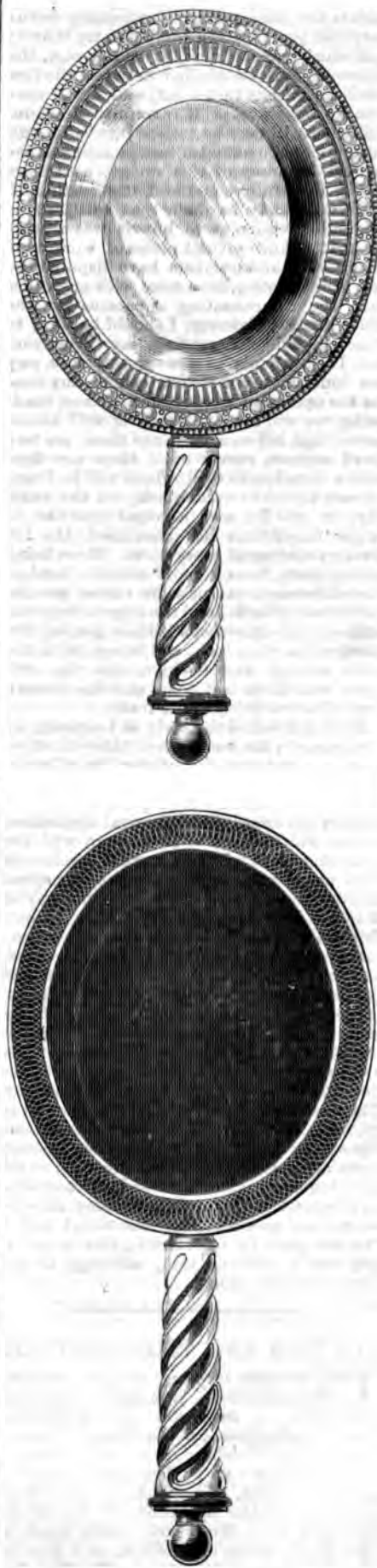
By J. H. EVANS.

It is now time to refer further to the use of the oval chuck, and the application will afford an interesting application, and the handle is a separate interest as it is the use of the spiral apparatus, as described, in connection with the chuck. It will be found by practice of the most beautiful work done by the working of these tools, in connection one with the oval chuck and spiral apparatus probably in next article as applied to the work, by which means only it is with the oval chuck. It will be found, with the chuck on, the apparatus used, as fitted to the front. However, be all put forth in its original state; but having had instructions for another illustration with the oval chuck, I think will form a good and easy device with this special tool. I have of this, as the back of an important feature, the use of the eccentric cutter, in connection with the oval chuck. In the division to be used and the eccentricity also, some little care must be used, in order that it should not cut itself out, so to be always safe to start from the ellipse, as the cuts must become wider apart at the ends. In doing many patterns, this gives some trouble, but in the present little difficulty will be overcome by my instructions are carried

on a piece of work such as is required will require a little care on the operator; first, in the selection of material, which, being ivory, must be with judgment. The best is a nice sound hollow end of a piece of ivory, of sufficient length for the work to be done, of course, a little extra. We will now begin, and with ivory to thickness, just make possible with the aid of a rasp smooth it, it will be better as one, screw a well-seasoned wood on to a flange-chuck, and then the slide-rest in the rough.

Place the oval chuck on the set the movable ring at the chuck denotes that it is in the position of the flange-chuck with the wood on it on the oval chuck, and then smooth surface upon it in the adjusting of the ellipse of the ivory as near as possible to that as little as can be done. It is a good plan just to set the chuck to that point which will be to the shape of the ivory, and with a pencil strike a line which is larger than the material. Where the ivory should be done within this line with glue. There is no absolute adhering strictly to the line, but easily adjusted with the

front wheel after to the exact position required. When the glue is sufficiently set to allow of the ivory being turned, which will be



about forty minutes, the ring of the chuck must be carefully adjusted, so that the ellipse to be turned agrees as near as pos-

sible with the material to be worked upon. We will assume that this has been done, and proceed to turn out the recess which is to receive the bevelled glass; this must be quite a quarter of an inch deep, and the size of the glass. If possible, it is better to procure a French glass, the size wanted, for two or three reasons—it is less expensive, and much better cut on the bevel, while to get one cut takes a long time; at least such was my experience. The recess to receive it should be well fitted, because if it does not the glass will shift, and show more bevel on one side than the other; such a mishap might lead anyone examining the work to fancy that the ivory part was not true.

Having turned out the recess at the back, it will form the means of chucking it to do the front; but in this case, as there is a pattern on it, which must be cut before it is removed, in order that all may be perfectly true together. The divisions for this are taken from the divided pulley in the same manner as for ordinary circular work; and, as I before stated, the only difference will be that the cuts will be closer together at the minor axis. This particular pattern was cut with a double-angle tool in the eccentric cutter of 45° eccentricity, three and a half turns, and cut deep enough to bring the pattern up sharp all over in the original from which this engraving was taken. The effect of this pattern is very pretty indeed, and as a hand-glass of this description is likely to be turned about in all directions, it is as well to have the back as effective as the other parts. There is nothing more in cutting this pattern than any ordinary one with the eccentric cutter, except that the oval chuck is used. The back being finished, the ivory may be taken off the beechwood chuck, and to re-chuck it, a good, sound piece of boxwood will be the best. I must here take the opportunity of pointing out that a wood chuck only should never be used for any kind of oval turning, for the reason that any extra pressure put upon it is likely to screw the chuck further round on the nose, and so alter the position of the ellipse. All wood chucks used for such purposes must be screwed on to metal backs, and the most useful are what we term flange-chucks. I need scarcely point out the result of a wood chuck going further round on the nose; the effect, however, would be the same as turning the tangent-screw of the front wheel, which must, of course, on no account be moved, or the work will be thrown into a different direction. Having offered these cautions, we will proceed to chuck and turn the front part of the frame. The boxwood being fixed to the flange chuck, let it be well bedded home, and with the oval-chuck ring at exactly the same setting—in fact, it should never be moved until the work is finished,—turn a fitting that will fit nicely into the recess, which, being flat inside, will form a face-bearing. The outer face, having the pattern cut upon it, must not be covered with glue; and as there is another face inside for the purpose, there is no necessity for it. The fitting made, apply a little thin glue wherever it touches, and put it under a weight just to keep it down, and in about 30 minutes it may be worked upon, although it is better to wait longer if not pressed for time. In setting about the ornamenting of a frame of this description it will be well always to turn the outline form first, and, in doing this, endeavour, as far as possible, to determine what kind of pattern you are going to cut on the various parts. In doing the present one under our notice, I began from the inside, and cut the moulding. The tool used was a large but shallow moulding drill, and the division of 192 on the pulley, cutting at every hole, the result being, of course, 192 consecutive cuts; although perhaps not distinctly noticeable

in the engraving, they are, of course, closer together at the ends than at the sides; but as before mentioned, this is inherent in all work ornamented by means of the oval chuck, unless a special extra apparatus is added to the lathe-head. This speciality will be treated upon as I will say no more of it at present. I will here bring before the notice of all readers that such patterns as the one now under notice should always be set up sharp, the difference between the major and minor axis is not then so perceptible. We now pass on to the next part, and that will be the plain bead. The difference in the two tools used for these special purposes—viz., the drill spindle and hand tool—afford me a fitting opportunity of fully impressing upon my readers the necessity of strictly adhering to the greatest accuracy with regard to the height of the centres in each case. Should there be any difference between either, perfect work cannot result, and in order to prevent errors arising from such a cause, I always have at hand a centre gauge, that is, an instrument set exactly to the centre of the lathe, which I apply to the point of every tool used, to test its accuracy. To some, especially those of small experience in turning ovals, there may seem to be undue care required. This is not so, and the result of one tool being higher or lower than the one previously used will be to alter the relative outlines of the work to it, and so cause the work to touch the work only at opposite corners, and as a natural consequence, destroy the proportion of the ellipse.

Having impressed upon our readers an important thing to observe, we will proceed, and now arrive at one of the principal features of this specimen of turning—the beads, of which there are 51 in all. It will be observed that these beads are all the same relative distance one from the other, and as I have left the compensating apparatus at the back for the present, I will endeavour to explain how I effected the same with the present case. To begin with, the apparatus used for this particular piece of work was the segment apparatus, which consists of a metal wheel attached to the lathe headstock and set into a tangent wheel, mounted by a screw of the same pitch as a frame wheel. I will not go further into this now, but I hope to illustrate the same thing again, so as to say that the apparatus consists of a means of dividing the work into any number required.

Having mounted the hand tool that will cut the work from the part on which the beads were to be turned, the exact width of the tool is set, and start at any point; but I must advise any one to begin at the centre, and the first now depends with the measurement and depend to a certain extent upon the eye, perhaps it may be argued that this is not a sufficient accuracy, but I may state with all confidence that I do not witness the use of a vernier in any of my work; but when I was asked to make a series of cuts or beads upon the lathe, I found that I was very much mistaken, and as the work of precision is very simple, I will endeavour to explain how it is accomplished. Having made the first cut, the tangent wheel is moved round until the side of the tool is close to the edge of the work. I may say that the tool must be what is known as a "flat" at the end, that is, flat at the ends, the object of this being that all the work between the beads will be finished at the same time the bead is cut. There will not be any difficulty in making the beads perfectly true, but as there are a number of the last two or three beads, the last one coming in the middle, it is better, when about 10 beads are cut, just to go

round the remaining places where those now uncut are to come and see what really is the result, and it may be that a little too much material, or not sufficient for the last bead, will be the result of this experiment. If such is the case consider it extremely fortunate that you took the trouble to try it first; and whichever is found to be the case, the difference must be divided between the few remaining beads to be cut, and I will venture to assert that if carefully done no difference will ever be noticed; and although I cannot and do not wish to argue the mathematical accuracy of this dodge, as I may call it, I am fully convinced that sound and good work may be done that will be free from all detection as to how it was accomplished. I have several pieces of work done in this way, and numbers have disputed the fact of its having been done with any other than the compensating apparatus for the oval chuck. However, I should be sorry to state anything regarding my profession that I am unable to prove; therefore, any one doubting my assertion can at any time see the operation carried out. These beads being, we will say, finished, it will be observed that between each one there are two small concave curves cut; these are done with a round-nose drill. These will be found an easy thing to accomplish; on the outer edge it will be seen a round-nose tool of larger dimensions has been used, the 192 division cutting at every hole. These being cut up sharp, form a most suitable border. The slide-rest must now be turned parallel to the bed of lathe, and the edge of ivory cut with a round-nose tool a little larger, say five hundredths of an inch, and being cut at the same setting and division, the edge will agree with those last done, and this forms a very effective finish to the frame.

Having finished the body so to speak, we now come to the handle, and this will afford us an opportunity of studying the effect of the spiral apparatus used in conjunction with the oval chuck. I propose, when completing the description of spiral apparatus, to give illustrations of it in gear with the oval chuck. It will be seen that this handle is of an elliptic form and that the spiral twists round it, in exactly the same way as if it had been a circle instead of an ellipse, this can only be done when the spiral apparatus is fixed to the back of the lathe-head, as it must of necessity occupy the space and room of the oval chuck if in the front; consequently, both cannot be used at the same time. The tool used for cutting out the pattern was a step-drill, and as there are four consecutive twists or strands, the dividing chuck had to be divided into four. Thus, starting at 96 as the zero, proceed to 24, 48, and 72. I merely repeat these figures in order to impress more clearly upon my readers, the actual meaning of the dividing or spiral chuck; and to show that in all spiral work the lathe-pulley must be abandoned as a divider. The round ball is the last part to be turned; this is not in any way a difficult task, although it will require careful doing.

THE IRON AND STEEL INSTITUTE.

THE autumn meeting of the Iron and Steel Institute, just held in London, has been a successful and interesting one. Capt. Jones, of the Edgar Thomson Steelworks, Pittsburg, Pa., sent a supplementary paper on "The Manufacture of Bessemer Steel," in which he gave some statistics of the operations at his works. The secretary, Mr. Jeans, read a paper by Mr. W. D. Allen, of Sheffield, on "The Use of a Mechanical Agitator in the Manufacture of Bessemer Steel," in which the necessity of securing the perfect diffusion of carbon and manganese throughout the metal was insisted upon. So long ago as

1863 Sir H. Bessemer was aware of the fact that some method of insuring homogeneity in the charge was necessary, but until recently no really perfect admixture has been effected. The method adopted by the Henry Bessemer Company is to stir the metal while in the ladle immediately before casting. For this purpose the ladle is brought beneath a vertical spindle driven by bevel gearing, to which is attached a rod of iron having at its lower end a plate of iron twisted somewhat into the shape of a screw propeller. The rod and the blade are covered with either loam or ganister, the coating being thoroughly dried, blacked, and prepared. Immediately the metal is turned into the ladle the latter is brought beneath the spindle, raised by the hydraulic crane until the "propeller" blade is immersed, and is again lowered and raised, so as to insure a thorough mixing. The blade revolves 100 times a minute, and when, in the judgment of the operator, sufficient stirring has been done, the casting proceeds in the ordinary way. Large quantities of occluded gases are expelled by this means, and the metal flows into the mould with the quietness characteristic of de-molting crucible steel. Every ingot, even from the largest charges, is now found to be perfectly uniform in quality. To obtain the required degree of hardness, it is sometimes necessary to add as much as 14 or 15 lb. of spiegeleisen to the charge of 5 tons of steel, and it is found that unless the mixture be well stirred the result is the production of hard places in the steel. Similarly, when adding ferro-manganese to soften the steel, it is equally necessary to bring about thorough admixture, and in this connection Mr. Allen stated that as little as 28 lb. of ferro-manganese (75 per cent. manganese), if well stirred into the converted metal, was sufficient to render every ingot of a 5-ton charge beautifully ductile and malleable. The violent frothing, so frequently seen in the moulds, is avoided by this process, which costs practically nothing, and the ingots are perfectly sound and uniform throughout. Mr. G. J. Snelus, of Workington, followed with a paper on the distribution of elements in steel ingots, in which he referred to a statement made at a previous meeting, that cast-steel ingots could not be really homogeneous, because a redistribution of the elements took place during solidification, the carbon, sulphur, and phosphorus going to that part of the ingot which remained fluid longest, so that the centre became the most impure. Mr. Snelus, in order to test this question thoroughly, had a large ingot, 7 ft. by 19 in., cast, from which he took slices and borings and submitted them to two able chemists. The analyses agree very closely, and clearly establish the point that carbon, silicon, phosphorus, and sulphur are in excess in the parts of the ingot which longest remain fluid, leaving iron and manganese in excess in the parts from which they have liquated. The discussion was commenced by Mr. Adamson, who held that a mechanical agitator could not produce a satisfactory ingot unless other means were adopted to prevent what he termed the hidden bound skin of the ingot. Dr. Siemens said that both papers deserved the attention of steel-makers, and expressed the opinion that if the metal were allowed to remain in the ladle for, say, a quarter of an hour, but so as not to lose much temperature, the admixture would be more thorough. He had tried agitation by the process known to copper smelters as "poleing," but had never been bold enough to resort to such an agitator as that described in Mr. Allen's paper. Mr. I. Lowthian Bell spoke at considerable length on the subject, and referred to experiments he had made with cast iron, which appeared to show a contrary result to those given in the case of steel by Mr.

there was the least carbon and the portions which remained. He thought, therefore, that ought to be frequently repeated trustworthy conclusions could be erring to the importance of a texture, as insisted upon by Mr. Bell said he thought it possible of the fractures of rails were difference in the chemical composition substances at different parts, then he remembered how small a phosphorus would convert a to an unsafe one. Prof. Abel previous knowledge helped to correctness of the results. Mr. Snelus, and said that fusibility of phosphides and could encourage a tendency of those compounds from the metal which solidified the redistribution of elements steel, Prof. Abel corroborated Mr. Bell, and stated that disced between wrought-iron plates, in carbonaceous matter and and to have lost a good deal of annealing process. After some Mr. Riley, in the course of ed that he had often found ty in the composition of steel ken only a few inches from one. H. Bessemer said that the the mechanical agitator had mer steel to successfully take crucible steel for many pur- pointed out that if in an ingot t a vein of different quality, al had been rolled or ham- might be that one side of a as a table-knife would be soft r side hard, and he gave of a hydraulic cylinder, and to have a vein or stratum at it could not be bored. ption of the mechanical agita- called crucible steel in Shef- d Sir Henry, most commonly el. A paper on the "Basic Herr Kupelweiser, was then h the author gave an account ess made with the Gilchrist- ition at Witkowitz, in Austria. that the weak point of the pro- vatively short durability of the in the special case of his own material, containing only a age of silica, has enabled an in the quality of the bricks to iler-plates made of the basic d at Witkowitz are at least e best brands, the material eat favour on account of vith which it is worked. ubes are welded up from d to the mills, and withstand old to from 20 to 36 per original diameter, while they aged and bent double without he success of the process is, w fully established, as was e reading of a paper by Mr. t, which had been prepared in with Mr. P. C. Gilchrist, and some statistics and technical al working. Mr. Holley, who the discussion, said that the merican manufacturers had not any basic steel, was because ot had time to erect new he demand for steel had been t they could not wait to alter ngements. He gave an inter- at of his visits to different Continent, and explained how America they get a greater h Bessemer plant than makers try. In one large works in king 100,000 tons a year, ade 507 tons; whereas in an works turning out 90,000,

one shift made 555 tons, the cause of the difference being that in the United States they paid attention to small details, and did not lose a minute in waiting for things that, in this country, are not always ready. Mr. Holley added that large works were most economical—two pits costing only 50 per cent. more than one. Mr. Snelus said that the very best class of steel could be made from dephosphorised metal; and Mr. Bell stated that he had found rails made by the basic process were absolutely identical in analysis with those made by the acid process. He also referred to the fact that railway engineers insisted on the old test of dropping a heavy weight on the rails, whereas the North Eastern Company had preferred a harder rail, one that would stand longer wear, and had accordingly increased the percentage of carbon, with, so far, good results.

On the second day Colonel Maitland read a long and interesting paper on the metal- lurgy and manufacture of modern British Ordnance, which was, in fact, a description of the processes carried out at Woolwich. Mr. H. J. Butter, also of Woolwich, read a paper on the "Application of Wrought Iron and Steel to the Manufacture of Gun-carriages"; Mr. Davidson, of Woolwich, read a paper on the manufacture of projectiles, and M. Ferdinand Gautier, of Paris, gave a description of the French method of using solid steel in small arms, projectiles, and ordnance. Dr. Siemens opened the discus- sion, and after some purely technical re- marks, referred to the fact that the Govern- ment Department at Woolwich had adopted his inventions and suggestions without so much as saying "thank you." Sir H. Bessemer gave an account of similar ex- periences in his communications with the Department. The discussion was carried over into the third day, several speakers taking part and criticising the technical details, while thanking the readers for bringing their papers to the meeting. The specifications prepared by the "engineers of Great George-street" were subjected to some ridicule by not a few of the speakers, because they specified tests which no iron could possibly stand. Mr. Wood said that he had a return of a large number of tests which gave for girder iron 18 tons with the grain and 15 tons across; whereas in the case of steel the breaking strain was as much as 48 tons. Mr. Thomas, replying to some remarks that had been made on his paper, said that silicon was purposely introduced for economical reasons, and that where the steel was to be used for rails it was no dis- advantage. The dephosphorised steel has no advantage over hematite steel, except that, with the soft varieties, the total absence of silicon and the very low percentage of phosphorus rendered it better adapted for boiler plates and for drawing into wire. The discussion on the different papers extended so far into Thursday afternoon, that the proceedings had to be closed with- out reading two other papers of an in- teresting character, which will be held over until the annual meeting. The excursions included visits to Woolwich Arsenal, En- field Small-arms Factory, the Stratford works of the Great Eastern Railway, the Newhaven harbour works, and several of the more important factories on the banks of the Thames.

THE PARIS ELECTRICAL EXHIBITION.—VIII.

ALL magnetic telephones are modifications of Bell's, which requires no battery. This, of course, is a great advantage, but in practice it is required that a loud or visible signal should be given to call attention from one station to another. In Gower's telephone this is done by means of a reed, which vibrates in front of the iron plate; the telephone is of a

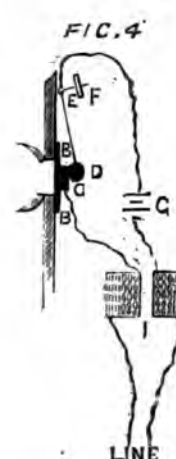
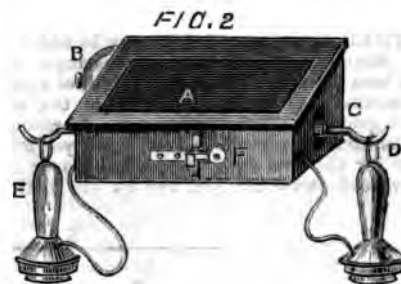
circular form, and from its centre hangs a piece of speaking-tube with mouthpiece. By blowing into the tube we set the reed vibrating, and the sound is repeated loudly enough at the receiving end to be heard in the room. Conversation is then carried on as in an ordinary speaking-tube.



Fig. 1 shows the form of magnet adopted in Gower's telephone.

In Siemens's telephone attention is also called by means of a vibrating reed. The best telephonic systems consist of a microphonic transmitter, a receiving telephone, and an ordinary electric bell for calling attention. Visitors to the Exhibition will have the opportunity of testing the different systems personally, thanks to the Société générale des Téléphones, who have placed in different parts of the Palais d'Industrie several telephonic posts, the general appearance of which may be judged by Fig. 2.

In order to use this instrument we press on F, which rings a bell at the receiving end, and



we wait until our correspondent informs us that he is ready to listen by ringing our bell, B. We then take off the telephones D E from their hooks and apply them to our ears, speaking in front of the microphone A. It will be observed that as we take off the telephone D, the automatic switch C rises, the bell is put out of the circuit, and the telephones are in circuit. When we have done speaking we must not omit to hook on the telephone D, which by its weight pulls down the switch C, or else the bell would not be in circuit for calling, and the local battery for the microphone remaining in circuit would soon get polarised. In all these microphonic transmitters an induction coil is made use of. The microphone and the primary coil are in the circuit of the local battery, and the line is in connection with the secondary coil. In my last article I described Ader's microphone and tele- phone. Crossley's differs in the arrangement of

the carbons, which are four in number, and fixed in form of a lozenge to a thin plate of wood.

Several good vertical transmitters are also exhibited. I notice the Pantophone, by M. de Loch Labye, the principle of which is shown in Fig. 3. A is a plate of cork, supported vertically by two springs, SS, on which is fixed a circular piece of carbon, B, which presses against a metallic claw, C. This metallic claw has its straight edge in platinum, and pressing against B, it is movable about the hinge D, in order to regulate the instrument. The rest of the apparatus consists of an induction-coil, a receiving telephone, an electrical call-bell, with automatic switch. M. de Loch Labye's pantophone is a very sensitive instrument: it will transmit speech at a distance of two or three miles. Of course, by shouting, the distance may be greatly increased.

Another very good vertical transmitter is Maiche's electrophone (Fig. 4), which consists of a cubical box, fitted with four of the transmitters shown in the figure, with the usual induction-coil, electrical call-bell, automatic switch, and receiving telephones. The electrophone may be spoken to at distance, and when spoken to close, it transmits sounds very loudly.

In Fig. 4, A is the opening before which the words are spoken: BB, vibrating disc; C, piece of carbon; D, ball of carbon suspended from E by a brass wire; F is a weight to regulate the pressure of the ball D upon C; G, battery; I, induction-coil.

C. Details.

CART AND WHEEL-MAKING.—XI.

By J. CHARLES KING.

(Continued from page 51.)

OTHER measures of height may be added to the chart: but all the usual bearings, &c., have been marked. When the height of scroll-iron is stated, it means the centre of the bolt which goes through the spring-eye. In reading off the measurements to find the depth you must have for the ironwork—say, scroll-irons, the difference between 2ft. 5in. and 3ft. 4in. bottom

side to side, and shafts also in their attachment, either under or to the sides of the body, the easier will be the ascent and descent by the steps to and from the ground, the lower step being placed several inches outward and forward from the upper step, which must be close to the body and shafts, as shown at B, Fig. 19.

2nd. The wider the spring bearings are upon the axle, the less strain on the axle-arms and springs, as well as other parts of the carriage; therefore lighter wheels, springs, and scroll-irons may be used, and, I may add, shafts also; for, though all these parts are carried on the axle, and by the wheels, it must not be overlooked that it is by the shafts these parts are drawn along and held back; if over rough roads or hills, a greater weight gives the shafts more strain. I cannot do a learner better service than by pointing out at once, by the chart, Fig. 19, the lateral strain on shafts, and the increased draught which is caused by placing the points of draught wrongly. In this matter, coachmakers have too often inconsiderably advanced backward. Technically, the point of draught is the hook to receive the trace of the harness.

I have often had to explain the reason of the draught of one cart being more than another of equal weight, and by a simple alteration of the points of draught, made it run lighter for the horse.

On the chart is marked four different points of draught, 1, 2, 3, and 4. No. 1 is in the middle line of the carriage, and in some dog-carts the point of draught by a swivelled bar called a "splinter bar." This shows the weakest point of draught, as will be obvious if a 6in. block is placed before one wheel only—here is the leverage of half the length of the axle against the horse, which he has to overcome by side pressure against one shaft as a lever.

No. 2 is the ordinary draught-hook, sometimes called a dragon's tongue from its shape. Here the leverage of the axle against the draught is materially diminished, and the strain on the shafts lessened.

No. 3 is the draught-hook fixed to the scroll-iron bolts on each side.

No. 4 is by an "outrigger" at the end of a common axle. Imagine Z to be a stone 6in.

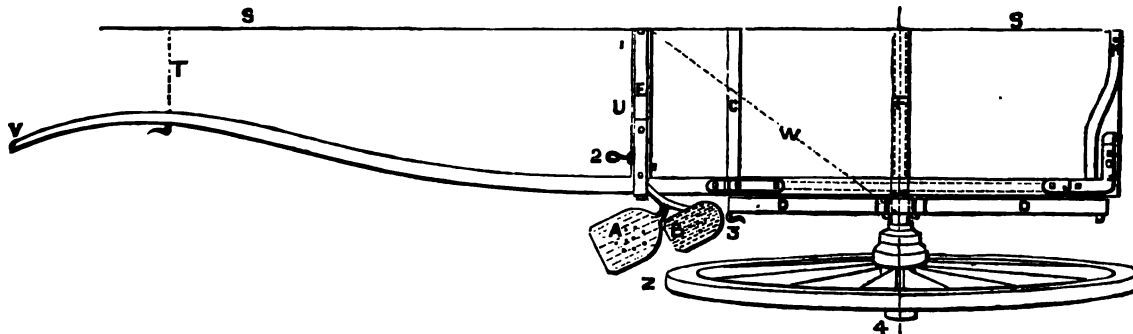
draught. No. 2 is the general point of draught. No. 3 is the position most convenient, and at the same time the best for power, and adopted by the writer for his own dog-cart, though scarcely known in the trade. No. 4 is now seen in England, except for military tumbrils and cannon-limbers, and in Russia and hilly districts in various parts of the world, where the bugbear of appearances and false notions of mechanics do not supersede common sense. How far below the shaft line vertically the draught should be, is of equal importance. If set above the axle, the draught pulls the wheel and load down on to the obstacle; if below the line of the axle, it lifts the wheel and load over the obstacle. The strain on the shafts and wear of harness are lessened. The difference of draught may be estimated at several pounds less, if brought down to the line of the axle.

By keeping the chart, Fig. 18, before you as you plan your carriage and ironwork, and by the use of chart, Fig. 19, it will enable you to rely confidently upon yourself in planning carriage, ironwork, and wheels, and of their being all in just relative positions to each other, and of due proportions when complete, and that your dog-cart shall be easy for riders to get in and out, and the motion of the horse shall be but little felt by the riders, while the draughts will be light—much lighter than some expensive dog-carts and gigs.

(To be continued.)

MOSELEY'S TELEPHONE TRANSMITTERS.

IT was announced some time ago that the Messrs. Moseley, of Manchester, had avoided any liability for infringement supposed to attach to the use of carbon telephones, and as the substance they employ has formed the subject of a patent we are enabled to publish the details. The principal improvement consists in the employment of that salt of copper variously known as precipitated sulphide of copper, proto-sulphide of copper, and cupric sulphide, the chemical formula of which is CuS . This substance is



of body is 4 1/2 in: this is the depth of the stem of the front scroll-iron.

The step-stem is from 2ft. 11 1/2 in., the height of the top of the shaft from the ground, to 1ft. 5in., the height of the lower step or 1ft. 3 1/2 in., depth of step-stem, the upper step being 2ft. 9in. from ground makes it 13in. from the lower step.

When a learner has a carriage ironwork in hand, he will find such a chart as this, even marked on a broad pine lath, more useful for reference than the full-sized drawing.

It must be clearly understood that the term "carriage" applied to any two-wheeled vehicle is the technical name for the shafts and cross-bars, the springs, wheels, and axle are fixed, and the whole is still termed the "carriage," as, of a dog-cart, gig, or sociable, whatever may be the trade name of the vehicle when complete.

To make these essays as exhaustive as possible of interpreting exact statements of construction upon which, even in the trade, there may be some variance, with a desire to promote a higher standard of excellence in cart-making, and to insure ease and safety for the riders, and to give a draught for the horse, I desire to point out that there are four principles of construction which should be considered, and when well understood, the rules for guidance in the construction will be obvious to a learner.

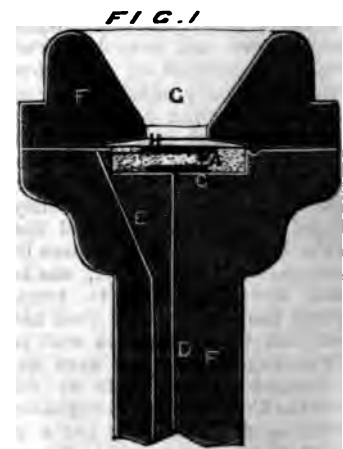
1. The position of the body from

high, which the wheel has to be pulled over, the learner will have no doubt which draught is most powerful for a trace to pull at. To comprehend more clearly the strain on the shafts at times, by the wheel having to be drawn over obstacles, or out of ruts in the road, suppose the shafts from U to V removed, so that the horse could not use them as levers sideways, the force exerted on a swivel-bar at 1 may be set at 180lb. for a wheel to be drawn over the obstacle Z, Fig. 19, by a straight-line draught, the line of the wheel being 2ft. 6in. from the line of draught SS. No. 2 draught is 1ft. 3in. from the line of wheel, and would require 120lb. force to draw the wheel over the obstacle. No. 3, or the scroll-iron draught, is only 9in. from the line of the wheel, and would require 100lb. force to draw the wheel over the obstacle.

No. 4 is outside the line of the wheel 4in., and equal to a 4in. lever to aid the wheels over the obstacle, and would require 60lb. force to make the wheel surmount the obstacle. Sometimes a chain is carried from the swinging or swivel-bar 1, to the axle and spring-clip on each side the axle, as is marked by the diagonal dotted line W. This makes no difference to the draught, unless the bar has splintree-straps, which are pieces of leather fixed round the bar about the distance from the swivel marked at U. This, of course, lessens the leverage of the wheel against the draught, but leaves it a defective

used either in a compressed or in a pulverulent state.

The proto-sulphide of copper is made to form



part of an electric circuit, and is so placed that it may be influenced by the vibrations of a diaphragm when the latter is set in motion by the

the trap together with the lip N, or the two lip and body all in one casting. If the lips are not cast in, they must be soldered to the



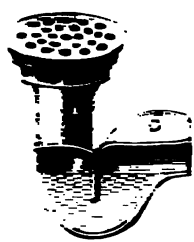
sides of the body. By first soldering in the bottom N, and afterwards the top O. This trap has a lock grating, which is sometimes made to work with the bayonet-joint. (See Eye and Answer's trap.)

Eye and Answer's Trap (Figs. 112 and 113).

This trap, as represented in Figs. 112, is made after the O-trap pattern, but has an improved lock-grating, which consists in the adoption of

FIG. 112.

FIG. 113.



the well-known bayonet-joint, as shown at A. The grating shown in Fig. 113 is different in this respect, that it has a screw, as shown in the sectioned part at B. These traps being made of iron are of course useless for water-closet work.

Trap Gratings (Figs. 114 and 115).

Trap-gratings should always be made to allow, so that the trap will take away: the holes should



be made taper from the underside, as shown in Fig. 114, in which it will be noticed they are tapered from the bottom side. Fig. 115 shows the top side, as also a section fixed with screw A. B. the section of which is shown in Fig. 116.



FIG. 116.



As the traps are made my remarks on the manufacture of traps, which, I trust, are now understood, at least the junior mechanics of the trade.

THE TELELOGUE.

EXPERIENCE proves that the visibility of signals observed at a great distance depends mainly on the contrast produced by difference in brightness of the signals and that of their background. Several systems of aerial telegraphy have been contrived, in which opaque bodies were presented on the luminous background of the sky. It is the opposite principle that is adopted by Captain Gaumet in his so-called *telelogue*, and the method has certain advantages.

The signals are produced by means of a silvered surface appearing on a dull black ground. The apparatus is slightly inclined, so that the silvered surface acquires considerable brightness through reflection of diffuse light from the sky.

Captain Gaumet has chosen as signals the alphabetical and numerical characters, considering that people will most easily make out at a distance the signs they are most familiar with nearest at hand.

The telelogue comprises two essential parts: (1) a telegraphic album, for supplying and presenting the signals, and (2) a telescope for observing them.

The former consists of a collection of 40 framed sheets of black canvas, on which the silvered letters are attached. To communicate, each is made to be folded once on itself. Each sheet bears, exteriorly, an index, by means of which it can be easily found. The signals comprise the 25 letters of the alphabet, the 10 numerals, and some signals for facilitating communications. The silvered rectangle serves to call attention. The cover of the album is formed of two right triangles, which can be combined in various ways, giving a tripod support, giving any desired inclination to the signals.

The telescope is small, and light, but has considerable magnifying power; and the observer, sitting behind the tripod, rests the telescope on the upper edge of the signal-frame. The dimensions of these instruments vary, of course, according to the distance. With the long-range kind, signalling can be carried on at 12 kilometres' distance; and there are also sets for eight and for four kilometres. In countries with a very clear atmosphere the maximum here indicated can be considerably exceeded.

For use by night, the telelogue requires an artificial luminous source illuminating the signals sufficiently. It is found, in practice, that a strong petroleum lamp suffices for the shorter distances. For the longer, two lamps are required. Of course, an electric or oxy-hydrogen light is much better when available.

When the apparatus is got into position the silvered rectangle is first shown, giving, at a distance, the effect of a bright point. Immediately this is perceived at the receiving station it is there repeated to indicate that the observers are ready to receive a message. Then the different letters of the telegram are successively exhibited. Between each word the rectangle is shown, and it is shown twice at the end of a phrase.

Where a letter or figure has to be repeated, it is momentarily hidden by a screen after being first shown. The receiving observer calls out the successive letters, as they are recognised, to an attendant who writes them down. Or he may himself write while he carries on the observations.

As the velocity of light may be considered infinitely great, each signal is perceived instantly on its appearance: thus the rapidity of transmission depends merely on the rapidity with which the various signals can be exhibited. It is found that the transmission of a telegram of 20 words can be effected in five minutes, each word being transmitted in full. The speed could be considerably increased if conventional values, fixed by vocabulary, were attached to the signals.

To meet the case of possible interception of a message, the field of vision may be limited by means of two sheets of dark canvas, or any system of cryptography may be adopted.

This telelogue is a simple and ready means of communication which is capable of various applications.

Thus it might be easily used between two localities within sight of each other, which cannot have the electric telegraph. Some tower or spire would, in many cases, be the most convenient signalling station. It is especially in mountainous regions that the telelogue is calculated to be of service, where the length of journey between two places is often twice or thrice the distance "as the crow flies." Much fatigue might thus be saved. In mountainous districts the construction of a telegraph line is often very arduous, and liable to frequent interruptions through storms. Across rivers, again, the telelogue should be a valuable means of communication. In military work there are various obvious applications of the system.

The apparatus has been publicly experimented with in Paris in presence of high scientific and military authorities. Instantaneous communications have been established with it, between the Trocadero, the Pantheon, the Tuileries, and the Ecole Militaire, and have given the best results, spite of rain and fog.

MEASURING CURRENTS BY ELECTROLYSIS.

AFTER introducing his system of absolute unit for measuring electric quantities, Weber determined the electro-chemical equivalent of water, that is the weight of water decomposed in a second by a current of electro-magnetic intensity equal to unity. Taking as units the millimetre for length and milligramme for mass, he found it 0.00011 milligrammes. Other physicists, including Joch, Bunsen, and Kohlrausch, redetermined this value, but as there is a variation of 1 per cent. on either side of Weber's result, it is questionable what is the correct value; and M. Mascot has therefore made a fresh measurement of the quantity. He employed a voltameter with electrodes of very fine platinum wire and water rendered more conductive by dissolved phosphoric acid. This was placed in a vacuum, and the gas evolved was drawn off by a mercurial pump and measured in a dry state. There is thus no formation of ozone or condensation of gas on the electrodes, nor any loss by diffusion in the liquid. This result was checked by the plan of weighing the deposit of copper in a solution of copper sulphate, and that of silver in a solution of silver nitrate. To measure the current he used an electro-dynamometer, in preference to the magnetic tangent galvanometers, which have hitherto been employed by other experimenters for the same purpose. Thus he was able to get rid of the earth's magnetic force as an element of the problem; and the effect of heating up the bobbin of the instrument by the passage of the current was carefully eliminated. By these means M. Mascot finds that the electro-chemical equivalent of water is 0.00011, a result which is almost identical with that of Weber, and which he considers correct within one-tenth per cent. Adopting the practical units of the British Association, it follows that a current of which the electro-magnetic intensity is represented by one weber decomposes in a second a weight of water equal to 0.00011 milligrammes, or more generally a fraction equal to 0.010416 of the equivalent of a body expressed in milligrammes. The intensity of a current capable of producing in a second of time the electrolysis of one chemical equivalent of a body expressed in milligrammes would, therefore, be equal to 9648 webers, or practically 96 webers.—*Engineering*.

THEORY OF THE ACTION OF RAILWAY BRAKES.

THE author first gives the equations for a heavy wheel moving forward on a rough horizontal plane, and at the same time turning round its axis with given angular velocity, and points out that if this given angular velocity be not originally such that the linear velocity of the periphery equals the horizontal velocity of the wheel (in other words, such that the wheel rolls on the plane) the effect of friction will speedily cause it to assume that particular value. He then takes the actual case of a railway vehicle acted on by a brake, and points out that the effect of the frictional resistance of the brake block is to produce an equal and opposite frictional resistance between the rail and the wheel, and that it is this latter variable resistance which is the real external force tending to stop the vehicle; the brake-block friction must be treated as an internal force. He then forms the ordinary equations for expressing the linear and angular acceleration of the wheel in terms of the applied forces, and from them deduces two expressions for fX , the frictional resistance between brake block and wheel, one of them in terms of the time, the other in terms of the distance which is passed over by the wheel from the first application of the brake until it comes to rest. (These expressions, however, assume that the coefficient of friction between brake block and wheel immediately becomes constant, and will require correction in order to take account of the fact, now established, that this coefficient varies with the speed, and is therefore never the same at any two moments during a stop). The expressions for X show that, when the wheel is stopping, the frictional resistance of the block is greater than that of the rail by an amount which is, in fact, the force expended at each moment in destroying the *vis viva* of rotation in the wheel. This excess, however, is insignificant, amounting, in the case of an ordinary railway wheel and axle, to about 20lb.

The maximum effect of a brake is attained when the rail friction which it calls into play is the utmost which the rail is capable of exerting, i.e., is equal to the weight on the rail multiplied by the coefficient of friction between rail and wheel. Any greater amount of brake friction can only be expended in stopping the rotation of the wheel, i.e., in causing it to slide. The value of this maximum pressure is easily obtained from the general equations. The high value of this maximum ap-

* By E. PEARSON, in the Abstracts of the Institution of Civil Engineers.

to conflict with the well-known fact that the heavily-loaded wheels of a tender can be skidded by means of ordinary hand brakes by a single man. This the author considers to be from two causes (1) the great mechanical advantage given by the screw-gear of an ordinary brake, amounting to about 60 to 1; (2) the fact that the surface acted on between wheel and rail is very much larger than that acted on between wheel and rail, and that, according to the law, the total friction for a given pressure is in the ratio of the area.

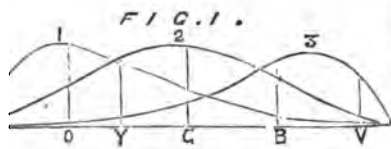
The author then goes on to consider continuous brakes, and lays down the five following essential features for a good brake:—1. Before everything, the brake must be of simple construction, combined with strength and mobility in the parts, for rapid application. 2. The brake to be controlled either by hand or by guards. 3. The action to be automatic, so that in case of accident the brakes shall put themselves on. 4. The brake to be available even when the train is not completely made up. 5. The brake power to be always ready, and easily increased or diminished, so that it may be used for stopping the train in ordinary running, as well as for stopping it altogether. The author finally describes the Heberlein brake, and observes that it is seen at once to fulfil the first four conditions, it is otherwise with the last, since it seems probable that a comparatively small friction roller will be able to produce the great pressure on the wheels required to elicit their maximum effects. Therefore, gives a theoretical investigation to show that by varying the angle which the hanger of the friction roller makes with the horizontal, a of any required amount can be brought on by means which actuate the brake block.

COLOUR BLINDNESS.—II.*

By R. BRUDENELL CARTER, F.R.C.S.

(Continued from page 130).

I have just stated, Professor Helmholtz, in his account of the theory of colour sensation, that there are in the normal eye three kinds of nerve fibres, that stimulation of fibres of the first kind produces the sensation of red, that stimulation of the second produces the sensation of green, and that stimulation of the third kind produces the sensation of violet. He assumes also that homogeneous monochromatic light excites these three kinds of fibres in varying degrees according to the wave-length. The red-perceptive fibres will be most excited by light of the greatest wave-length, the violet-perceptive by light of the smallest length. It must also be assumed, however, that each colour excites all three kinds of fibres, though it excites one kind much more strongly than the other. Helmholtz illustrates this by the curves shown in Fig. 1, in which the colours of



spectrum, omitting the indigo, are arranged in from red to violet, and in which the three curves represent the intensity of stimulation of the three kinds of fibres. The curve marked 1 represents stimulation of the red-perceptive fibres, the curve marked 2 represents the stimulation of green-perceptive, and the curve marked 3 represents the stimulation of the violet-perceptive

fibres. The red strongly stimulates the red-perceptive, the other two: sensation, red.

The yellow stimulates moderately the red and green-perceptive, feebly the violet: sensation,

The green stimulates strongly the green-perceptive, much less the other two: sensation,

The blue stimulates moderately the green and violet-perceptive fibres, feebly the red: sensation,

The violet stimulates strongly the violet-perceptive, feebly the other fibres: sensation,

Strong stimulation of all the fibres gives sensation of white or whitish colours.

Professor Helmholtz is fully aware of the difficulties which impede the acceptance of Young's theory of their being three kinds of fibres, and suggests, as a possible modification, that three

separate functions may be discharged by each fibre. Whether this be so, it is not at present either possible or very important to ascertain; and either of the foregoing hypotheses, or the hypothesis of variations of tension rendering the fibres incapable of responding to certain rates of vibration, will serve almost equally well to explain the phenomena which have been observed.

In speaking of these phenomena, Professor Helmholtz has made use of Helmholtz's diagram, and has modified it in such a manner as to exhibit the effects of colour blindness. I could not present the whole question to you in any other way so well as by quoting his words, which I take from the American translation published by the Smithsonian Institution. He says:—

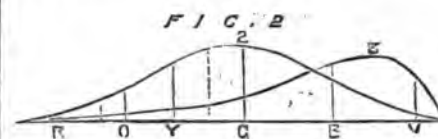
"To explain the abnormal sense of colours by the theory of the normal, we can, in advance, suppose various possibilities. Let us conceive that one of the three fundamental perceptions is wanting, or that one of the primitive colours is absent: it is clear that the whole chromatic system will be upset. It is evident, therefore, that this system must be completely different, according to the absence of one or the other of the three primitive colours. It is virtually just in this way that it has been attempted to explain cases of a strongly marked defect in the chromatic sense, or genuine types of blindness to colour, found in real life. The term colour-blindness has been justified by this, as it indicates in each case a genuine blindness to one of the primary colours. In this way, therefore, we distinguish, according to the kind of element wanting, three classes of blindness: namely red-blindness, green-blindness, and violet-blindness."

According to the theory, blindness to red is due to the absence or paralysis of the organs perceiving red. Red-blindness, then, has but two fundamental colours, which, adhering strictly to the theory, are green and violet. The curves in the second diagram distinctly show what aspects the various kinds of light must have for a person who is placed in such a condition.

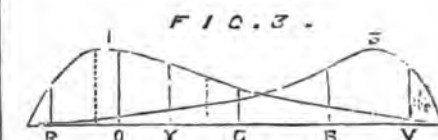
The red of the spectrum, which feebly excites the perceptive organs of green, and scarcely at all those of violet, must appear to the red-blind as a saturated green of a feeble intensity, more saturated than green as visible to the normal eye, for into this sensible portions of the other primitive colours enter. Feebly luminous red, which affects the perceptive organs of red in a normal eye sufficiently, does not on the other hand sufficiently excite the perceptive organs of green in the red-blind, and it therefore seems to them black. The yellow of the spectrum seems to them a green, saturated and intensely luminous, and as it constitutes the precisely saturated and very intense shade of that colour, it can be understood how the red-blind select the name of that colour, and call all those tints that are, properly speaking, green, yellow. Green shows, as compared with the preceding colours, a more sensible addition of the other primaries, and it consequently appears like a more intense but whitish shade of the same colours as yellow and red. The greatest intensity of light in the spectrum, according to Seebeck, does not appear to the red-blind to be in the yellow region, as it does to the normal eye, but rather in that of the blue green. In reality, if the excitation of the perceptive organs of green, as it is necessary to assume, is strongest for green, the maximum of the total excitation of the red-blind must be found slightly towards the blue side, because the excitation of the organs perceiving violet is then increased. The white of the red-blind is naturally a combination of their two primitive colours in a determinate proportion, a combination which appears blue-grey to the normal sight; and this is why the red-blind regards as grey the transition colours of the spectrum from green to blue. Then the other colour of the spectrum, which the red-blind call blue, preponderates, because indigo-blue, though somewhat whitish according to their chromatic sense, is to them, owing to its intensity, a more evident representative of that colour than violet.

This description of the manner in which the red-blind form a conception of the different kinds of light of the spectrum is assuredly a conclusion logically deduced from the theory; and it accords so well with the experience acquired in examining the colour-blind, that it might serve to corroborate and support the theory. We will simply add one point for our special practical purpose, or rather will emphasise one point. As a matter of fact, it is clear that red light and green light excite one and the same element in the colour-blind. Rays which are respectively red and green, or objects which are respectively red and green, to the normal sense, must seem to a red-blind person to be of the same colour; and if, in special cases, he knows how to discriminate between them, his judgment is simply guided by the intensity of the light. The intensity of the light is much more feeble, as shown by diagram 2, in red than in green. If then, a red-blind individual finds that a red and a green tint are exactly alike, the green would, to a normal eye, be much less intense than the red. This is distinctly shown by the vertical dotted lines between R and

O, and between Y and G, in Fig. 2, and is also entirely confirmed by experience.



Green-blindness derives its origin, according to the theory, from the absence or paralysis of the perceptive elements of green. The green-blind has therefore only two fundamental colours, red and violet, and the spectrum for green-blindness should be constructed as in Fig. 3. In such a case

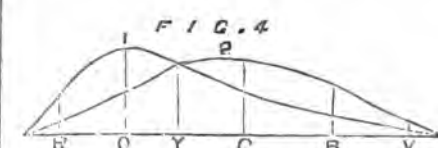


the red of the spectrum, which strongly excites the perceptive organs of red, and but very faintly those of violet, must appear to the green-blind as an extremely saturated red, but of a light somewhat less intense than the normal red, which is comparatively more yellowish, as green forms a part of it. The orange of the spectrum is again a very saturated red, but much more luminous. Yellow is undoubtedly a more intensely luminous red than the red of the spectrum, but, on the other hand, more whitish, because a sensible portion of the other primitive colour enters into its composition.

Green, with its shades inclining to yellow and blue, ought, correctly speaking, to be a saturated purple, and with a mean intensity of light; but it is the white or grey of the green-blind, being composed of almost equal parts of the two remaining primitive colours.

The blue is an intense violet, but a little less saturated than indigo, which is more strongly luminous and more saturated. Violet is a little less intense, but more saturated than normal violet. The tints most luminous, and at the same time most saturated, which must constitute the types of the primitive colours of the green-blind, are orange, or its immediate neighbour in the spectrum, red, and indigo-blue. Now orange is a colour which, in ordinary language, especially amongst the uncultivated and unpractised, is indiscriminately called red and yellow: this fact explains why the green-blind denominate their first primary colour sometimes "red" and sometimes "yellow." We will add to this description the same remark that has been made about red-blindness. In green-blindness the same organ is found affected by the red and by the green of the spectrum. Red and green are therefore perceived by the green-blind in the same way, or, in other words, are to him exactly the same colour. In cases where he succeeds in distinguishing them, it is by the aid of the intensity of the light; but, with regard to this intensity of light, it is the opposite of what occurs in the case of the red-blind. A green tint which to the green-blind appears exactly like a red one would to a normal sense of colour be sensibly more luminous than the red. This is shown by the dotted vertical lines between R and O, in diagram 3, and also by those between Y and G, and is confirmed in every respect by experience.

Violet-blindness is due, according to the theory, to the absence or paralysis of the elements perceiving violet. The two primitive colours of the violet-blind are then, according to the theory, red and green; and their spectrum must be represented as in Fig. 4. In this condition the red is a pure



red colour, not yellowish, than normal red, but still less saturated. The more it inclines towards orange, the more strongly luminous it is, but it is at the same time less saturated, more whitish. The yellow is, as it were, a combination of almost equal proportions of the fundamental colours which form white. Green is a strongly luminous but whitish green, which in tending towards the blue, becomes more and more saturated, so that greenish blue must be the type of these hues. The

* Substance of a series of Cantor Lectures delivered at the Society of Arts.

blue is a green of moderate luminosity, and strongly saturated; and violet is green very feebly luminous, but also saturated in a much higher degree than the normal. A violet strongly luminous is sufficient to induce this green, but a feeble violet, although very sensible to the normal eye, is black to the colour-blind in question. It is plain that the violet-blind, whose primitive colours are red and green, do not confuse these colours.

Besides the cases arranged under the three foregoing heads, in which one colour is absolutely expunged from the spectrum, there are others in which the perception of one colour, although not entirely wanting, is yet deficient in acuteness; and this deficiency may vary greatly in degree. There are also cases in which there is a deficiency of acuteness in respect of all colours, so that, in a diagrammatic representation of the state of function of such an eye, all three of the curves would be drawn lower than the normal, although no one of them would be absent. Such a condition would imply, manifestly, a diminished acuteness of perception for white light, that being formed by the union of the rest, and it is found in the cases of so-called night blindness, the subjects of which, although able to fulfil ordinary avocations in the daylight, almost lose vision on the approach of dusk. There can be no difficulty in perceiving that colour-blindness, or rather defective colour vision of this kind, may merge insensibly, as in the progress of disease, into absolute loss of vision.

In the perfectly healthy eye the power of distinguishing colours varies greatly with the part of the field of vision from which the colour proceeds. In order to examine the lateral parts of the field of vision we use an instrument called a perimeter, of which I here exhibit one of the forms. The eye under examination is made to look steadily at this central point, while a second object is made to glide along this arc, from its termination towards its centre, and the arc is shifted from one meridian to another as may be required. Now the second or moving object first becomes visible in the outer parts of the field, solely by form and not at all by colour, which cannot be recognised. Its appearance depends mainly upon whether it be lighter or darker than the surrounding area, and hence the moving object, of whatever colour, will appear black or grey on a light ground, and white or grey on a dark ground. As the object advances it enters a zone of the field of vision which is sensitive to violet, next a zone which is sensitive to green, and sensitiveness to red only commences at a still later period, while full sensitiveness to all three of the primary colours exists only in the central portion of the retina. With a little practice, it is not difficult to hold a red object in such a position that its form is still visible, while its colour ceases to be distinguished.

Upon the basis of the foregoing facts, Professor Hering has proposed to divide and classify colour-blindness as follows: and his proposals have received the general assent of those engaged in the investigation of the subject:—

1. Total colour-blindness, in which the faculty of perceiving colours is absolutely wanting and where the visual sense consequently can only perceive the difference between darkness and light, as well as the different degrees of intensity of light.

2. Partial colour-blindness, in which the faculty of certain perceptions of colour, but not of all, is wanting. It is sub-divided into—

1. Complete colour-blindness, in which one of the three fundamental sensations, one of the three perceptive organs of colour in the retina, is wanting or paralysed, and in which, consequently, the coloured visual field has but two ranges. This group includes three kinds, namely:—

- (a) Red-blindness.
- (b) Green-blindness.
- (c) Violet-blindness.

2. Incomplete colour-blindness, where one of the three kinds of elements, and perhaps all, are inferior in excitability or in numbers to those of the normal chromatic sense. Incomplete colour blindness exhibits like the normal sense, three aspects to the visual field but is distinguished from it by an unusually small central field. This group includes the whole of a series of different forms and degrees: a part of which, comprising the superior degrees, might be called incomplete red-blindness, or incomplete green-blindness, or incomplete violet-blindness, and constitutes the transition to the corresponding kind of complete colour-blindness; while another part, comprising the inferior degrees, which we call a feeble chromatic sense, constitutes the transition to the normal sense of colour.

Of the varieties thus indicated, two, the complete red-blindness and the complete green-blindness, are overwhelmingly more important than all the rest, and to them, in the subsequent lectures, I shall have chiefly to direct your attention. The violet-blindness is a comparatively rare condition, and, in the present state of industry, we are not

aware that it is a source of harm or danger to anyone, although it may possibly sometimes be responsible for errors of colour in pictures, in decorations, and in dress. The complete forms of red and green blindness, on the contrary, have been contributory to much destruction of life and property in railway travelling and in steam navigation; and are sufficiently common to have a pressing interest for us all. I may perhaps add, in this place, that whereas there is nothing intrinsically impossible in the supposition that incomplete colour-blindness may be improved by cultivation and practice, there is great weight of evidence, as well as all analogy and probability, in support of the belief that complete colour-blindness is an unalterable condition, upon which educational efforts are simply thrown away. If there are no nerves capable of responding to a given stimulus, the mere repetition of the stimulus will have no tendency to create them.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE first meeting of the session of the above society was held on the 12th inst., at King's College, Strand, the President (Professor Martin Duncan, F.R.S.) in the chair.

The list of donations received since the last meeting was submitted, and the thanks of the society voted to the donors. The President remarked upon the great beauty of the photographs presented by Dr. J. J. Woodward, of Washington, illustrative of the appearances of the specimens described in his paper on "Pseudo-polypi of the Colon," as seen with the naked eye and under the microscope.

Mr. Crisp exhibited and described Cosson's dissecting and observing microscope, Goltzsch's binocular microscope, Lacaze-Duthier's large porteloupe, Nachet's microscope for the examination of the skin, &c., and a microscope, of German construction, with movable stages on the plan described on pp. 880-1 of Vol. III. of the *Journal*. Also some micro-photographs of various objects, by Mr. J. H. Jennings, of Sherwood Rise, Nottingham, taken with the eyepiece in place so as to avoid the central more or less marked "flare spot," found to exist when the objective alone was used, the definition, nevertheless, being unimpaired, and the photographs sharp. Mr. Crisp also called attention to a slide of Foraminifera of exceptional excellence, exhibited by Mr. J. H. Bolkwill, of Dublin, containing 50 species on a photographed background, with the name of each species.

Mr. J. W. Stephenson exhibited two slides of test diatoms, the one mounted in balsam and the other in phosphorus, pointing out, in reply to a question, that where the refractive index of the medium was approximately the same as that of the object, the latter would be nearly invisible when mounted, its degree of visibility depending upon the difference between its refractive index and that of the medium. The refractive index of the silica of the diatom was about 1.43, that of the balsam 1.54, and of the phosphorus, 2.1. So that the visibility of the diatoms in phosphorus, as compared with balsam, was as 67 to 11.

Mr. Curties inquired what was the mode of mounting, and what preparation was required beforehand?

Mr. Stephenson said that the medium was a solution of phosphorus in bisulphide of carbon. Care was required owing to the extremely inflammable nature of the mixture; but the bisulphide of carbon evaporated so completely that the diatoms might be said to be mounted in nearly pure phosphorus.

Mr. Beck said that Müller had been making a series of experiments on mounting diatoms in these highly-refractive substances, and he had found that, when phosphorus was used, the results were very remarkable.

Mr. Ingpen said he should like to hear from Mr. Stephenson what would be the difference in visibility between a substance mounted in a medium of much greater refrangibility than itself as compared with one mounted in one which had a much lower refractive index.

Mr. T. C. White inquired if Mr. Stephenson had employed phosphorus as a medium for mounting histological subjects? He thought the extension of its use to such objects would give very interesting results.

Mr. Stephenson said that, in addition to diatoms, the only objects he had so mounted were scales of *Lepisma*, *Fedura*, and some others. The visibility of a diatom in air would, as he had said, be about 1.43 as compared with 2.1 in phosphorus, and the difference of .67 would give as a result that the object would be about 47 per cent. more visible in phosphorus than in air.

Mr. Crisp said that the difference in visibility between the two slides was even more strikingly brought out by looking at them with a low-power pocket-lens. While nothing could be seen but the

outline in the case of the balsam objects, the markings of those in the phosphorus were clearly distinguished.

Mr. J. Mayall, jun., at the request of the President, explained the construction of the new form of diaphragm adopted by Messrs. Queen and Co., of Philadelphia, for Beck's vertical illuminator.

Mr. Mayall said the application of serviceable diaphragms to the vertical illumination had long been recognised as a serious want by those who were familiar with the use of the device. The wheel of diaphragms applied by Powell and Lealand no doubt gave good results in the hands of an expert; but it was felt that there was still something needed to give greater command of the illumination. The diaphragm he exhibited (which he figured on the blackboard) was an attempt in this direction. It was devised by Mr. Tighlman, of Philadelphia, and constructed by Messrs. Queen, of that city, and was remarkable for its simplicity. It consisted of a short piece of cylindrical tube, from which about one third of the circle was cut out, made to slide at will as an outer jacket over the circular aperture through which the illuminating rays passed on to the reflecting plate of glass, and thence were refracted to the object by the objective—the objective thus serving as the illuminating lens. The square end of the sliding cylinder passing variously over the circular aperture cut off larger or smaller segments of the opening in the main tube, either vertically or horizontally; and two small openings gave additional facilities for varying the effects by the movement of the sliding cylinder. Whilst admiring the simplicity of this arrangement, Mr. Mayall said he was bound to remark upon the difficulty of using any form of diaphragm attached to the nose-piece of the microscope focussing by the nose-piece, where the slightest touch of the hand generally produced the most bewildering excursions of the image. He had hitherto obtained the best results with the vertical illuminator, not by using a diaphragm but by careful adjustment of the position of the lamp. He had not yet had an opportunity of testing Mr. Tighlman's diaphragm, but obviously it would give a considerable range of effects by very simple mechanism.

Mr. Crisp described, by means of a drawing on the board, Nachet's improved form of camera lucida with a gold film, which he believed had been seen for the first time in this country at the recent Sanitary Exhibition at South Kensington.

Mr. Ingpen said he had used one of the same kind for three or four years, with the exception that he had a silver film instead of a gold one.

Mr. Crisp called attention to the explanation of Prof. Abbe in regard to the use of two illuminating beams for binocular microscopes, whereby advantage was taken of the large effects of parallax presented by wide-angled objectives, while, at the same time, the loss of penetrating power attendant upon the wide angle was diminished by one-half.

Mr. Stewart described a curious appearance of luminosity observed studding the sides of the dark caves and tin-mines in the neighbourhood of Dartmoor. On examination he found it to emanate from a number of small cells filled with a pedicel cell-sap, and containing some small chlorophyll bodies. The appearance was that of the emission of a golden-green light, and was apparently produced by the cells reflecting white light, which assumed a greenish tinge from the colour of the chlorophyll bodies. The effect was probably due to a reflection similar to that of light from droplets of dew. He believed that these cells were an immature form of moss.

The President reminded the Fellows that at their last meeting he had called attention to some silicious spicules obtained from great depths, and had specially referred to some minute canals seen in them, and to some evidence which seemed to show that a minute cell-form had to do with the perforation and enlargement. He confessed to having felt some little doubt as to the derivation of the spicules, although when things were given to him by a friend he felt bound to accept the representations made about them. In this case, to make sure, he asked Mr. Moseley to let him have a small quantity of deep-sea soundings, taken during the *Challenger* expedition, and he found there not only spicules with these canals, but also found the green uni-cellular substance itself. In correspondence with Mr. Carter, he had obtained sufficient information to enable him to venture to write a short paper on the subject in the "Annals of Natural History." He found also very clearly that the little penetrating tubules did not always reach the axial canal, but often ended in a bulb. Of course, this thing must have a name, and so the name *Spongiophagus* had been proposed for it, and he was very glad to find that Mr. Carter was investigating it. The great interest, of course, was as to the manner in which a growth of that kind could absorb the silica and seem to feed upon it; probably, however, its nutriment was derived from the remains of the organic portions of the sponge.

Mr. Crisp said that Mr. Carter had recently dis-

ed a *Spongiophaga* in some fresh-water forms had not previously been recognised.

President announced that the Council had nted a small committee to consider the sub- of standard gauges for eyepieces and sub- s, and they would be glad to hear any ons from Fellows present as to carrying out latter. A great deal of attention had recently drawn to the subject.

Beck, in reply to the President, said it might bly be considered to be out of place for a ifactor to give an opinion upon the subject; e thought that the suggestion would be found alt to carry out in practice, particularly if it contemplated that all opticians should accept me standards. It was beyond question that s desirable that there should be a uniform e for object-glasses, so that those of various rs might be interchangeable; but when they eyepieces, he thought that if the Society d say that he must make his eyepieces the size as Nachet's, for instance, he could not t it, although, no doubt, Nachet had as good ns for adopting his own pattern as English rs had for theirs. It must also be borne in that the length of the body was an important with some makers, and so was the length of istage, and the same apparatus would clearly suitable for all microscopes.

Crisp said that he did not suppose it would ggested that there should be only one gauge yepieces.

T. Powell, in reply to a question, said that ite concurred in the remarks of Mr. Beck. Curries did not regard it as an impossible result ry out the object for which the committee appointed, but he should himself prefer that latter be left where it was. A maker doubtless his apparatus in the way best suited to his microscopes, and he could not be responsible a performance when otherwise employed.

Groves said that, speaking as a worker, he ht that if the idea could be carried out, it d be a great comfort to himself and his fellow- ers, especially in the case of a class of students, e it would be of the greatest convenience to le to apply various apparatus to the same scope.

Crisp said that at their first meeting after the ee of the British Association at York a protest d be entered, not against the remarks of Sir Lubbock, but against the provincial papers had headed the paragraphs of the Presiden- Address which related to the visibility of s with the title, "Stagnation of the Micro-." Before many years the Society would be rating its jubilee, and perhaps then their lent would be able to show how much had done during the last 50 years to improve both trument and the objective.

Beck said that he should very much like to mited action amongst the Fellows of the ty in regard to some special subject for al examination, and to have an evening set for its consideration, so as to see the different e in which different persons had approached object. He thought that in this way a prac- bearing might be given to the work of the ty. Take, for instance, the subject of Bac-; there was no consensus of observations upon id yet it was a subject which could so well be ht before the Society, and if it was put forth e proper quarter, those who had already ed at it would no doubt be glad to meet her for conference. Take also the anatomy life-history of particular classes of animals, f the Arachnida or Entomostraca. It need e one subject only, but two or three might be d at the same time. It was increasingly alt, he knew, to get papers brought before society. There was a time when the other ies did not give attention to research made the microscope, and then a considerable er of papers were brought here, but now that began to recognise the value of it, a paper ore on the subject of geology was taken to eological Society, and the results of micro- al study in botany or zoology to the Royal ty or the Linnean Society.

e President said that he quite appreciated the rks which had just been made by Mr. Beck. s was really no limit to the subjects which t be taken up with advantage. He then ad- ded the meeting till November 10.

e following were elected Ordinary Fellows:— ra. E. Carr, M.A. (Camb.), F.M.S., J. D. t, M.D., F.R.C.S.I., J. J. Pilley, T. S. Rowe, , and E. Ward, and eight others were nomi- for the next meeting.

removal of Stains of Aniline Ink.—Red e ink stains may be removed by moistening ot with strong alcohol acidulated with acetic Unless the stain is produced by eosine, it pears without difficulty. Paper is hardly ed by the process; still it is always advisable ke a blank experiment first.

SCIENTIFIC NEWS.

THE Dun Eght Circulars Nos. 33 and 34 contain elements, &c., of Denning's comet 1881, *f*, those in 33 being computed by Mr. S. C. Chandler, jun., of Boston. The elements and ephemeris computed from three observations by Dr. Copeland and Mr. Lohse are: $T = 1881$ Sept. 12.0143 G.M.T.; $\pi = \Omega 309^\circ 18' 24''$; $\Omega 72^\circ 47' 45''$; $i 7^\circ 45' 12''$ (mean equinox 1881); $\log. q 9.859822$. The ephemeris for Oct. 24 is R.A. 10h. 3m. 54s.; N. Dec. $14^\circ 50'$; $\log. r .03918$; $\log. \Delta .02910$.

A *Science Observer* Circular gives the elements of Barnard's comet, 1881 *e*, as computed by Mr. Chandler: $T 1881$ Sept. 14.785 Washington M.T.; $\pi 271^\circ 22'$; $\Omega 260^\circ 43'$; $i 107^\circ 27'$ (mean equinox, 1881); $\log. q 9.7053$. The comet is decreasing rapidly in brilliancy.

The Gresham Lectures on Astronomy will be delivered by the Rev. E. Ledger on the evenings of Nov. 7, 8, 10, 11; those on Geometry by the Dean of Manchester Nov. 15, 16, 17, 18.

It is stated that the Government have offered to the Rev. S. J. Perry the control of the arrangements for observing the Transit of Venus at Madagascar next year.

At the annual meeting of the Mason Science College, Dr. Tilden announced his intention to develop a metallurgical department in connection with the chemical laboratory.

The Young Professor of Technical Chemistry at Anderson's College has issued his syllabus for the Session, which commences on Nov. 7, with a series of lectures, to be continued on Mondays, Tuesdays, and Wednesdays, at 10 a.m. The lectures will be illustrated with experiments, diagrams, and models, as well as by the actual inspection of manufacturing processes; and the progress of the students will be tested by periodical examinations. Mr. J. Snodgrass, senior assistant, has arranged to deliver a series of thirty lectures and demonstrations on physico-chemical measurements, and also a course of evening lectures on iron and steel manufacture, in time for the May examination.

The Museum and Library, Bristol, has an attractive list of lectures for the season, amongst which we notice Prof. S. P. Thompson, B.A., D.Sc., on Electric Storage and Lighting; Mr. J. E. H. Gordon, on the Leyden Jar; and Mr. Saville Kent on Infusoria. The lectures commence at 8 o'clock, and the committee makes the excellent rule not to reserve seats for ticket-holders after 8.5.

A public meeting of the University College Chemical and Physical Society will be held to-day, at 7 p.m., when Prof. A. W. Williamson will deliver an address on "An Error in the Commonly-accepted Theory of Chemistry."

A patent has been obtained by Mr. F. W. Webb for improvements in locomotives, which consist in the use of an extra cylinder or cylinders. Two outside cylinders are placed some little distance from the front ends, and the connecting-rods take on to cranks on the trailing-wheels. The centre pair of wheels are fitted with a cranked axle and are driven by a cylinder of larger diameter, placed directly under the smoke-box. The object is to work compounded, but arrangements are made for supplying each cylinder with steam from the boiler. When working compound, the steam is passed from the small cylinders to the large one through a repeater fixed on the smoke-box on the boiler. The specification is No. 1128, 1881.

The subscriptions received for the Rolleston Memorial Fund amount to about £530. It is hoped that this sum will be augmented, especially by subscriptions from Oxford at the beginning of the present term. All promoters of the movement are requested to make its existence known to others likely to interest themselves in the matter. The treasurer is E. Chapman, Esq., of Frewen Hall, Oxford. A general meeting will shortly be held to determine finally the form which the memorial shall take.

Indian-ink drawings that are to be coloured or washed over with tints should have a little bichromate of potash added to the ink. After the drawing has been exposed to light for an hour or so, the lines can be gone over without washing them up.

Serious alarm is now felt at the long-continued absence of the *Jeannette*, no tidings of her having been received from any of the whalers. It is already proposed to send out relief ships next season.

On the 11th inst. Mr. W. H. Davis, the president of the Metropolitan Scientific Association, read his opening address for the session, the subject being "Evolution, considered in reference to the Marsupialia."

The principle of the radiophone may be applied, M. Mercadier has recently shown, in telegraphy. And the system allows of several messages being sent simultaneously on a single line, in the same or in opposite directions. It will be remembered that a regularly intermittent luminous beam, obtained by rotating a disc with a circle of apertures in the path of the beam, and meeting a selenium-cell in an electric circuit with telephone, produces a musical sound in the telephone. By pressing a Morse-key, a diaphragm attached to this may be raised before the apertures, and the note in the telephone may be interrupted a longer or shorter time, giving the Morse alphabet acoustically. In M. Mercadier's system (of which this is the essence), a battery at one of two stations gives a constant current, traversing, at station A, some selenium-receivers and telephones (one or more), then the line, then corresponding receivers and telephones at station B. Before each selenium-cell is a perforated wheel with Morse K, &c., as indicated. Each wheel is made to give a different note (either by varying the number of holes or the speed) and each listener with a telephone confines his attention to one note, to exclusion of the others, and observes the interruptions of it. This is said to become easy with a little practice. The system is stated to be applicable to long lines, for selenium-receivers of great resistance may be used (30,000 to 100,000 units), acting very well with 2 to 10 Leclanché elements. Thus the relative resistance of a line as much as 1,000km. long and of the telephones would be very small.

From a series of careful thermometric observations in the Mammoth Cave of Kentucky. Mr. Hovey finds the maximum temperature 56° Fahr. The minimum $52\frac{1}{2}^\circ$, mean 54° . This seems to require correction of certain previous ideas on the subject.

There is at present, in round numbers, 25,000,000 barrels of crude petroleum stored in iron-tanks in the oil regions of Pennsylvania. The oil held by those (1,800) tanks would fill to a depth of 10ft. a square reservoir or lake measuring 3,747ft. each way. There are now indications of a falling off in the daily production of the wells, and so of the amount tanked. This amount has been growing from $4\frac{1}{2}$ million barrels in 1878 to the present 25 millions. Tank building is quite a large industry, dating from 1861. The tanks are iron and circular, the largest having a diameter of 94ft., and a height of 28ft., and weighing 93 tons. The plates vary from $\frac{3}{16}$ ths to $\frac{3}{16}$ ths of an inch thick, according to position in the tank.

A recent investigation by Herr Reuss, of the injury done to trees by the smoke of smelting-works in the Upper Hartz region, yields the following among other results. The smoke is injurious, he states, mainly by reason of its sulphuric acid. All trees are capable of absorbing a certain quantity of this through the leaves, whereby they are rendered unhealthy, and often killed. Their growth in the smoke is irregular and difficult. Leafy trees, especially the oak, resist the smoke better than the Conifere. No species requiring humus or mineral rich soils prosper in those regions. The oak seems really the only tree that can be successfully grown. Trees that have been injured by the smoke are not exempt from injury by beetles. All smelting authorities should unite in effort to prevent this injury to vegetation. By instituting sulphuric acid manufactories, effecting condensation of the smelting vapours, the evil may be greatly reduced, and brought to a minimum. Places cleared of vegetation by the smoke may be brought under cultivation again after removal of the injurious cause. (Herr Reuss's report appears in full in *Dingler's Journal*.)

A very light building-stone, which absorbs no moisture, and is not liable to decomposition, is produced by Grunzweig and Hartmann by moulding and drying a mass of pulverised cork, clay, lime, waterglass solution, and hairs. The

The transpiration of plants, in its relation to the spectrum, has been actually studied by S. S. Kozlov, and is the following conclusion: Transpiration is not only subject to the action of physical agents affording energy for the rise of a free water surface; it is also affected by light, a plant transpiring more in blue light, in light than in darkness, and the rate of rise increases with increasing power of light; thus transpiration proceeds at a maximum rate after mid-day, but is not at its highest because transpiration is not only affected by absorbing substance in the plant, but, under otherwise like conditions, also by the composition, which is more liberally absorbed, and the transpiration is greater in blue light than in the spectrum in which the rays are more light. The transpiration of a water surface is least under influence of the light which enters complexes with that of the liquid, it is raised in light of the complementary colors. The author's researches have been described by the *Reale Accademia dei Lincei*.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR of the
ENGLISH MECHANIC, 81, Tavistock-street, Covent-garden,
W.C.

All Cheques and Post-office Orders to be made Payable to
J. PASSMORE EDWARDS.

* In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person as such a fountain, the source of things, knows no more than that they do, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physics: a view from whence great inconveniences derive their original."

—MONTAIGNE'S *ESSAYS*.

"UNA VOCE (POKER FAR)"—THE AS-
TRO-CHROMOSCOPE—PERSONAL—A
GHOST IN THE TELESCOPE—CO-
LOURS IN THE SUNLIGHT—THE
CISSOID OF DIOCLES—STAR SPEC-
TROSCOPES—PLANISPHERE—PHO-
TOGRAPHING THE MOON—ASTRO-
NOMICAL COMPUTATIONS, &c.

[19321].—It would seem that there are three Comets at present visible in the sky: Encke's, Barnard's, and Denning's. Would "Penelope" (should this happen to meet her eye) mind asking her friend, the "distinguished astronomer," how it is that the temperature has recently been so very low, and upon what principle the explanation of the fact is to be found that three of these bodies acting simultaneously have failed to "stir up" the Sun, "excite him, as it were, to action, and move his latent heat and fire into unwonted energy"? Because I personally feel rather aggrieved to find the minimum thermometer descending to 31°deg. Fahr. in the clock-case in my observatory early in October, with such a redundancy of poker-power running to waste in the planetary system.

The idea of Mr. Hopkins, developed in letter 19279 (p. 112), seems to me an excellent one. How far it may succeed in practice can, of course, only be determined by actual experiment. Meanwhile, I may say that should it stand the test of real use and be producible as a piece of apparatus, at a moderate cost, it will be welcomed by a good many people who have vexed their souls in vain efforts to compare the colours of Stars with those of printed tinted discs viewed by the yellow light of a bull's-eye lantern.

I am singularly unwilling to obtrude anything here of a private or merely personal nature; but I cannot refrain from saying with reference to the gratuitous sneer contained in reply 44741 (p. 119), that, while it is impossible to conceive that any amount of mental distress or distraction could ever cause Major Herschel to misunderstand the point of any question whatever (no matter how obscurely worded), yet that I venture to think that had he undergone one half the trouble that I have within the last few weeks, he would assuredly not have "sought to answer" anyone at all. I have got into a habit of writing to the ENGLISH MECHANIC, and the Editor does me the honour to collect what I send to him into a fortnightly letter; and hence I feel under a sort of obligation to reply to many of my brother-readers who, I know, look for answers. Otherwise I should certainly have remained silent for a month or two past. As it is, I have no possible object in standing in Major Herschel's way; and will cheerfully hand over to him the task of answering questions on astronomy and cognate subjects in these columns, on his intimation that he will accept the charge, and himself "seek to answer" them. Meanwhile, I congratulate "H. K." on the perfect solution of his difficulty contained in the reply which has called forth these remarks. I earnestly hope that he is the wiser for it.

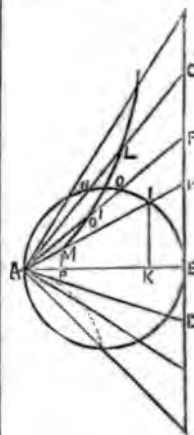
I cannot quite understand the cause of the appearance described by "J. F. E." (query 44919, p. 124) if it remains stationary in the field of view. A "ghost" proper has its origin in the reflection from the inner surfaces of an eyepiece of the image of a star or planet, and (the telescope being fixed) crosses the field in the opposite direction to that in which the body causing it is carried by the diurnal rotation. Of course in the case of a clock-driven equatorial, though, such a ghost would remain in the same part of the field. My querist does not say anything on this head, and it would be difficult to give a definite opinion without more information; or, in fact, without seeing the instrument. I am afraid that there is no cure for a

"ghost" but to get a new eyepiece. By the by, "J. F. E." omits to say whether the phenomenon he describes appears in *all* his eyepieces, or only in one. Should it be visible in the whole battery it might well be referable to spherical aberration in the object-glass, which, in that case, if worth it, must be regrind and polished.

Plateau was so careful an observer, that I think it exceedingly likely that the proportions given by "Aconite" as existing between the angular diameters of the variously coloured discs in their order of visibility (in query 44932, p. 123) are correct. This, however, I take to refer to the perception of the discs, as discs (i.e., with a definite circular outline), because there can be no doubt that certain objects directly illuminated by sunlight can be perceived at a distance at which they subtend angles very considerably less than 12", or 2".

Dr. Royston-Pigott, F.R.S., and Mr. H. J. Slack, F.G.S., have both seen a spider-line thus illuminated, when it can scarcely have subtended an angle of a single second. "Ordinary daylight" means sunlight reflected from the surface of a cumulus cloud, as contradistinguished from the direct rays of the Sun.

In reply to "Aconite's" next question (query 44933, same page), Hutton, in his "Mathematical Dictionary," in defining the Cissoid of Diocles,



gives, in effect, a method of constructing it. He adds that there are others, but without specifying them. He says, "At the extremity B of the diameter A B, of the circle A O B, erect the infinite perpendicular C B D, to which, from the other extremity A, draw several lines, cutting the circle in I, O, N, &c. : and on these lines set off the corresponding equal distances—viz., $H M = A I$, $F O = A O$, and $C L = A X$, &c. Then the curve-line drawn through all the points M, O, L, &c., is the Cissoïd of Diocles."

Newton ingeniously described this curve by the continued motion of a square ruler. I do not possess Emerson's book, and am ignorant of his mode of proceeding.

If the object of "Amlie" (query 44954, p. 124) be merely to see star-spectra, without measuring them, then the McClean Star Spectroscope, sold by Browning, is at once the cheapest and most efficient instrument he can possibly obtain. A little more expensive one, but of more use for mapping stellar spectra, or comparing them with the bright-line ones of the metals, gases, &c., is Browning's "Amateur's star spectroscope." This, furnished with a photographed micrometer, would really form a very efficient adjunct to a telescope the size of that of my querist's. I speak with the more confidence of these two instruments, since I have them both in use with my own equatorial. Of course if "Amlie" chooses to spend some £10 or £15, he can obtain a much more elaborate apparatus; but as he specifically mentions that he wants "the cheapest and most convenient" form of star spectroscope, I have told him what I myself have found to be so.

I assume that "Ebor" (query 4490, p. 120) intends to draw his plan of the Zodiac in a cylindrical projection. In this case he will use that as hour-circles in reality all meet at the Pole, if he is going to represent them as parallel straight lines, the scale on which (say) an hour of Right Ascension is represented must increase as we depart from the Equator. Hence, if we are to preserve the proper proportion, the scale of declination must increase in the same ratio. "Ebor" himself knows that the length of 15° (or one hour) of Right Ascension at any given declination is the equatorial length of $15^\circ \times \cosine$ of that Declination, so that as Right Ascension will be represented on his chart by one uniform distance, the scale for declination must increase inversely as its cosine. In other words, directly as its secant. That, suppose that $23\frac{1}{2}^\circ$ of Right Ascension measures 1lin. on his map, the $23\frac{1}{2}^\circ$ parallel of Declination will be nearly 1lin. (10-9in.) from the Equator. In strictness, he will see that the Ecliptic would not be an arc of a circle upon such a projection; but practically he might describe it with a pair of compasses on the scale to which he will probably construct his chart. Perhaps, after all, he will save himself a great deal of trouble if he will buy Peck's "Handy Star Map," of which I remember a notice in your penultimate volume. (Since writing the above I have noticed the reply of Mr. Grover on p. 145. I think, though, that that gentleman will turn back to "Ebor's" question as originally put, he will find the question an idea of projecting the Zodiac in a form only attainable by the employment of something akin

to Mercator's Projection. At least this is how I read it. Malby's (not Malsby's) is a circular planisphere on a globular projection; and while I agree with Mr. Grover in his estimate of its valuable qualities, it strikes me that it is not at all what "Ebor" wants.)

Mr. J. Hale (query 45027, p. 147) will find a considerable amount of information, which will be very useful to him, in the chapter on "Celestial Photography" (pp. 707 et seq.) in Chambers's "Descriptive Astronomy."

Premising that the *Nautical Almanac* gives the places of the planets (both Geocentric and Heliocentric) for every day at Mean Noon, as also their Right Ascensions and Declinations at the instants of their Transit over the Meridian of Greenwich; and that, moreover, the Geocentric Right Ascension and Declination of the Moon for every hour of the day, with their variations for every 10 minutes, are also to be found in its pages; I may say that it is simply impossible to answer such a question as that of "J. L." (query 45033, p. 147) within the limits of a letter—or a page either—in these columns. There are tables published, such as Le Verrier's, but they are bulky and costly, and would, I fear, be wholly unintelligible to my querist. Those to which I have referred are to be found in Vols. IV., V., VI., XII., and XIV. of the *Annales de la Paris Observatory*. The *Lunar Ephemerides* in the *Nautical Almanac* are computed from Hansen's "Tables de la Lune," published at the cost of the British Government in 1857. Let me advise "J. L." to read pp. 328 to 333 of the latest edition of Sir John Herschel's "Outlines of Astronomy," as affording an available means of obtaining some elementary notions of the principle on which such calculations are effected. Of course, if your correspondent merely wishes to find the position of any one among the heavenly bodies for a time intermediate between others for which its places are furnished, that is a much more simple matter, explicable in a comparatively few lines. It is a very different thing, though, with the computation of an original ephemeris.

A Fellow of the Royal Astronomical Society.

SELENOGRAPHICAL.

[19322.]—In letter 19186, p. 38, Mr. Birt quotes the following words from Mr. Neison's book on the Moon: "It appears probable that a very small residuum of aqueous vapour may, if not must, exist upon the surface (of the moon) at times and in places. If this be so, then a certain amount of moisture must be liberated when the temperature of the surface increases beyond a certain degree." In the course of continued observation of the moon, I have often observed the following fact which, perhaps, confirms this supposition, at least, it does so to my own mind. Soon after the sun has risen on formations, perhaps a day or two after, they show a certain amount of haziness, which, as the sun rises higher, disappears, until at full moon they stand out with the greatest distinctness. I have not noticed this particularly on deep formations where Mr. Neison suggests that vapour would be more likely to remain, but over the whole surface of the moon. It has struck me forcibly month after month, and I have sometimes wondered at not having seen it noticed by others. There is just the amount of dimness which would be caused by a very small quantity of vapour being drawn out by the sun's rays. The dimness does not appear till the sun has risen to a certain height, and at full moon it is completely removed, the myriad of white spots and craters, even the very smallest, which cover the surface shining out with a distinctness which they had not before. In fact, the surface is then covered with spots which were not visible before, or, if at all so, were by no means distinct.

If any one notices the surface within the terminator any time within full moon, and compares it with the appearance it presents at full moon, I think he will observe this. Can the effect be produced by anything but moisture being fine-drawn out and then in some manner removed.

Besides this, I have at times observed a local obscuration extending over a certain region, while all beyond it was perfectly distinct: this proving that it was not caused by anything in our atmosphere; the fact that delicate detail on the moon was visible also proving the same thing. I observed this on at least one occasion over Plato and the region immediately surrounding it. This former phenomenon I describe are totally distinct from one another; but both have impressed me with the belief that there is some aqueous vapour on the surface of the moon which at times makes itself apparent by either local or general obscuration or haziness. The first-mentioned phenomenon I observe continually, the second more rarely. I have often thought of drawing attention to it, and Mr. Birt's letter leads me now to do so.

M. A.

THE NEW COMET.

[19323.]—This object has been observed here on the mornings of October 4, 5, 6, 10, 12, 13, and 15.

The motion of 30' E. daily appears to have been well sustained during this interval. I regret extremely that my observations, which are made with one of Browning's 10in. reflectors, mounted on alisimuth stand, are not sufficiently exact for purposes of calculation. It is, however, satisfactory to know that the comet was picked up at Lord Crawford's observatory at Dun Echt, on October 9, 16h. 45m. 10s., Dun Echt mean time, when the position was, $\alpha = 9h. 34m. 30.74s., \delta = 14^{\circ} 48' 1.1'' +$. Mr. Lohse describes it as "very small, fairly bright."

By the time these lines appear in print the moon will have left the morning sky, and the comet will, no doubt, be seen with moderate apertures. The position on about October 21 is between Regulus and η Leonis, much nearer the former. A few sweeps in the region 2° N. of Regulus will be certain to bring it into the field.

I may mention that the comet was found as the result of a systematic search for these bodies. A few months ago I procured several low-power eyepieces, and since then have devoted most of my time to the search. Several hundreds of nebulae, catalogued by the Herschels, were re-detected, but I had found no very suspicious object until the morning of Oct. 4, when the present comet came into the field and immediately struck me as an object which I had failed to see in the same position on either the mornings of Sept. 29, or Oct. 1, when the same region had been thoroughly explored. I also failed to identify it as a nebula, and on reobserving it the ensuing morning found it to be a comet by the marked change in position.

Bristol, Oct. 15.

W. F. Denning.

EVOLUTION OF COMETS.

[19324.]—It is clear that only those comet-orbits whose perihelion distance (when the plane of comet-orbit is projected upon that of any planet) is less than the aphelion distance of that planet can in any position of the line of apses of the planet intersect its orbit. A close approximation to the least distances of the two orbits when the above condition is fulfilled will be $r \sin i \sin (\alpha + \omega - \Omega)$. Where r is one of the radii vectores of the comet which equals the radius vector of the planet, α is the corresponding true anomaly of the comet, i is the inclination to one another of the two orbits, ω and Ω the longitudes of perihelion and node respectively, the latter measured on the planet's orbit.

There will be in general two positions of this nature. Now a practically remains constant, but ω and Ω , in consequence of the secular movements of perihelion and node, may vary to any extent in general. So that the angle $\alpha + \omega - \Omega$ in course of time goes through all values, including zero. When this is the case the orbits of course intersect. Remarks are frequently made about comets, which are founded upon the assumption apparently that, notwithstanding the movement of the node (which may be very considerable) and perihelion, the angular distance of perihelion and node may be considered as nearly constant. For instance, a comet's orbit which at present comes very near the Earth's, or that of some other planet, has very often its present form attributed to such close contact, as if the close approach were something permanent and not accidental.

Whereas, however distant an orbit may be at any time, it will sooner or later (provided its perihelion distance be not too large) intersect any planetary orbit—all the meteor comet-orbits, of course, approach the Earth's very closely. But it is extremely improbable, as it has been asserted, that any one of these orbits owes its present position to the influence of the Earth. The secular movement of node and perihelion is the vera causa, in consequence of which all comets, whose perihelion distance is not too great, will become in their turn possible meteor-comets.

With regard to the Leonids, I have previously, in the "E. M.," drawn attention to the circumstance that for the last 1,000 years or so that comet's orbit has been rather favourably situated for a meteor display, and at present it is passing through the position of intersection with the Earth's orbit, and will commence now to pass from that position, so that for the future there will be a very slow secular diminution of the brilliancy of the meteor shower. Biela, the comet of the Andromeda, appears to have had its orbit intersecting the Earth's about 1832. This stream appears to be of small dimensions, for it has been stated that this shower has not been observed before 1790—that is to say, 42 years before its theoretical maximum. If this be so, with some degree of approximation, we cannot expect to see the shower much longer; the orbit of the stream passing now as rapidly from the position of intersection as before 1832 it was passing towards it, and this will be very nearly at the same rate; for the rate will depend almost entirely upon the position of the orbit with regard to Jupiter. I have already shown, in the "E. M.," that, upon the supposition that comets are intro-

duced into our system by the influence of the planets, this in no wise explains the singular relation of the cometary aphelion distances to the length of the major axes of the four great planets. Another hypothesis has been put forth to account for this: namely, that the Jovian comets are projected from Jupiter himself, and so with the rest, *mutatis mutandis*. It may be interesting to examine this in the case in which, for the sake of simplicity, the projections are supposed to take place in the plane of Jupiter's orbit. Let $V \cos \theta$ be velocity of projection in direction of Jupiter's motion, $v \sin \theta$ velocity perpendicular thereto, v = velocity of Jupiter in its orbit. Whence the velocity about the sun of the projected body squared will be $V^2 + 2Vv \cos \theta + v^2$. θ may be anything from 0 to 2π ; whence, taking the extreme cases—

For major axis infinite $V^2 + 2Vv \cos \theta = v^2$. For major axis = $\frac{1}{2}$ Jupiter's $V^2 + 2Vv \cos \theta + v^2 = 0$.

In the first case $\frac{v^2 - V^2}{2Vv} = \cos \theta$.

In the second case, $-\cos \theta = \frac{V^2 + v^2}{2Vv}$.

The first is possible for various values of V : the latter is only so for $V=v$. So that the probability of an orbit so arising not as satisfying the condition in question affecting the aphelion distance is enormously greater than that it should do so; so that this hypothesis fails as decidedly as the other to account for the phenomenon.

It would not be difficult to form an estimate of the probability that a given comet (the dimensions, of course, being supposed known) should collide with the Earth in a given time, provided the comet did not in the mean time fall a prey to some other planet; but the four greater planets, in especial Jupiter, are so preponderant that the true probability as regards the Earth would no doubt be very small indeed. Jupiter, in the course of his future career, will no doubt experience many such collisions.

Not taking account of Encke's comet, three others have been discovered which are entirely within the orbit of Jupiter. Now if these comets were introduced into our system by means of Jupiter, we must suppose that their aphelion distance has been diminished by a similar cause to that acting upon Encke's comet, or, which is perhaps more probable, the eccentricity and position of Jupiter's line of apses was such at the time of introduction that the comet's orbit intersected that of Jupiter.

The aphelion distance is not much affected by the perturbations, as they experience a sort of mutual destruction as respects that element. The smallest aphelion distance is that of 1873, II., which is about 4.68. Therefore, at the nearest time when introduction was possible, upon the postulated hypothesis, Jupiter must have had its eccentricity a maximum (much larger than at present), and its line of apses must have moved 115° between that and the present time; so that the comet could scarcely have made less than 10,000 revolutions.

W. C. E.

FEEDING AND SHRINKAGE OF MELTED IRON.

[19325.]—I HAVE read the interesting article on "Feeding and Shrinkage of Melted Iron," in the "E. M." for Oct. 7, page 108, and, with your leave I beg to make a few observations on what the writer of the article quotes as often stated by writers, viz., "that melted cast iron expands at the moment of solidification, so as to copy exactly every line of the mould into which it is poured," and which he characterises as very absurd. In so far as his observation may apply to the expansion of cast iron at the moment of passing from the liquid into the solid condition, I think the fact is capable of unmistakable proof, of which he can satisfy himself by a very simple experiment with a pot of molten cast iron, as run out of the cupola at the foundry, by taking up a piece of cold pig-iron, and plunging it into a mass of the same metal in a molten state, when he will find the solid and cold iron floating, instead of sinking, in the molten iron, and proving that the specific gravity or density of the hot fluid is very markedly greater than in the solid condition of cast iron.

This familiar fact seems, however, to be limited to only a few of the metals, and some of their alloys, whose structure in the solid form assumes a strictly crystalline form, as in the case of cast iron and type metals, but does not apply to lead and some others which do not present crystalline structure in the cold state; and if this view is correct, then the behaviour of cast iron is strictly analogous to that of water, although in a much less degree, when it passes from the fluid form by freezing into solid ice.

The law giving rise to expansion by heat, and contraction by cold, applies equally in the case of cast iron or water while they continue in the liquid or in the solid condition; and if crystallisation has to do with the solid condition, as in the

two bodies named, the transition from the fluid to the solid state is, at the moment of its occurrence, accompanied by a marked enlargement of bulk, and the converse must also hold true that cast iron or water acquire their maximum density at the moment after passing from the solid into the fluid condition, and their minimum density at the moment before passing from solid to fluid.

I have no doubt many of your readers would be pleased to have this topic dealt with authoritatively by some one of your numerous scientific contributors, who are more competent for the task than

John Reed.

Ferry-road, Edinburgh, 10th Oct.

SPIRAL AND ORNAMENTAL WORK IN THE LATHE, AND A PLAN FOR ADAPTING ORDINARY LATHES SO AS TO DO ON THEM GEOMETRIC PATTERNS WITHOUT GOING TO THE EXPENSE OF A GEOMETRIC CHUCK.

[19325.]—In Vol. II. of the *Journal of the Amateur Mechanical Society*, "G. C. C." describes the modification of the spiral apparatus added to the back of his lathe by Mr. Kennan, of Dublin.

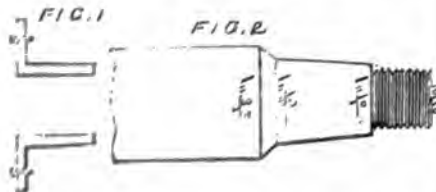
I am sure he would confer a very great favour on many of your readers if he would put the whole apparatus together on his lathe in connection with the slide-rest and have it photographed and sent to you for illustration, with such remarks as he may consider necessary. He would thus make his paper and drawings in the *Amateurs' Journal* better understood by those who have no spiral apparatus attached to their lathes.

Perhaps he would give his opinion as to a proposed addition I think of making to my lathe. I propose adding to it a set of collars to fit inside the present ones, to take a traversing mandril which I can substitute for my present one, when necessary. As no alteration will be made in the present bearings, the removal of the new bearings and the traversing mandril, a work of two minutes, will enable the old one to be replaced. My lathe is one of Holtzapffel's, for ornamental turning, and the present mandril runs between a conical collar and a back centre in the usual manner.

I have been much interested in Mr. Evans's recent contributions to the pages of the *MECHANIC*, and the clearness of his instructions on "Lathe Construction," has induced me to attempt a fresh bit of lathe reconstruction. With my 5in. lathe, made by Holtzapffel for ornamental turning, I find I cannot conveniently do any metal turning, so I am having patterns made for castings to add back-gearing to it. The head was so light that I could not fasten lugs to it in the usual manner; and moreover, doing so, or even adding uprights, as in Taylor's apparatus, described in the "Lathe and its Uses," would interfere with the oval chuck and with the spiral apparatus, for which my lathe is already partly fitted, having been so by Mr. Evans when I got it from him some three years ago.

It appears to me that then there is no reason why everyone who desires a traversing mandril should not add one to his lathe. I purpose doing so to mine in the following manner, which I shall describe before referring to the supplementary head.

I purpose removing the present mandril and fitting into the old collar a cone of steel, as shown on drawings herewith, No. 1. No. 2 is the represen-



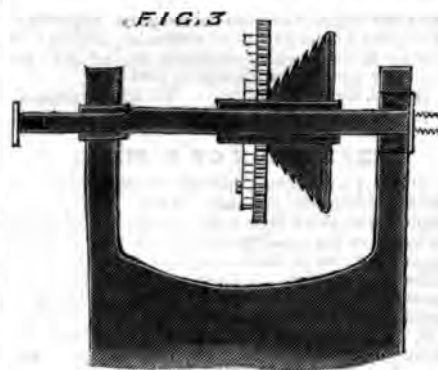
tation of my present mandril, with the sizes given of each part.

The hole at back part of lathe-head, through which the back centre passes, is 13-16th of an inch, into which a suitable steel collar will be fitted, for the back end of the traversing-mandril, the diameter of which will be 3-32nd smaller than the hole of the steel collar fitted to the old collars or holes, thus allowing the new collars sufficient thickness for strength. The nose of the new mandril will be identical with the present one, Fig. 2, but will have a shoulder behind it; it will thus take all the chucks of the present mandril. Its front traversing portion will be 31-32nds of an inch, and that of the back portion 23-32nds of an inch in dia., and it will have a traverse of 1 1/4 in. only. If a larger traverse is wanted, it must have a narrower pulley of its own fitted to it, as the present pulley, with its division plate and segment stop-plate, with a cogwheel of 110 teeth between, as

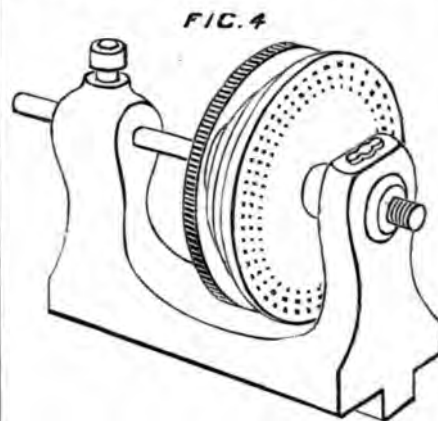
will be presently described, takes up 3 1/4 in. of the space between the front and back of the head.

The new collars, it will be observed, are made with flanges, to enable them to be fixed by small screws passing through these flanges into the inner part of the headstock. As the traversing mandril is of less diameter than the old one, the pulley, with cogwheel and segment-plate attached, will not fit it, they will be therefore carried on a sleeve, which will be fitted to the new mandril by being bored exactly to its diameter, 31-32nds of an inch. When I want to use the traversing mandril, I can easily take out the ordinary one, and having placed the new collars in position, and having fixed them by the small screw passing through their flanges, I have only to pass the tail-end of the mandril through from the front, it passing successively through the front collar, the sleeve, carrying pulley, cog-wheel, &c., and, lastly, the back collar; the sleeve will not revolve without carrying the mandril with it, being prevented so doing by a feather or a screw, as may be found most convenient. The thin end of the mandril which projects behind may now be fitted with the usual screw-cutting sleeves and guides.

The arrangement of this mandril as above described will be apparent from Fig. 3, which shows



a section of the elevation of the lathe-head, the old collars in situ traversed by the new collars, through which the new mandril runs, and a perspective drawing of the head. Fig. 4.



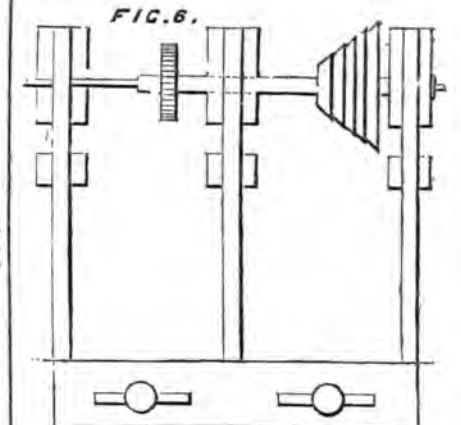
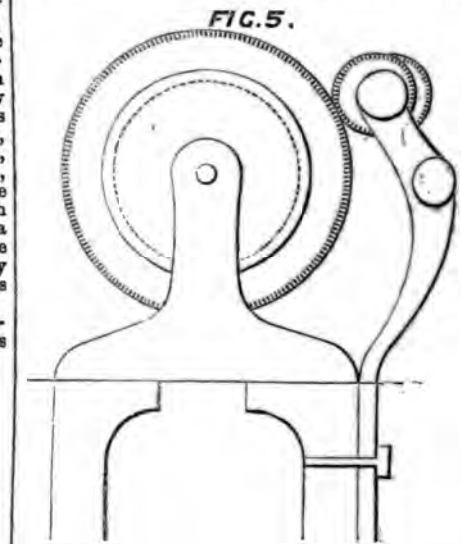
It is by no means a difficult task, the only necessity being that the diameter of the present mandril is sufficient to admit of fresh collars being inserted.

The instructions lately given to us in the pages of the *MECHANIC* on "Lathe Construction," by Mr. Evans, show how the back centre may be bored out cylindrically and truly to admit of the present adaptation. I shall feel obliged if "G. C. C." will give his opinion on the matter.

I purpose fitting the supplementary head for carrying the driving-pulley and pinion (required to drive the cogwheel, &c., attached to the traversing-mandril) to the back side of the lathe-bed, parallel to and beside the head, as shown in Figs. 5 and 6. By Figs. 5 and 6 it will be seen that it is so fitted by bolts screwing through slots in the casting to the bed of the lathe, as to admit of its accurate adjustment for gearing with the cog-wheel referred to.

The driving-spindle will only carry a pulley corresponding with that belonging to the lathe, attached to which will be a pinion or cogwheel of 14 pitch, with 16 or more teeth. This spindle will run in an eccentric, by means of which it will be thrown into a wheel 8 in. in diameter, with 110 teeth. I intend, as stated already, to fix this to my pulley behind, removing for that purpose the seg-

ment-circle, which is placed at present behind the pulley. Of course it will be refixed behind the gear-wheel. This will be apparent from the drawings enclosed. I also think of fitting the head so as to do a little engine-turning. I shall do this in the following manner: It will be observed in the drawing of the supplementary head that I have provided for a supplementary spindle on a level with the



lathe-spindle, the nose of which will correspond with it, and may carry its chucks. By putting an eccentric chuck on either mandril a vibration of the head will be produced, which, when required for this purpose, will be elevated 1/2 in. above the lathe-bed, and suspended between two points of screws, through a casting that fits between the sides of the lathe-bed, and carries the head. See

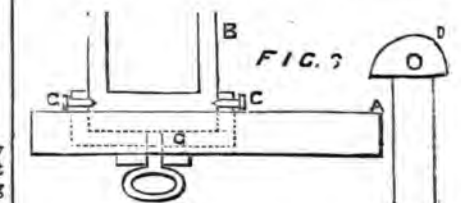


Fig. 7 (A, lathe-bed; B, lathe-head; C, support for head between points; D, front view of support).

The upper supplementary mandril is only used for driving, but the lower one, when the mandril in the head is not in use for traversing or screw-cutting, and the head is not elevated in the points for vibration, may be used to guide the vibrations by using it as a rest to carry a rubber point of blunt, but polished, steel allowed to press against pattern-wheels, to be placed on the back of the lathe-mandril, behind the segment-plate. When this is done, the lathe-head will have to be attached to the supplementary head by two strong spiral springs, or by a heavy weight passing over pulleys. By this arrangement the lathe-head acts as the ordinary rose-engine. By placing a rubber point against the gear-wheel of 110 teeth, a similar number of waves will be produced on work fixed to a face-plate carried on the nose of the mandril, for as the mandril revolves the vibrating head will be moved to one side; as the teeth of the wheel or the variations of the guide-plate rub over the steel point every depression will allow

prings or weight to drag it to the back, and elevation will force it to the front, the result that if a sharp point be held against the by the slide-rest, a wavy circle will be cut. ilar effect may be produced by placing an tris chuck on the supplementary lower mand- and connecting it by a link with the vibrating it thus would take the place of the upperman- used by Mr. Taylor. And thus the supple- ymandril may be used to originate all sorts of na, by being made to carry shaper-plates or which may be used as guides in regulating the ions of the vibrating head; or if that is let on the bed becoming an ordinary lathe-head, nected with the supplementary lower spindle, aper-plates may be used to give a recipro-; movement to the slide-rest carrying a tool, s done with the apparatus described by Mr. oott in "Turning Irregular Forms." By g these plates at different speeds, great variety would be produced, and no doubt by g the centre of these cams or patterns by s of the eccentric chuck, further varieties be produced; in fact, the capabilities of the so arranged might, so far as the tracing of ental patterns is concerned, be described as oscopic.

there will be two mandrils running parallel e another, a simple arrangement of the lide of the slide-rest will enable an article d on the one mandril to be copied on ial carried on the other, as is done in the nment dock-yards and arsenals, and in the factories for small-arms and agricultural ments by using flying cutters driven by the ead. Those who have screw-cutting lathes easily add to them a disc carrying cams a by the back shaft, by means of which they originate scrolls and patterns quite as beauti- intricate as those produced by the geo- c chuck, as described by Mr. W. H. North- a his book on Lathes.

first I intended using a cog-wheel of 112 , as it was at 14 pitch the number to give a wheel of 8in. in diameter; but as I find to would have to get a wheel of that number ally made for me, I have decided to use one of Lloyd's, of Birmingham, of 110 teeth, for he charges 1s. 9d. Pinions to gear with it, ry number from 15 to 24, can be had from t 4d. each, which will meet every require- W. M. Skues.

IMPROVED TRICYCLE-SEAT.

327.]—I HAVE received so many letters of ry about the tricycle-seat to which I alluded former letter (19254), it is quite evident to at the usual arrangements do not give satis- m. As I hope it may be useful to others to e and describe the one I use, I have asked received permission of the inventor to do so. s designed two years ago by Mr. W. Bindon l, the inventor of the Dublin Tricycle and Bicycle. I have had mine in use with the satisfactory results during two riding sea- The manner in which the seat is attached a frame is radically different from every

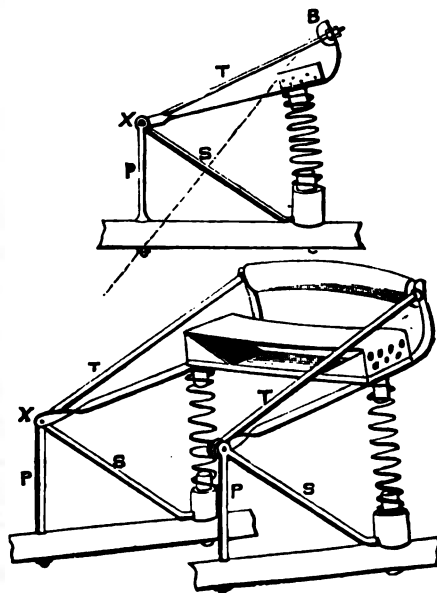
e fixed points (x x) upon which the whole works must be above and in front of the line rust (a b) drawn between pedals and back of

The helical springs are not essential, and t be replaced by other kinds, but I doubt if rramgement would be bettered by so doing. seat plays up and down (or, rather, around x x entre), with rider's weight and overroa- hness, in the most luxurious manner; but it ot yield backwards to any amount of pressure the pedals. The back of the seat therefore itutes an unyielding support from which mous purchase can be obtained, and dispenses ely with the usual strain upon the arms.

re let me forestall a possible objection—that train on the rider's back may be fatiguing, or ious to health. This is not so. I have never ienced the slightest inconvenience, nor have rs who use this seat ever complained of it. there is no reason why a weak-backed person id not use purchase-handles if he prefers g so. For my part, I have always found gain- purchase by the arms instead of by the back a more fatiguing. I have constant hill-riding, can climb ones as steep as 1 in 10, without h exertion, or even even thinking of gaining hase by my arms. It is essential that the back eat should press against, but not above, the of the hipbone. Whenever I ride upon other cles, no matter how good they may be in r respects, there is nothing I miss so much as eat of my own machine. I feel as if all my ar were gone.

a minor, but most essential, improvement, I no cushion. I tried many kinds of cushion out satisfaction. Acting upon hints derived experiments of mine, Mr. Blood devised the ent arrangement, which leaves nothing to be red for coolness and comfort. I sit upon a e of doubled No. 1 sailcloth tightly stretched

over and tacked to a triangular block of wood at each side. The seat is 6in. deep, front to back, and 16in. wide from side to side. The canvas can be easily tightened if it gets slack, by inserting wedges in spaces left for the purpose where it turns over the blocks. A nice way to tighten it would be to have one end fastened to a roller, like a window-blind, with a key and ratchet and pawl, like a wire-fence strainer. All who have tried this seat, and the way it is fixed to the frame, acknowledge it is the best they have ever sat upon. How to adapt it to different builds of machines must be left to the ingenuity of riders and makers.



The front supports or pillars (p p) and the diagonal stays (s s) are made of 5-16in. steel. The tension-rods (t t) are 1/4in. iron. The flat bars upon which the canvas seat is fixed are 1in. wide by 1/4in. thick. The lengths of the above cannot be specified, as they must be made to suit the length of riders' legs and position of pedals. The most important thing to bear in mind is the upward and forward position of the fixed points (x x) in relation to the line of thrust (a b). The helical springs were procured from Salter, of Birmingham. They are made of steel wire, No. 7 B.W.G. There are 10 coils; the spiral is 1 1/4in. diameter clear inside. My springs are 7in. long when at rest. This strength will suit weights between 10 and 14 stones. Heavier or lighter riders may require springs somewhat stronger or weaker respectively, but great latitude is allowable in this. The triangular blocks upon which the canvas is stretched are 3in. high by 6in. deep.

W. H. Staurope Westropp.

Lisdoonvarna, Oct. 13th.

P.S. Permit me here to correct a clerical error in my letter (19287) of Sept. 29. In the fourth paragraph from bottom, where I say "the rider should have an extra good grip of the ground," substitute "rudder" for "rider."

TRICYCLES.

[19328.]—"56-INCH" very properly directs attention (19305) to an error of mine, which I had discovered for myself and intended to rectify even if he had not written. His examples, though mechanically correct, would not be satisfactory in working, for he assumes that the large wheel geared down and the small wheel geared up—using the terms "large" and "small" as related to the medium size best suited to each rider—have cranks proportioned to the actual sizes of the wheels instead of to the (medium) size they are speeded to run at, which means a long crank for the large wheel and a short crank for the small wheel, without any reference to the length of the rider's legs. This would make all the difference in the world to the rider. I now restate my examples, and shall be much obliged to anyone who will disprove my conclusions if they are wrong.

Take a 50in. wheel geared down to run as 40in., a 40in. one geared level, and a 30in. one geared up to run as 40in. Each has a uniform crank-throw of 5in. The leverage—i.e., the ratio of the length of cranks to the actual diameter of the level geared wheel, or to the diameter of the size the geared ones are speeded to run at—is identical in all three. There is no gain of power or of speed in travelling (though the geared-up or down wheels may revolve at different velocities from the cranks) in one over either of the others, so any advantages each may possess must be referred to

their relative friction, weight, resistance to wind, and smoothness in running.

I am glad "Delta" has alluded (19303) to the Omnicycle. I have never ridden it, but it has always appeared to me to be a machine of exceptional merit. Will some one who uses it give us the benefit of his experience?

On my machine I have the choice of steering with both or either of my hands. I invariably do so with the left hand, though I am not left-handed, as I prefer leaving the right hand free.

W. H. Staurope Westropp.

October 15.

[19329.]—I HAVE taken an interest in and have ridden a tricycle, the Coventry, for about two years—not excessively, as I am not a young man, but moderately, and I have covered about sixteen hundred miles, my longest ride in two days being eighty miles—viz., fifty one day, and thirty the other.

I am induced, in consequence of the interesting correspondence going on in your very useful paper, to make one or two remarks, in order to elicit information, as I am naturally anxious to secure the easiest-going and safest machine. The one I use I had made to order, having previously hired one of the first pattern; and with a view to steadiness and safety, I had it made two inches wider, so that mine runs thirty inches.

Now whatever may be said in favour of other machines—and doubtless there is much may be advanced—has not the Coventry certain points of advantage?

Is not the two-track an advantage over the three, whether the steering-wheel be in the front or rear? Then, can the steering be more perfect than in the Coventry?—the two side-wheels tracking each other so beautifully, and the front one being under both eye and hand. The open front is certainly all that can be wished for, and to me there is a sense of freedom in having no large wheel, on my right hand, which enables me to get at my bag at the side, and affords such a convenience for carrying a fishing-rod, umbrella, &c. Then, again, what can be better for the lamps?—as I have one immediately over the front guiding-wheel, and a danger one behind, the one in front throwing a bright light far ahead. Then I sit directly over my driving-axle, which certainly seems desirable. It is true I work mine on the treadle principle, and it does not yet seem clearly settled that this is so much, if any, inferior to the rotary action. I have, however, raised my seat considerably, and lowered my treadles, so that I sit much higher than usual, and I do not keep my feet continuously on the treadles, except in going up an incline, and hardly then; consequently, as a rule, my stroke is short, and my legs do not rise unduly.

I have a band-brake, which, with me, has hitherto proved both safe and efficient, and I have felt secure going down the steep hills at Hampstead, Highgate, the Alexandra Palace, &c.; but of course, I never apply it suddenly, or attempt to go at a reckless pace. My neighbour, who has a "Rudge," with the steering-wheel behind, and the rotary action, with ball-bearings, can neither get up a hill so well as I can, nor has he the command over his machine, going down, that I have.

I certainly should like to be able to suspend my seat, which I think would greatly add to my comfort; but I am not clear how to accomplish this to my satisfaction, and I should much like to see a drawing of the seat so highly spoken of by Mr. Westropp.

I, for one, would not ride any tricycle that had not an open front, and it seems to me that a two track must be better than a three; and I have yet to be convinced that there is a better brake than the band on the driving-wheel, when it is properly and carefully used. My tricycle appears to be unnecessarily heavy, as it weighs 115lb. at least, and my weight is under eleven stone. My driving-wheel is 50in.

I may say that I have tried several other machines, but I do not appear to be able to work them so well and comfortably as the Coventry; at the same time I am open to conviction, and shall be only too pleased to see one at the show in February next that will induce me to buy it. May I suggest the desirability of a few meetings being held at the same time for the exchange of experiences, and for the suggestion of improvements, &c.?

It always strikes me as a waste of strength to ride up hills, as it seems to me impossible that any machine can be made to do so without considerable extra exertion; and, consequently, is it not wiser and preferable to get change of exercise by walking, the same as would be done in driving?

Will it not ultimately be found, whatever may be said about multiplying gear and other complications, that the more simple tricycles can be constructed, and the more perfect the work and material, the more useful and enjoyable they will become.

October 8th.

C. J. H.

TRICYCLES.

[19330.]—UNLESS I have misunderstood the description of brake given in letter 19288, it is similar to that applied to the "Omnicycle"—viz., two spoons acting through the medium of one lever on the lower part of the driving-wheels; but I was not quite satisfied with its action when, on one occasion, I endeavoured to stop the machine in descending a hill.

"Sunlight" (19289) condemns the band-brake; but I think he will agree with me that there are different methods of arranging leverage for applying it, which should be considered, and also different degrees of care exercised by the users.

I ride one of Hillman and Herbert's "Flying Dutchmen," 52in., original pattern, and can run safely down a hill at a moderate rate of speed; but the band-brake requires to be applied with care, and the machine gradually checked and kept under control. An engineer in charge of winding machinery would hardly exert the full power of his brake suddenly, as inexperienced tricyclists are apt to do.

The size of driving-wheel, I think, should accord with the throw of cranks and diameter of chain-wheel. In my machine these are relatively 52in., 6in., and 8½in., and the brake-wheel is about 5½in. diameter.

The object of my letter is to draw attention to the fact that the dimensions of driving- and chain-wheels and leverage of crank should all be considered in relation to one another and at the same time; otherwise, some readers might accept the recommendation of a correspondent upon one point, and use his own possibly inexperienced judgment upon all the others, thereby neutralising the good intentions of his adviser. F. J.

[19331.]—In "Sunlight's" first letter to you, (19173, p. 14) on this subject, he made, and attempted to prove, a statement that a 40in. wheel, geared to equal a 50in. one, would run easier, especially up-hill, than a 50in. one geared level, on account of what he called the extra centrifugal force. No mention whatever was made of the throw of the cranks, and consequently of the space through which the rider's foot moves. Now it is clearly borne out by mechanical laws, that if two wheels are taken with the same section of rim, and with the rims travelling at the same speed, the angular momentum in both cases is directly proportional to the radius. It is plain that if the two machines travel at the same speed, the rims of all the wheels in both machines would run at the same speed also, no matter what their size is.

When "Sunlight" says that the difference in the weight of a 40in. and a 50in. wheel is very little (19285, p. 113), he is arguing against himself, for, whatever the difference is, it is just so much gain to the small wheel—especially for up-hill work!

I don't quite know what hypothesis I have made which "Sunlight" cannot agree to. I stated nothing in my letter to which he could possibly object, but fully established mechanical laws. Which of these is it he cannot accept?

In 19173, p. 14, "Sunlight" says that a small wheel would go over an obstacle easier than a large one, and in 19285, p. 113, he says that a small one would go over an obstacle almost as easily as a large one! Is this another instance of his confessedly bad memory?

I should imagine the readers of the E.M. would not feel much flattered by what "Sunlight" says about "centrifugal force." He uses the term because he is afraid they would not understand the meaning of angular momentum; and thus, by the weight of his influence, helps to perpetuate what he himself acknowledges to be a popular error! It scarcely requires a knowledge of "abstract science" to understand the difference between these two words. J. H.

[19332.]—THERE can be no doubt that the most important requisite in a tricycle is a good brake, for thereon depends the safety of the rider. That the tire of the wheel should be the best place to apply the brake is true; but, practically, I have found that on greasy roads it is almost useless. Also, if from any cause the spoon does not act straight on the tire, it may—should the rubber be loose anywhere—push it from its place, thereby upsetting the machine. Again, it is necessary that in single-driving machines the spoon acting on the loose wheel should come into action before the other, because the friction caused by the gearing of the driving-wheel acts to some extent as a brake. I have found that if the brakes press equally on both wheels the geared wheel is stopped before the loose one, consequently the machine suddenly turns round, and when going down hill the chances are the rider will thereby be thrown out. The only objection that "Sunlight" has made to the band-brake is that grease might get on it. Could not it be so constructed as to render this impossible with ordinary care on the part of the rider.

How is it we do not hear more of the ground-brake? What are the objections against it? Anyway, I think that it would not be a bad plan to

have a ground-brake attached, as in the event of the ordinary brake going wrong—a thing that might happen with the best machine—there would still be a powerful brake under the rider's feet.

I fail to see—as "Delta" apparently does—that all the advantage lies with machines with front steering-wheels. In the first place, all the machines of this kind that I have seen appear to be very much heavier. The lighter a machine is, consistent with strength, the better, as it is less weight to take up hill. The other objections have been well given by Mr. Westropp (19287). When one is used to steering, it is as easy with the wheel behind as in front. If a saddle is used, and it is better than a seat, the rider can put nearly all his weight on the pedals, and the machine will not tilt up. I would wish to observe here that, in my opinion, the hind steering-wheel is placed too close to the driving-wheels. If it were placed further away better steering could be obtained, and the extra length of the backbone would prevent the tilting forward. With a saddle, too, one can easily sit further back going down hill, or come more forward over the pedals when going up.

The less the friction in a tricycle, the easier it should be to propel. That is evident; but of two machines, to all appearance exactly alike, it will sometimes be found that one works easier than the other. This may arise from bad workmanship, hard bearings, or more likely from the gearing. If the gearing is too tight (chain) or too close (cog-wheels) there will be more friction than there should be. Can anyone tell us of a ready means of estimating the power necessary to overcome this friction, which system has the least friction in it, or, if the machine is on smooth level ground, the rider on his seat, and the pedals horizontal, what weight placed on one of them should be sufficient to move the machine, and what proportion should this weight bear to the united weights of rider and tricycle? Charles F. Steel.

[19333.]—I SEE this question is well to the front again in your issue for October 14th, and I also rejoice to note that the question is already attracting fresh authorities, who have already raised several points to which I will refer later on. But in passing, I should like to say that I note "Paulgul" is another convert to the 40in. wheel theory, and referring to his mention of double drivers in connection with gearing one wheel up and the other down, I have devised and rejected more than a dozen schemes to do this. But the great difficulty, and it is I fear, insurmountable, is to prevent the chain and wheels not actually driving the machine from working or revolving until thrown into gear. One simple way of getting over the hill-climbing difficulty, so far, is to have two sets of pitch-chains and gears. The two pitch-wheels on the drivers to run loose on the wheel-hubs, and to be thrown in or out of gear by two clutches. This plan has the advantage of few parts, simplicity, and giving the rider the power to back pedal. But it involves both chains running round, except when going down hill, when the clutch-lever being placed half-way, both clutches would be out of gear, and the pedals could be used as foot-rests. With the clutches on the hub, it is practicable to use such proportions that the wear of the chain-wheels, when running loose, could be reduced to a minimum; and, in fact, if the pitch-wheels were steel, with hard steel bushes, running on similar sleeves on the wheel-hubs, the wear would not show in years of work. On this point I have the proof afforded by actual experience of such joints at work for years under circumstances far more trying than having to withstand the wear of the mere revolutions of a wheel doing no work.

I fancy "Delta" is decidedly outside of the general opinion in one or two facts. I do not know if he is identical with a similar signature in a contemporary which deals with matters pertaining to the tricycle, but I certainly think I can do something to show where our friend errs. He states he cannot make out why myself and others, for instance, advocate the back-steering machine. Now, let me say that my ideal of a good machine was one to steer in front. I urged against the many objections to it arguments which have lately been most ably upheld in this journal even, and I was sure that nothing but a "Devon" or "Salvo" would suit me, but a very short experience of these machines fully convinced me, although it was against my inclinations most sorely. Step by step I was forced to admit that my theory was not in accordance with practice, until I had to give up the matter as a bad job, and take to the open-front machine. I certainly, however, must add, that I have never had the least chance to say that the arguments I formerly used could in any way dispassionately be justified.

Now, I hardly think that the question of majority is to be relied on. "Delta" names several front-steering machines as the "best class." But, against these, I would urge that the three last he names are not better known than his namesake Birmingham Small Arms Co. (the very well known "Cheylesmore,"

"the Meteor," "the Caroché," and others, so that, in point of numbers, there are, I think, as many well-known makers of open-fronted machines as with front steering.

After a series of pretty exhaustive experiments, I am in a position to show that the front-steering machine is anything but the best adapted to utilise the rider's power. To place the rider in the best position to propel the machine he must be placed behind a vertical line drawn through the line of the driving axles. The reasons for this are many and indisputable. Take an actual example, which is better than any amount of mere statement alone: let me instance the extra-light "Special Salvo": there the saddle is placed as far back as it dares go. Yet, even then, we do not get a perfect machine—as instance, that, in order to place the rider as far back as possible, so as to get him in the best practical position, owing to the form of the machine, it renders necessary an arm or appendage behind to catch him when he tilts back, which he is sure to do if he puts himself into the best position to drive.

And I would further instance, also, another of the machines he mentions by name, the "Phoenix," the latest pattern of which places the rider well back, so as to throw nearly all the weight on the drivers, and this also necessitates the use of the steel arm or appendage behind to catch the rider. Therefore, "Delta's" argument as to the small amount of weight on the hind steering-wheel of the open-front machine, and hence wild steering, is not only applicable to the front-steering class, under the circumstances, but it also shows another defect—viz., that the front-steering machine tilts backwards, and to such an extent that makers of it recognise the fact, and mend it with a very clumsy remedy. And in favour of the open-front machine, I may say that no efficient rider on a properly-constructed one ever need fear tilting forward—unless he most absolutely leans forward—and even then I have proved that a rider can, in riding a hill, actually lean forward until the centre of gravity was brought so far forward that not only the whole of his weight was thrown on the drivers, but that he had so far inclined himself to the front that if the machine was standing it would actually tilt up. But so long as the machine was moving forwards and the rider urged it, he would not fall. This may sound strange, but it is a fact, nevertheless. Therefore, on the first portion of my remarks, I think I have shown that "Delta" ascribes to the open-front machine the very defects that the maker tacitly admits belong to the front steered one.

May I also add that the back-wheel steering of the "Salvo" was not really altered for the reason stated, as that all machines with a brake on the back wheel are unsafe at a high speed down-hill; not that the back steering is the cause, but that in applying the brake hard it has the effect of turning the steering-wheel to one side, whereby the machine appears to steer wild. But let us apply the brake to the drivers, and although the brake is hard on, the steering is not affected at all. Therefore the erratic steering is not due in actual fact to the back steering, but to the action of the brake.

And, therefore, no doubt the maker of the "Salvo" fully saw this, and for that and other trade reasons adopted the front steering. One more item, and I think I shall have shown a few defects of the front steerer. It is this: Living in a very hilly country, I could not understand why some of the crack riders on going up a certain long hill always turned machines with a front steering wheel round when they reached the foot of the hill and rode up backwards. I used to ride up with my face the correct way until I was told the reason for running the machine backwards. Suffice to say that I always rode it in that manner up a very steep hill, and found great relief thereby. I have this week only tried an open-front machine reversed on the same hill, but found a considerable augmentation of the labour. A very simple theory accounts for this fact.

The gear described by Mr. C. F. Steel is W. H. J. Grant's patent, and is the specialty of the Arrow Tricycle Company. In common with many other makers, this machine drives on the one side only, and this is the true cause of the defect in the steering mentioned. All single-driven machines, if the rider be properly placed, must suffer from this defect, as the power to propel being all on one side it naturally tends to force the machine to one side, and the great bulk of the weight being on the drivers, the small steering-wheel is forced on one side. This, I consider, is an argument in favour of the double drivers, but not against the open-front machine as a class. And amongst the machines which suffer from the effect of single drivers more than any other is the "Coventry," whether the lever or rotary. To keep a straight course you have to always keep the two guiding-wheels going away from a direct course, to balance the side-push of the big driving-wheel, a result most per-

plexing to a novice, and one that tends to make him progress in a fine corkscrew fashion.

"Y. L." in paragraph 4, I think, puts the question of hill-riding on the ordinary machine to a most practical issue. I quite agree with him that there is a decided gain in pushing a machine up some hills, rather than expend a lot of power in riding it, which is far better used to advantage on a level.

I have this week fitted the plan I mentioned at page 134, as to a new adaptation of spring to the seat. I have, in fact, tried two new plans—one the idea I described; the other an attachment to the seat itself. I find that it makes the motion something wonderfully easy; and the cost of fitting it has been less than 10s. I find it fully affords all the advantages I thought it should.

To "Faber" I would say that I have not yet got delivery of the "National" I mentioned, but expect it almost every day. I see another friend has apparently tried it, and that he approves of it. I have not the least doubt that either this machine, or such a machine as the National Special, or the No. 3, will be in great demand when they are better known. The idea of a large wheel speeded down, gives a very fine-looking machine and one easy to ride—far more so than the level-gear machine. But not the least advantage is the double-driving gear and hill-climbing dodge: both of these are exceedingly good; the double driver being the only plan that I have seen that really is double gear in turning a circle or against unequal resistance.

Sunlight.

P.S.—After writing the letter dealing with many points and statements mentioned by "Delta," I was still unsatisfied on one point in particular—that the "Salvo" was originally a hind-wheel steerer, but being found prone to tilt forward was altered to what it is now—viz., a front-steered machine. I was still of opinion that there was a special reason which had come to my knowledge on this point. I have since carefully gone through my series of ride-books, and find that I was quite correct in my floating ideas, and that the "Salvo," although a back-steered machine, in the first place had the axle between the two large wheels running across, in order to allow the double driving arrangement to be used. Hence the seat, to allow the rider's legs to clear the straight axle, had to be placed so far forward that it did on actual trial tilt the machine. This argument, however, would not for a moment hold good with the present open-fronted machine, and it cannot be urged against them, because the defect does not exist, and if the original "Salvo" had been made as the "Meteo" and other similar machines now are, without a straight axle right through, there would have been no possibility of such a statement being made; but it simply applied to that particular form which involved the placing of the seat really in front of the machine so that the rider was clear of it, and which therefore was liable to tip forward in consequence. I just mention these facts, as I know the readers of your journal like to get the fullest and most complete information on any point that is being discussed.

[19334].—I HAVE been much interested in the tricycle correspondence which has been going on in the ENGLISH MECHANIC, as I invented a plan of hill-climbing gear last July 4th, which I have patented, and of which I am now working out the details. There is one point on which I should be glad of information, and which I have not seen mentioned so far, though it seems to me far more important than the size of the wheels. Why is the steering-wheel of most tricycles placed in the middle? Why is it not put in front of one of the driving-wheels? This would give two tracks and an open-fronted machine. Is there more danger of capsizing? I believe it has been so placed in one or two machines. Can any riders give their experience?

I find on the "Coventry Tricycle" I can keep the two steering-wheels in the cart-rut, and the driving-wheel in the horse-track, and have often ridden thus for miles, where riding on a three-track machine would have been impossible.

I should perhaps add that it makes no difference to my invention whether the steering-wheel is placed in front of one of the driving-wheels or in the usual position, only the former seems to me to be clearly the right position for any tricycle unless it is dangerous.

Cardiff, Oct. 15.

T. Edward Heath.

THE PRODUCTION OF ELECTRICITY IN THE VOLTAIC CELL.

[19335].—THE experiment described in the second letter of "W. T. R." where, in a cell composed of an oxygen-coated plate and a "clean" one, the former is the positive pole, seems certainly difficult to explain on the accepted theory; but the production of a current by the mere passage of gas through the liquid, would, apparently, be in contradiction to the principle of the "conservation of energy," which is too well established to be lightly

thrown aside, and it would therefore be well to consider whether some other action does not take place. If a current occurs, heat is developed in the circuit and is dissipated by radiation. Where did this heat-energy come from? Can the mere transfer of gas across the liquid be considered a source of energy? I think not; but if we knew more of the initial and final states of the films on the plates we might find a source there. Perhaps when the oxygen has been distributed on both plates it is in a more condensed state than when on one only, because in greater proximity to the platinum which attracts it. Such condensation would evolve energy, and as the gas has to be transferred electrolytically through the liquid the energy would appear in the form of an electric current. It is well known that the current in the cell is always accompanied by the transfer of the two components of the electrolyte (the ions) in opposite directions; but to produce this transfer, with its accompanying heat evolution, and consequent dissipation of energy, we must supply the energy lost, be it by chemical combination, by change of state as in the process above suggested, or even by gravitation, as in a cell (which I believe I have seen described, but forget where) consisting of a tall jar of copper sulphate solution with a copper plate at the top and another at the bottom. The tendency of the copper to fall from the upper to the lower plate caused (if I remember right) a difference of electric potential between them. I hope, however, "W. T. R." will not look on this attempt to explain his interesting experiment as discouraging to further work on the subject. He has, at all events, put the old experiment with gas coated plates in a new light.

Belfast.

J. Brown.

NORTH BRITISH ENGINES.

[19336].—MR. LAWRENCE (letter 19238, p. 68) asks someone to give some information regarding the N.B.R. engines. Most of the N.B. engines are inside-cylinder engines. About two-thirds are six-coupled. The principal class of passenger express engines is of course Mr. Drummond's 6ft. 6in., with leading bogie. They have cylinders 18in. by 26in., and weigh about 43 tons. They are all named after various places on the Waverley route, &c. They work the heavy and fast traffic between Carlisle and Edinburgh, and also between Edinburgh and Glasgow. Their coal consumption is about 28lb. or 29lb. per mile. I know of at least twelve of this class—viz., Nos. 476–479 and Nos. 486–493. The next class is 7ft. singles, cylinders 17in. by 24in. They are great favourites, the only cause for regret being that they are only two in number (474, 475). They are generally used for the 7.10 p.m. and 9.10 p.m. Glasgow trains, which are the fastest on the N.B. system. They also run stopping trains to Berwick. Both of the above classes are designed by Mr. Drummond; and as dimensions have already appeared in the E.M., there is no need for taking up space in repeating them. Some of the coupled class have been painted a light yellowish green, and the framing a light ruby colour, which is a great improvement on the dingy olive colour which they were formerly painted. There are a good few of Mr. Wheatly's bogie engines still running. They are easily distinguished from Mr. Drummond's engines. The former have C.R. style of chimney and splashers, while the latter have G.N.R. style of chimney and splashers entirely closed in; besides, the latter are much heavier. They have inside bearings to all wheels. The principal dimensions are: Cylinders, 17in. by 24in.; bogie wheels (solid), 2ft. 9in. diam.; coupled wheels, 6ft. 6in.; 203 tubes, each 1½in. outside diam.; heating surface, tubes 894 sq. ft., firebox, 87 sq. ft., total, 981 sq. feet; grate area, 15½ sq. ft. Some are heavier than others. Nos. 224 and 261 weigh, on leading-wheels 11 tons 6 cwt., on driving-wheels 12 tons 7 cwt., and trailing-wheels 12 tons 7 cwt.; total, 36 tons. Nos. 421, 422, 423, 425, and 426, &c., weigh 38 tons, distributed as follows: On leading-wheels 13 tons, on drivers 12 tons 10 cwt., on trailers 12 tons 10 cwt. Nos. 418, 419, 424, 429, and some others have only 6ft. wheels and a single pair of leading-wheels. Nos. 341–393 are a very motley class, mostly old Edinburgh and Glasgow engines; wheels all about 6ft., cylinders 16in. and 17in.; some have double frames and outside side rods, others have single frames; the majority of them have no domes. Some of them have bell-mouthed chimneys coppered over, but the greater number were altered by Mr. Wheatly to his own style. There is one, No. 164, exactly like the 420 bogie class, with 6ft. 6in. wheels, no dome, and a single pair of leading wheels. For the last few years Mr. Drummond has largely employed a class of tank engines almost identical with the Brighton "Terriers" for local traffic. Their dimensions are—Cylinders, 15in. by 22in.; six coupled wheels, 54in. in diam.; 146 tubes, each 1½in. outside diam. Heating surface (tubes), 602 sq. ft.; in firebox, 62 sq. ft. They have wing tanks containing 600 gals. About six months ago some of this class were superseded by another class. This class has four wheels coupled,

and a leading bogie. The cylinders are 16in. by 22in., and coupled wheels 5ft. The bogie wheels are solid. Both classes are very light on fuel, especially the latter, which consume 18 or 19lb. per mile. Some engines of this or a very similar class run between Ladybank and Glasgow, and one (104) is running between Edinburgh and Roslin, via Glencorse. There are some gigantic tank engines on the Helensburgh and Burntisland sections. They are, if I remember rightly, leading and driving coupled 5ft. wheels and 18in. by 26in. cylinders. They stand very high, and resemble the large goods engines. I had almost forgotten to say that Mr. Drummond has rebuilt some of the E. and G. "singles." They have cylinders 17in. by 22in., and leading and trailing wheels about 3ft. 6in., and driving wheels 6ft. 6in. They have outside bearings to leading wheels, dome over the driving wheels (nearly); the splashers is of a style largely used by Beyer and Peacock. They have cabs of the G.N. or G. and S.W.Ry. style. The 474 and 493 classes are fitted with the Westinghouse automatic brake to the tender wheels and steam brakes to the driving or coupled wheels. The 420, 264, and 219 class have the Westinghouse on the driving wheels as well as on the tender wheels. A great many of the 341–393, 74, 164, 317–334 classes have the Westinghouse brake on the tender wheels, as have also the old E. and G. singles (Nos. 211 to 218). As I have taken up so much space describing the passenger engines, I will have to devote very short space to the goods engines. There are about 350 six-coupled goods engines, of which 36 are Mr. Drummond's fine 18 by 26 cylinder goods engines. They are numbered: Nos. 100, 139, 153, 242, 270, 278, 281, 287, 292, 304, 305, 316, and 454 to 473, and also 502–505. Another class, 506–527, &c., are exactly similar in appearance, but have only 17 by 24 cylinders. Mr. Wheatly's goods engines 1–35, &c., have cylinders 17 by 24, and coupled wheels, some 4ft., others 5ft., and about 1,010 sq. ft. of heating surface, and weigh 32 tons, or about 56 tons with tender. There are some much older classes, some with double frames. There are a few very large engines with copper-topped chimneys, polished brass domes, and safety-valves. This class was built by Dübs and Co., many years ago, before Mr. Wheatly's time. If Mr. Lawrence wishes any other particulars of N.B.R. engines, I shall be happy to assist him as much as lies in my power.

Carstairs.

NORTH-EASTERN ENGINES.

[19337].—WILL you kindly allow me space for a few remarks on Mr. Kendal's letter in your issue of the 7th?

Firstly, with respect to my assertion that the N.E.R., Leeds and Thirsk section, contained all that tended to make railway-travelling unsafe. I did not for a moment refer to the mode in which the line is worked, as everyone is well aware that the N.E.R. is, by the adoption of the absolute block system, the use of efficient brakes, &c., ahead of every other company in endeavouring to insure the public safety. But as to the physical conformation of the line, there is a rising gradient of 1 in 100, for six miles, to the entrance of the Bramhope tunnel, down which there is a fall for 1½ miles of 1 in 94. The tunnel also is extremely tortuous, and, from the formation of the soil above, is considered very unsafe. At the north end of this, whence trains issue at a very high speed, there is the set of facing-points forming the junction with the Ilkley branch.

But the line must be too well known for it to be necessary or expedient for me to occupy your space with a detailed description.

I was a passenger for some time on the line, and the foregoing was not my own opinion merely, but that of nearly every other passenger.

I am grateful to Mr. Kendal for his explanation as to the diversity of engines on the N.E.R. With, however, the exception of the double frame, the sketch I inclosed was an accurate one of a loco. I saw at Starbeck, two months ago, in charge of a trip from Middlesbrough.

As to the shape of its cab, the engines running on the Leeds and Hartlepool line are all provided with similar ones. No. 1166 (North-road Engine Works, Darlington No. 160), and the engine which took the 6.15 p.m. Leeds to Hartlepool on Oct. 8, are examples. These also possess cylinders inclined as I stated. Also, the engine which comes into Harrogate from the North at 9.40 p.m.

I have, so far, merely wished to vindicate myself from a suspicion of having misled our readers. No one will doubt the splendid work they do. By the way, I believe some are called Quakers, owing to their being built by the firm of Messrs. Pease, and not with any reference to peculiarity of shape, as stated by a former correspondent.

John T. Lawrence.

THE BOW-ROAD ACCIDENT.

[19338].—GENERAL HUTCHINSON's report upon the collision which took place at the Bow-road station of the Great Eastern Railway, on the 3rd

of September, has just been issued, and it will be read with interest in consequence of the facts given relating to the working of the block system.

It will be remembered that upon the day in question an empty-carriage train, consisting of four teen vehicles, left Fenchurch-street for Stratford about 9.26 a.m. These vehicles were fitted with the Westinghouse brake, and were charged with air; by some strange arrangement, which has not been explained, the engine provided to work this empty-carriage train was not one of those fitted with the Westinghouse brake, therefore the driver had no control over it.

At Bow-road station the brake upon the carriages from some cause stopped the train; in about three minutes the brake had been released by means of the release-valves, and the driver was about to start, when the 9.33 passenger-train from Fenchurch-street to Forest-gate, consisting of a tank-engine, running coal-bunker in front, and eight vehicles (four of which were fitted with Clarke's chain-brake), dashed into the rear of the empty carriage-train at a speed of about 10 miles an hour.

The driver and fireman were killed and eleven passengers injured; very considerable damage was also done to the rolling-stock.

The line is worked on the absolute-block system; therefore many questions have been asked and inquiries made as to how or why such a collision could take place? A perusal of General Hutchinson's report will clearly explain. He says:

"It is hardly credible, but, nevertheless, seems to have been the fact, that though the Bow-road signalman, Mattick, was watching the empty train while thus standing for three minutes near his cabin, he took no means to protect it by signal, using neither the down home nor down distant signal, nor the slot on the home signal at the gas-factory junction, this latter having been provided for the very purpose of being brought into use on an occasion similar to the present."

The principal cause of the collision was the great negligence of the signalman in not protecting the train by putting "on" his signals and "slot."

The signalman at the gas-factory junction lowered his signals for the second train without having assured himself that the block signal for the train had been accepted, and we are informed in the report that he "deserves very severe censure."

This collision, however, directs attention to the necessity which exists for the adoption of means for preventing signalmen making such a mistake, and "no unnecessary time should be lost in putting such means in force."

The conduct of the driver, fireman, and both guards of the empty train appears to me to be perfectly incomprehensible. When the train had stopped we have it in evidence that these four men all saw that the signals had not been put "on" to protect their train, and yet not one of them took the trouble to call the signalman's attention to this error; the rear-guard, who should have gone back at once with hand signals to protect his train, as required by the company's rules, neglected his duty, and actually walked towards the engine to find the cause of the stoppage, thus committing the error so frequently made, and to which I referred in my letter on the block system, p. 68.

In the driver's evidence a very strange fact comes to light. The train was stopped against full steam; both driver and fireman left the engine "with steam on and the reversing-lever full over" when they went along the carriages to release the brake. Suppose for a moment that the brakes had become released before the driver had time to get back to the engine; what would there have been to prevent it from starting off of itself?

This should be a warning never to leave engines with steam on.

The next point for consideration is the cause of the Westinghouse brake stopping the train.

Some of the daily papers stated that there must have been a small leak. General Hutchinson points out that the leakage arrangement will allow of a small leak going on without causing the brake to be applied.

A similar train was provided to the empty carriage train, charged with 45lb. air-pressure, was run experimentally from Stratford to Tottenham, with a leak (purposely made) not quite sufficient to put on the brake; but although the air was nearly exhausted on reaching Tottenham, the brake-blocks remained off the wheels.

This, therefore, shows that a small leak in the empty train was not the cause of the stoppage, and if it had been a large one, all the air would have been exhausted before the train arrived at Bow-road; this certainly was not the case, as after the brakes had been released by hand, there was a considerable quantity of air left, as the collision caused the brakes to be automatically applied. The report states:

"In the absence, therefore, of any other explanation, it seems reasonable to suppose that one of the guards must have inadvertently moved

the tap in his van, and have thus unintentionally applied the brake, which he was then powerless himself to release."

There can be no doubt that this is the correct conclusion, and it is also a fact that guards have, upon some other occasions, made similar errors.

We now come to the brake-power upon the second train, which had four of the vehicles fitted with Clark's chain-brake, and was at once applied by the guard; but we are told, "Had the Forest-gate train been fitted with a continuous brake throughout, instead of to only half the vehicles composing it, applicable by the guard as well as the driver, it is highly probable that the collision would have been altogether avoided." This fully confirms the opinion I expressed upon p. 43, let. 19205.

Finally, attention is called to the very dangerous practice of running tank engines with the coal-bunkers in front; it is entirely due to it that the driver and fireman lost their lives upon this occasion, and many others have, in past years, been killed from the same cause.

The accident seems to have been the result of a number of preventable errors, which, it is to be hoped, the directors of the Great Eastern Railway will do their best to prevent in future before any further accident happens.

Clement E. Stretton.

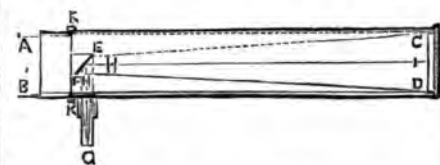
Saxe-Coburg-street, Leicester, Oct. 15th.

ADJUSTMENT OF MIRRORS.

[19339].—I VENTURE to suggest to your readers and contributors on this subject that the appearance of the reflection, central or otherwise, on the flat, or its shape, is unimportant if the flat is large enough to receive all the cone of light from the mirror.

The essential points in the adjustment of Newtonian reflectors appear to be the following:—

1. That the large mirror shall be so adjusted in



its cell as to receive all the cylinder or column of light ABCD.

2. That the flat shall be large enough, and be so placed, as to receive all the cone of reflected light CDEF.

3. That the eyepiece-tube shall be parallel to the axis GH of the reflected cone of light EFG, by which means the eyepiece is placed at right angles with it, and is truly centred upon it at any focus.

It is clearly of no importance what shape or size the flat may be in excess of the circular section of the cone of light it reflects, except so far as its excessive size obstructs light which would reach the mirror. I would ask those interested in this matter to consider it simply as one of optical adjustment, irrespective of the telescope-tube, the flat, or the eye-tube; these should be made to conform to the optical centre of the cone of reflected light.

The cylindrical column of light reaching the face of the large mirror and equally surrounding the axis of its reflection HI, is of course constant in its relation to the mirror.

A flat intercepting the cone of reflected light at a point coincident with its own diameter will throw a shadow on the large mirror practically central; in fact, eccentric away from the eyetube, but so slightly as to be imperceptible in adjusting, and the angle at which the flat is placed will determine the direction of the reflected cone of light to its focus.

In practice the ordinary adjustments advised by the opticians are very good, as the first steps to a close approximate adjustment, and then it may be completed accurately with the aid of a central spot on the large mirror and discs at each end of the eye-tube with central pin-holes, the eye-tube being then adjusted parallel to the centre or axis of the reflected cone of light, mentioned above as the third essential point of adjustment. If, when so adjusted, the image or reflection of light on the flat should not appear exactly concentric with the circumference of the flat, what does it matter? Unless indeed any portion of the cone of light passes on one side of the flat unreflected. In that case the flat can readily be moved by its supports and screws KK nearer towards that side of the telescope-tube so as to receive and reflect all the section of the cone of light.

I offer these remarks, trusting they may be of practical use to others using Newtonian reflectors, and to prevent them from attributing to mathematical or geometrical error, in the construction of their telescopes, that want of correct adjustment which in most cases will be found to result from

the eyetube not being parallel with the axis of the reflected cone of light.

Southampton, Oct. 10.

T. A. Skelton.

[19340].—If "Paugul" looks again at my diagram, 19195, p. 40, which is simply a drawing of section of flat and cone of rays, full size, when in adjustment, the diameter of the cone being 2in. at 9in. from focus, I think he will see that he has considerably underrated the eccentricity of the flat. In this case, which is 12in. mirror with 4ft. 6in. focus, which I drew short to show the difference more clearly, B C measures 1 1/2 in., and C A 1 9/16 in.; difference 5/16 in. A line drawn from B at right angles to the axis of cone measures 1/2 in., and from A to same axis produced, 1 1/2 in., the difference, which is the eccentricity of the flat, is 1/2 in.

The diameter of a cone from 12in. mirror 9ft. focus at 12in. from the focus is 1 1/2 in., length of B C 1/2 in., C A 1 1/16 in. from B to axis 1/2 in., A to axis 6/8 in., difference = eccentricity of flat 1/2 in. These measures are not absolutely correct, but near enough for practical purposes, and they are fully borne out by the appearance when looking through the eyetube with the drawtube removed, as in my last letter, p. 134.

If this mechanical eccentricity affected the adjustment, it would throw it out altogether; but the key to the solution is, that the optical angles on each side of the axis of the cone of rays being equal, it is all that is required, and the adjustment is therefore perfect.

Fordingbridge.

T. Westlake.

P.S.—Without resorting to mathematical exactness, the eccentricity of the flat, with 12in. mirror and 9ft. focus, seems to be: With flat at 9in. from focus, 1/16 in.; with flat at 13 1/2 in. from focus, 3/32 in.; with flat at 18in. from focus, 1/4 in. With 4ft. 6in. focus at 9in. from focus, 1/4 in.—T. W.

BRASHEAR'S SILVERING PROCESS.

[19341].—In answer to Mr. Holmes (19260), I can say that I have tried several modes of silvering, and find none so easy, certain, and economical as Brashear's. I never failed but once in producing a film, and that was the first time I tried it, and I attributed it to the fact that I made the reducing solution immediately before I used it. It would appear that the organic constituent (sugar) and the inorganic constituents require some time to mutually act on each other before their full reducing power is developed. I tried several days after my first trial and failure, and then I succeeded, with exactly the same solution. I should advise that the reducing solution be made a week before it is required.

I find that 1-10th of the silver solution for a reserve is not enough if I am to clear up the remaining 9-10th of the silver solution with the ammonia, till I cannot see any precipitate, when I hold up the glass vessel to the light and look through it. I, therefore, reserve now 1-6th, and only clear up the solution till I can see the bottom of the vessel from the top. Until I adopted this plan I had to mix some fresh silver solution each time.

I hope some of our chemical friends will help us, as Mr. Holmes suggests, by telling us the chemistry of the various steps in the process, and the reasons for all.

H. A. Wassell.

Addenbrook Villa, Love-lane, Stourbridge.

[19342].—It may be well to direct the attention of those who use this process to the fact that the digestion of silver oxide with ammonia for some hours produces a most violently explosive fulminate.—See account of an accident occurring from this cause in a recent number of the *Scientific American*.

Belfast.

J. Brown.

MEDICAL REPLIES.

[19343].—ERYTHEMA (45007).—"Anxious" will probably cure his son's complaint by giving him four drops of "Fowler's solution," in water, after breakfast and after dinner.

Two drachms of "Fowler's solution" should be got from a druggist, and the dose carefully adjusted.

If the boy is made at all sick by the medicine, stop it for a day or two, and then recommence with half the former dose.

James Edmunds, M.D., &c.

8, Grafton-st., Bond-st.

AMATEUR PIANOFORTE-MAKING.

[19344].—A GOOD deal has been said about the folly of attempting to teach amateurs how to make such a complicated piece of workmanship as a piano. I think some of these critics would be rather taken by surprise, as I confess I have been myself, if they had an opportunity of inspecting some genuine amateur work, and of hearing the

the tone from some of these "home-instruments. It may be thought that I am a little too much disposed to make liberal for defects. How far this suspicion is a following notice from last week's *County Gazette* will show:—"This ex-Mr. Minns infinite credit, both in the ship he has turned out and the quality of is produced. The instrument is of full seven octaves. It has an iron back and sounding-board. The tone is full and and is equal in character throughout the the effect of the soft pedal is all that is required for soft passages, or for accompaniment."

It is necessary to state that the above was the first attempt of an amateur whose daily avocations are far removed from piano-making as such well could be, and whose sole direct measurements were, with very trifling exceptions, taken from these pages. I do not underrate the difficulties that amateurs have to overcome before they can be equally (indeed, to tell the truth, I feel rather to take the opposite course, for there is no where these things may end), but as I have seen many who have already planned a piano for the long winter evenings, and to show them what patience and perseverance can accomplish, and to urge them not easily discouraged.

W. H. DAVIES.

ADVICE TO JOINERS AND OTHERS.

—THE following may not be new to you, but it may be new to others. If you have a very fine, with scarcely any "grain" in it, apply a coat of flour-cream with the oil; the effect is magical. A hard useless stone becomes as a piece of the best Turkey; in fact, an article may be made of a piece of stout sheet Collodion.

ANSWERS TO QUERIES.

In their answers, Correspondents are requested to mention, in each instance, the number of the query asked.

[44455.]—**Hæmorrhoids.**—I have unfortunately had some experience of the discomfort of hæmorrhoids, but the best remedy, one readily obtained at every respectable chemist, is—"Nutmeg and Opium Ointment," applied in small quantities. If the blood is by sarsaparilla or quinine, the cure will be rapid; and should anyone be liable to re-attacks after much walking, he should rub the parts adjacent with good soap and prevent chafing. If any of your friends make a good trial of the above, I am willing to obtain permanent relief, and I would they would ultimately write you to that effect. E. BRAY, Lancaster.

[44456.]—**Hollow Shaft.**—Rankine's rule for the strength of hollow shafts is—

$$M = 196 f \frac{D^4 - d^4}{D}$$

M = twisting moment in inch-lb.
 D = external diameter of shaft in inches
 d = internal diameter of shaft in inches
 f = modulus of rupture of material.
 To know the value of f for Whitworth's pressed steel; but for illustration, I will take 80,000 lb. per sq. inch, which will not, I am far wrong.
 $= 196 \times 80,000 \frac{(24)^4 - (14)^4}{24}$
 $= 196 \times 80,000 \frac{331,776 - 38,416}{24}$
 $= 2395.77 \times 80,000$
 $= 191,661,600$ inch-pounds,
 800 pounds at the end of a lever one foot

as of f are for wrought iron 50,000 lb.
 " " for cast iron 27,000 lb.
 Putting these values for the 80,000 lb. in the calculation, you may readily find what would be the strength of shaft if constructed of these materials.—GLATTON.

[44457.]—**Painting Decks.**—I do not know of that will stand being walked upon; but on a material called corticeine, I think, the decks of small launches, with success, are painted with cement and narrow strips of sheet round the edges to the deck, so as to be raying. The material is sold as a floor-plate. I believe it to be a compound of india-rubber and powdered cork.—GLATTON.

[44458.]—**South Africa.**—If you could get into the country, you would probably find plenty of employment. A friend went there about three years ago, and was doing well as surveyor; but

some disease attacked his eyes, and he was forced to give up his appointment.—GLATTON.

[44244.]—**Arranging Piano forte Music for Full Band or Orchestra.**—I regret that I know nothing about music; but if "C. A. E." can beg, borrow, or steal Vols. XX. and XXI. of the *English Mechanic*, he will find there a series of papers, commencing on p. 570, Vol. XX., under the heading, "The Amateur Bandmaster; or, Hints on Arranging and Scoring for Various Instruments," which contains precisely the information which I believe he wants.—GLATTON.

[44253.]—**Paper Bowls.**—I am sorry this query has got into the U. Q. column. I should like to see an answer from some one who is practically acquainted with the industry. In the mean time, it seems most probable that the bowls are not turned at all, unless, perhaps, at their edges. A pair of polished metal discs would leave the papier-mâché with a good surface. To turn the edges I would use either a firmer chisel or a woodturner's chisel with a very thin edge, used like a knife.—GLATTON.

[44330.]—**Amber.**—The German pipe-makers place a lamp under the amber to keep it warm while in the lathe; it is then less brittle. Do not warm it too suddenly, or it will crack. Sorry I cannot help you with regard to tools.—GLATTON.

[44339.]—**Measuring Wind from Fan-Blower.**—The best method will be to use an anemometer, convenient forms of which are to be had at philosophical instrument makers. The simplest, perhaps, would be to use a bent U tube partly filled with water, and with one end bent so as to face the current of air. The relative heights of the two surfaces of water would afford a rough estimate of the velocity of the air in blast-pipe, and by multiplying this by the area of pipe "Tomkins" can get the volume of air which passes in a given time. If "Tomkins" likes to try this method, and will give diameter of blast-pipe, I will give fuller details.—GLATTON.

[44358.]—**Salicylic Acid.**—There is another preparation which has lately been much puffed—Glaucaline; but whether better or worse than salicylic acid, I cannot say.—GLATTON.

[44372.]—**How to Clean Chamois Leather.**—After washing, stretch on a frame to dry.—GLATTON.

[44455.]—**Chloride of Zinc Battery.**—There is a cell—the Grenet—which is similar in construction to the Leclanché cell, but charged with a solution of chloride of sodium or common salt, instead of with a solution of sal ammoniac. The Cl combines with the Zn to form $ZnCl_2$. Is this what is meant?—GLATTON.

[44457.]—**Cutting Diamonds.**—Iron, not steel, charged with diamond-powder, is used for slicing. I do not know of a lapidary's toolshop, but doubtless there are such.—GLATTON.

[44460.]—**Eczema.**—If "T. W. W." would kindly give particulars of his vapour-bath in the columns of this journal, it would most probably benefit many other of its readers, besides "A. O. S.," as a surgeon to a London hospital for the skin, writing in the *Daily News* of September 22nd last, page 8, estimates the present number of sufferers from skin-diseases in Great Britain to be 250,000; and he states, "for every person who has a dry skin the vapour-bath is not only a necessity of life, but a comfort and a luxury."—A. O. S.

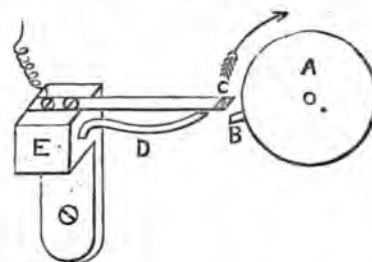
[44461.]—**Water-Engine.**—Supposing the engine perfect, the quantity used would be $\frac{229 H}{S P}$ cubic feet per minute, where H = indicated horsepower, S = number of strokes under full pressure of water per minute, P = pressure per square inch. In your case the formula becomes $\frac{229}{22.9}$, but no engine is perfect. Suppose its efficiency is .6, then cub. feet of water per min. = 1.66 times the above quantity = $\frac{38.16}{S}$.—GLATTON.

[44464.]—**Chloride of Zinc Battery.**—See reply to 44455.—GLATTON.

[44517.]—**Scrap-Book.**—Photographs are best mounted with paste made with starch instead of flour. Pencil drawings may be fixed by floating on skim-milk until well wetted, or by brushing with thin isinglass size.—GLATTON.

[44531.]—**Electric Contact.**—In compliance with "Old Subscriber's" request, I send rough sketch of my arrangement, at the same time apologising for the delay. A is a brass disc, mounted on the escape-wheel arbor of my regulator. Between the dial and front plate B is a platinum point, firmly soldered into the edge of A. C is a piece of sheet platinum soldered to the end of a thin flat steel spring. D acts as a steady spring. E is an ivory block; one wire is joined to the left-hand end of C, the other wire is fixed to the movement. The diagram

shows the working of the contact, which I think is all right after all, for, upon examining the gathering pallets of my secondary clock, I found a fault



which undoubtedly caused the loss of time complained of. I have the clock fixed in the open air, and is working splendidly with four Leclanché cells.—S. B. McCLELLAN.

[44558.]—**Civil Service Health Certificate.**—(U. Q.)—"Bristol" would have to be examined by his own doctor, who would answer questions sent him by the Civil Service Commissioners respecting the health of the candidate, and he would also be asked to state whether he considered the candidate suitable, from a medical point of view, for an appointment in a public department. The candidate would have to state the nature of any diseases from which he had ever suffered; whether he was subject to blood-spitting; and also whether any members of his family were consumptive or insane. From this information the commissioners would determine whether the candidate should be admitted to the service. It will probably be a long time before another examination for Customs out-port clerks takes place.—C. S. COACH.

[44576.]—**Eighteen-Ton Armstrong Gun.**—(U. Q.)—The gun you saw at Shoeburyness last year was not a new Armstrong gun: it was one of the ordinary breech-loading guns. The new gun we make is a wire gun, 10 2/3 in. in the bore. I am sorry I cannot give a sketch, as we are not allowed.—ELSWICK.

[44603.]—**Screws, Twin.**—(U. Q.)—You must have two engines to work twin screws effectively: one screw on each side of the rudder. One screw turns right and the other left. You can turn the vessel quicker by having two screws.—ELSWICK.

[44603.]—**Screw.**—In some steam pinnaces I saw at Portsmouth the screws were right and left-handed, and, therefore, ran in opposite directions. Otherwise, every time the stern lifted the boat would slew round.—GLATTON.

[44611.]—**Metropolitan Locos.**—The pipes lead to ejectors for producing vacuum for brake service.—GLATTON.

[44611.]—**Metropolitan Locos.**—(U. Q.)—The pipes "Mot" asks about are vacuum-ejectors, for working the vacuum-brakes, which are fitted to this company's rolling stock.—GUIDE YOKE.

[44622.]—**Machine to Extract Iron from Brass.**—I am much obliged to Mr. Lancaster for his kind answer to the above. I understand most, and can make all you recommend; but is it not a mistake in saying electro, instead of permanent magnets, as you make no allusion to wire or battery?—does lin. rod mean bar magnets lin. diameter? A rude sketch of magnets on shaft would greatly assist me; all the rest is quite plain.—ONE IN WANT.

[44634.]—**Removing Ink-stains.**—One of the safest processes is to immerse the linen or ink-spot into a weak solution of Holme's ozone bleach—the ink is effectually removed, the linen uninjured, and nothing poisonous in the liquid.—WARRINGTON.

[44635.]—**Boiler.**—In reply to this query I think there is some misunderstanding. "Sunlight," in his reply, gives nine circular inches on the piston to require one square foot of firegrate surface (a rule that I work to myself). Now, in a cylinder 3 1/2 in. in diameter, there are 14.0625 circular inches in area; this sum divided by nine would give rather over 1 1/2 times; but, to have ample room, say 1 3/4; this, then, would require 1 3/4 sq. feet of grate surface. To get this amount we should want a firebox 18 in. diameter, which would give 254.4 square inches in area, and this divided by 144 (the number of sq. inches per foot) would give 1.76 square feet, the required size of firebox. "Sunlight" gives 14 in. for diameter of the firebox, which would only be a little over one square foot. Perhaps he would kindly go over the figures again, for I cannot see how he makes 153.938 square inches equal to 1 1/4 square feet, for 153.938 square inches divided by 144, equals 1.069 square feet as "Amateur" makes it.—METEOR.

[44662.]—**Old G. W. R. Engines.**—(U. Q.)—The following are the chief dimensions of the old

"Ixon" class of G. W. broad-gauge engines:—cylinders (inside), 15½ in. by 18 in.; driving-wheels, 7 ft. diam.; 131 tubes, 2 in. diam., representing 732 square feet of heating-surface; heating-surface of fire-box, 97 square feet; grate-area, 13·4 square feet; weight of engine empty, 22 tons.—GUIDE YOKES.

[44677].—Drawing Maps to Scale.—The simplest way is to get a pantagraph, and set it to the required scale, to be obtained by means of an ordinary rule. The querist does not say what scale he has drawn his maps to, and yet asks the simplest way to draw them to a scale of 6 in. to a mile, &c.—NUN DOB.

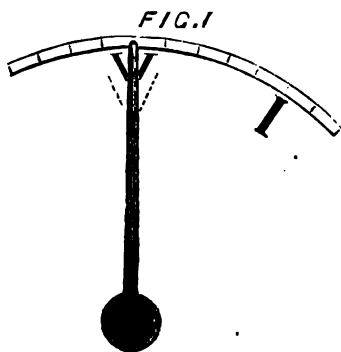
[44686].—Even Temperature.—It is extremely doubtful whether pitch can be kept at an even temperature by means of steam, unless it is constantly stirred. It might be done in narrow vessels, with steam all round, except at the top; an ordinary copperful of it would have too much body.—NUN DOB.

[44692].—Substitute for Glass.—The only thing that suggests itself to me is the best white gelatine.—C. M.

[44703].—Charcoal Siftings.—If ground fine could be used, very likely, by firework makers and by foundries.—S. R.

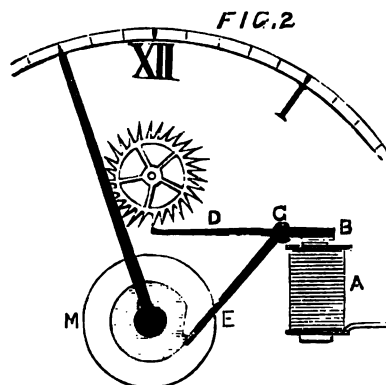
[44715].—Gongs in French Timepieces.—To reply fully to this question would occupy a page of the MECHANIC. I will, therefore, render a few remarks which I hope may prove to be useful. In the first place, the size of wire is selected which will produce the "pitch" or "depth" of tone required, which is according to the length of the gong when completed, and may be ascertained by trial. The usual form of such gongs represent about two-and-a-half coils, say three in some instances. The convolutions of gongs are formed by means of a "lathe-head" in order that the grain of the wire in the production of its coils shall be unbroken in its whole length. When formed, and quite bright and flat, the stem-end of the "gong" should be fitted very tightly into its brass block, which attaches it to the required "stem." It has then to be blued, which produces the clear tone. Such is effected by placing it upon brass flings or coarse emery contained in a small shovel or pan, and holding such over a clear fire, and when blue, removed therefrom and allowed to cool gradually. When cold it should be soft-soldered, very solidly, into the brass block, by which it has to be secured to its fixture. It must be borne in mind that any bending of the gong after such fixing will destroy the tone of it. The depth of tone is regulated by the size of wire of which it is composed. The deeper tones are produced by large wire being used, which can only be applied to clocks which have sufficient mainspring power to carry a hammer of sufficient weight to "bring out" the tone.—SECONDS' PRACTICAL WATCHMAKER.

[44727].—Synchronising Clocks.—Many attempts have been made to synchronise or correct clocks by electric current. Several systems are in use in London, Edinburgh, and other towns, where correct time is a necessity. All that I am acquainted with use an hourly current. Mr. Alex. Bain invented a plan for setting the hands of clocks to correct time about 40 years ago: this plan is shown in Fig. 1. Behind the dial of the clock to



be corrected, an electro-magnet was placed; the armature of the magnet carried a rod which came through the dial-plate, and to its end was attached a V-piece about the centre of the figure XII. A pin projected backward from the minute-hand, so placed as to clear the arms of the V when the armature was at rest. At the last second of the hour the electrical circuit was made by the standard clock, automatically closing a pair of contact springs; the electro-magnet attracted the armature and drew the V-piece upward, forcing the pin in the back of the minute-hand against one or the other of the angles, and so bringing the hand to the exact hour. This method has lately been

revived and a clock so set may be seen in the window of Hudson Bros., West Strand. Another method has been introduced and patented by Messrs. Barraud and Lund, of Cornhill, and has been applied to a large number of clocks in the City of London and elsewhere. Hourly currents are also used in this system. The armature of the electro-magnet has two pins attached to it, which act in slots cut in two levers. On the ends of these two levers are two stout pins which come through the dial, and when the armature is attracted by the electro-magnet at the hour, it draws the ends of the levers carrying the pins together, grasping the minute-hand and setting it back or forward as the case may be. A pair of scissors will serve to give an idea of this method. Another system is in use by Lund and Blochley, of Pall Mall. In this a weighted lever is raised during the hour by the clock itself. This is left upon a catch shortly before the hour, and to this catch is attached the armature. When the armature is attracted by the hourly current, the catch is withdrawn and allows the lever to fall with a force depending upon its own weight. The setting is effected by a V on the lever and a pin on the minute-wheel in exactly the same way as Bain's system; but the action being so close to the centre, it requires a good blow to set the hand. The electric current, however, has nothing to do with supplying this extra force, all that is required of it being simply to release the catch, so that the lever may fall, the clock thus supplying its own correcting-force. This is a very ingenious device, but is necessarily somewhat complicated. Messrs. Ritchie and Son, of Edinburgh, are the patentees of another system which differs entirely from those previously described. In this the hands are not interfered with; the plan adopted is to give the clock a slight gaining rate, and at each hour to stop it as much as it has gained since the last hourly current set it right. The hands may, therefore, be firmly attached to the works, thus doing away with a source of failure in the other methods; for in them the hands must be left somewhat loose, or probably the current would not set them. Consequently the hands sometimes slip and the clock loses time. Fig. 2 shows this



form, which was described by Mr. F. J. Ritchie, in a paper read before the Royal Scottish Society of Arts as follows. The clock to be corrected is caused to gain slightly, or rather is regulated not to lose time, the amount of gaining rate is immaterial, and may be one second in a week or forty minutes. The minute-hand will, therefore, arrive at the hour, less or more, too early, and our aim is to arrest its progress to that extent. The electro-magnet A is excited 15 seconds before the hour by a current from the normal clock, and by its attraction on the armature B acting on the fulcrum or centre C, would raise the lever D, with the stop-pin at its extremity, into contact with the 'scape-wheel, thereby arresting its motion until the cessation of the current. A disc M, carried by the wheel to which the minute-hand is attached, here performs a most important part in the arrangement, as by it the 'scape-wheel detent is prevented getting into contact with its teeth, until the minute-hand arrives at the 60th minute of the dial, when a notch in the periphery of the disc corresponding to that minute allows the lever E to pass, and with it the other arm D carries its stop-pin into contact with the 'scape-wheel and arrests its progress. Immediately the current is cut off by the normal clock the magnet ceases to attract its armature; the preponderance of the levers causes them to fall out of action, and the clock is started to go on for another hour. The stop-pin must be so placed that when it is holding the wheel it does not jam the escapement, or it will stop the pendulum, and the clock will not start when the current ceases. It should be so arranged that one pallet winds the wheel back a little at every other vibration. The Leclanché battery is the best for these hourly signals.—A CLEVERWELL CLOCKMAKER.

[44739].—Vernier.—I purpose giving full instructions for verniers and circles in a few weeks;

but I will tell you how to make your declination vernier. Assuming that your circle is divided on the flat, then you can easily make a cardboard vernier. First, take a piece of cardboard that will be a little longer than 20° on the divisions on circle, then, with a pair of compasses, describe an arc on card, same radius as centre of divisions on circle. Now fasten, with paste or gum, or with a little gelatine; fix the cardboard on to the inner diameter of divisions; have a very fine pointed pen, and mark a series of 20 dots, exactly in continuation of the divisions on the circle; then, with a thin straight-edge, moving on a point same distance as radius of circle, and using a fine ruling pen, carry the lines on exactly true for say ½ in.; having done this truly, then, with a pair of dividers, measure the distance between nine divisions on the circle, and with the compasses measure the width of ten of the divisions on the cardboard, and at the place where ten of the divisions on the card are same width as nine on the circle, make two dots, and with the compasses describe another arc, cutting through these two dots; then the vernier will be a good one. Fit it on to the arm that has to carry it, and adjust it, so that the tenth division on either side cuts exactly the ninth division of circle. Number the centre line on vernier 0, then the 5, and 10 on either side respectively. When done, varnish with pale copal varnish, and you will have a vernier that will read correctly and last a long time. Of course, this vernier will only read to 6', but if your circle is divided into half-degrees and you divide the vernier so that thirty divisions equal twenty-nine half-degrees, then you can read to a minute in declination. You proceed just in the same manner with the vernier for hour-circle. If you have a lathe, &c., I will tell you how to make a dividing machine if you would like to make one.—W. J. LANCASTER.

[44740].—Waterproofing Brick Walls.—I should not like to advise "Devonshire Squire" to use the solution of paraffin wax instead of stucco until it has been more fully tested by time if he does not object to stucco, but if he wishes to retain the appearance of bricks I should certainly recommend a trial, as the expense is not great, and the stucco could probably be used just as well afterwards should the other fail. It appears to do equally well on any bricks either soft or hard. Where I live (in Surrey) the rain is probably never so continuous as in Devonshire, but it will keep out many hours' driving rain here, and I, therefore, expect it will do so for any length of time.—S.

[44743].—Repairing Geneva Watch.—"J. J. W." had better refer to No. 428 ENGLISH MECHANIC, "The Watch, &c." I think he will find all he requires; if not, another query will meet my attention.—SECONDS' PRACTICAL WATCHMAKER.

[44768].—Hardening Bright Steel.—If "Steel" will send name and address, I will send him, for the cost of it, a compound or mixture for coating the bright steel goods with, which, after being hardened with it, present a bright silvery appearance.—J. W. MITCHELL, 5, Park-street, Keighley.

[44772].—Beams and Girders.—When "M.I.C.E." gave 500 tons as the safe load for your beam, he simply took into account the shearing-stress, never mentioning the enormous bending moment which such a load would set up. Now, the bending moment in a beam of this kind = Load × distance between supports = 500 × 15 = 7,500 ft.-tons.

To resist this we have a mass of metal in girder No. 1 on the tension side 3 in. × 12 in. = 36 sq. in. The web may be neglected, being allowed for shear. The max. safe stress per sq. in. in wrought iron is 5 tons; so the max. safe load on the tension flange is 36 × 5 = 180 tons. Then if we measure the distance between the centres of the flanges, viz., 16 in. or 1·33 ft., and multiply it by 180 tons, 1·33 × 180 = 240 ft.-tons, which is the moment of resistance of beam No. 1. In No. 2 we get a tension flange 3 × 14½ = 43½ sq. in. × 5 = 217½ tons as the safe load on the tension flange; 217·5 × 1·083 ft. (the distance between the centres of the flanges) = 236 ft.-tons. If this moment of resistance be added to the moment of resistance of No. 1, 236 × 240 = 476 ft.-tons. Now, 476 ft.-tons, the combined moments of resistance of the two beams must be = the bending moment. Taking 476, then, as the bending moment, 476 ÷ 15 (see first equation) = 127 tons, which is the max. safe load on the centre of the beam. The oak had better be thrown in for the good on account of its deflection before taking any appreciable portion of the load. The breaking load would be four or five times that amount, viz., about 550 tons.—J. H.

[44775].—Feed-water Heater.—To "SUNLIGHT."—In such a case, where there is an existing straight length of exhaust-pipe, I should, for cheapness and simplicity, use an ordinary circular heater, which could be well carried overhead like the present exhaust-pipe. I should advise it to be

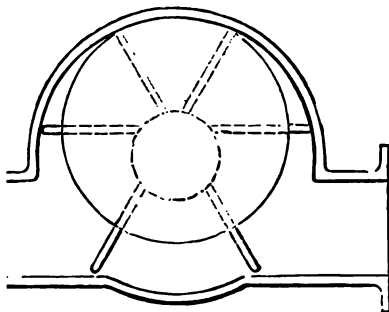
hamber and the fume-pipe, before the light ad to it, an explosion, not perhaps without may result. This is obviated, at the outset, by the light at the same instant the gas don. As I sit writing this letter, 5ft. away ny stove, I feel the constant and gentle emitted from it, and inwardly thank the for the comfort I experience.—ALFONSO.

55.]—Gas Fire in Bedroom.—There are of manufacturers who supply burners that fitted into the grate now in your bedroom, when fitted, can be filled up with asbestos, rice stone, which becomes quite red-hot he gas is lighted. And there is another kind ke a sheet-iron basket to fit into the grate, can be lifted out and placed into any other m grate, and by connecting it to the gas rubber tube, you are then ready to light have had one of these in use for some time, I find very convenient. If "H. O'B." vertise his address in 6d. column, I will send awing and prices of the above.—JOE BLAIR, 3.

57.]—Carbonic Acid Gas from Chalk.—rts of chalk, if it consisted of pure carbonate ium, would require for exact neutralisation s of pure sulphuric acid or oil of vitriol; the ty of commercial vitriol required will depend strength of the vitriol. The querist can ascertain this by taking the density with el's hydrometer. These can be obtained 6d. each. Having obtained the density, o tables to be found in most chemical books chical character. One pound of pure chalk eld 23 6-10ths gallons carbonic acid gas at l temperature and pressure. "One volume gas at 0° C., becomes 1.003665 volume at or 273 volumes of any gas at 0° C., become lumes at 1° C., and 275 volumes at 2° C." horpe's "Chemical Problems," 1s. 6d., pub- by Macmillan).—CHEMISTIANA.

57.]—Carbonic Acid.—The action of pure ric acid (vitriol) upon pure calcium car- (chalk) is represented by the equation $+H_2SO_4 = CaSO_4 + CO_2 + OH_2$; which that 100 parts by weight of calcium car- are completely decomposed by 98 parts of ric acid, yielding 44 parts by weight of onic acid gas." As the chalk and vitriol are ely to be pure, you may use 1lb. of chalk to vitriol, or 9 fluid ounces by measure. Now, occupies two volumes, 1 litre of it weighs, nd 760mm., 1.97 grammes, and at the usual rature of 15° (= 59° Fahr.), 1 litre weighs grammes, or 1 cubic foot weighs 52.97 as = .117lb. nearly; so that the gas arising lb. of chalk will occupy $.44 \div .117 = 3.75$ cubic feet. "Carbonic acid gas," like all gases, within limits, expands 1-273rd of lume at 0° C. for each degree above that rature; so that 273 cubic inches at 0° come 274 cubic inches at 1° C., 288 3 + 15) at 15° C., &c. Full particulars as sion of gases, and as to chemical action e proper quantities, are to be found in any on chemistry. I recommend you to buy ers's shilling book on chemistry, and write if you do not understand my explanation.— ARUNDEL.

90.]—Exhaust.—The exhaustor is usually ified form of fan, in which the gas is, as it dealt with something after the fashion of a wheel lifting water. Generally they are with a series of blades or fans, which work, ere into the large main pipe from the retorts, per part of the fan being carried in a casing, f, as it were, on the top of the main pipe. To pre- scribe such would require a sketch, which I



are with, and which will give you a better idea arrangement than a mere description.—SUN-

96.]—Mainspring Winder.—1. The r is screwed in the board-vice; the outer end put in the barrel first, but the inner coil is over the projecting pivot; the handle is urned by the right hand, the spring being

held firmly between the first three fingers of the left hand. When the spring is all wound up, the pallet is reversed to keep from running back; the barrel is then suddenly put over the spring. 2. The lever over the tool is for holding springs full wound up that have the hook in the end of the spring, and not in the barrel. This lever is old-fashioned.—W. M.

[44996.]—Mainspring Winder.—Fix the winder in the bench-vice, and if for a lever or verge-spring, set the clickspring underneath so that the winding arbor will turn under and over, to and from you. If for a Geneva spring, set the reverse way for the majority of cases. Hook the inner coil of the spring on the arbor, and, if for a lever or verge, guide the spring, and hold with the left hand whilst you wind with the right. If the spring is fitted with a barrel-hook, bring down the "lever," and set it against the hook on the now wound-up spring, which will thereby be securely held, coiled up, ready to slip to its place in the barrel. In fitting a spring in this way, care should be observed that the coiled spring is only slightly less in diameter than the barrel, just enough to free the hook. If allowed too much recoil, the hook may be snatched off, or the spring injured at the riveting, by the strong jerk it receives when the hook catches in the hole in the barrel. With a spring having no hook, the "lever" is not needed.—ALFONSO.

[44996.]—Tithes.—"A Member of the Anti-Tithe League" will find in Hume's "History of England," Vol. I., how tithe was first imposed in England by King Ethelwulf at the instigation of the clergy. "The payment of tithes before his reign had been voluntary, and was considered a religious obligation" (Southey's "Book of the Church"); see statutes at large, 29 Hen. VIII. Tithe was commuted for money by the Act for the Commutation of Tithes in England and Wales, 6 and 7 Will. IV., c. 71, 97 clauses, 1836.—SADDLED.

[44999.]—Self-Feeding Fountain.—I regret to have to tell "O. F. C. C. O." that it is simply an impossibility to do what he proposes. If it were possible, not only would he have attained perpetual motion, but still more, he would have actually discovered a mode of obtaining power which so far would be totally against all natural laws. If he will look at the question again, he will surely see that the pumps to lift up the volume of water necessary to actuate the water-wheel would exactly absorb the power given off by that wheel, leaving nothing for friction. And further still, the pumps must actually lift not only enough water to drive the water-wheel, but to supply the fountain-jet. In any case it would be a total impossibility; but to do so in view of the extra volume due to the discharge of the jet, is making the impossibility still more glaring, to say the least of it. This, in some respects, is a parallel to the proposition made by a querist at page 507, Vol. XXXI.—SUNLIGHT.

[45000.]—Toning Bath.—"W. E. K." had better not try to doctor his bath in such a condition. It seems to be an acetate bath, and with some people this will never act well (AuCl₃ or gold-trichloride is not so very expensive), so throw it in your waste-tub. For a good bath try the following: Tungstate of soda, 2 scruples; gold-trichloride, 2 grains; boiling water, 16oz. fluid; use when cold. This will only last for one batch of prints, say, 170 C.D.V.; then make new bath, and save the old with your other gold waste.—WILLIAM PROX, Hayward's Heath.

[45000.]—Toning Bath.—As it is impossible to make sure of what should be done, the best way by far is to avoid any tinkering with the toning bath, and to make a new one up at once. The old one may be easily made to give up any gold held in solution by adding to it a little of the green sulphate of iron crystals, which will throw down the gold as a purple deposit, which may be washed and re-dissolved in aqua-regia, thus again forming chloride of gold. But don't waste time in trying to doctor your bath. As to a formula for a new bath—if you want purple tones, use chloride of gold, 1 grain, boiled with a little precipitated chalk until neutral, and then add 30 grains of acetate of soda, and water to make up to 8oz. But this solution must be 24 hours old. For architectural subjects, the same quantity of gold neutralised as described, and 20 grains of phosphate of soda and 8oz. water. This won't keep, mind, and the prints tone very rapidly.—SUNLIGHT.

[45002.]—Darkening Oak.—The best and cheapest method is to fumigate the work, either before it is fixed, by placing it in a chamber or room made airtight, or after the work is fixed in its place, by making the room airtight. You will require for a room, say, 20ft. by 15ft. by 11ft., about a quart of liq. ammonia 880, costing 2s. Put this in a dish, and leave it in the room for twelve or fourteen hours. Should the work not be dark enough, you must either put in more ammonia or leave the room closed for a longer time. When

you apply the ammonia with the brush, it not only raises the grain of the wood, which has to be rubbed down again, but it also stains the end wood very much darker than the other parts. The tighter you make your room or chamber, the less ammonia you will require for fumigating.—CAB.

[45006.]—Chemical.—With apologies to Mr. Allen, I may tell "W. S. F." that the quantitative valencies and atomic weights of the metals named are:—Cesium, 92; didymium, 96; erbium, 113; lanthanum, 93; thorium, 234; Yttrium, 61.7. Cerium is dyad and tetrad, the others are all dyads except thorium, which is tetrad. All these metals are precipitated as hydrates from their solutions by AmHO, KHO or NaHO. These metals resemble Al most, but uranium is clearly allied to iron. Brick red hydrate, pp., by AmHO, and black sulphide by 8Ams, green carbonate, green reducing soluble salts; so its quantitative, like that of iron, is dyad and pseudotriad, and its At. Wt. 120. You are no doubt acquainted with the curious uranyl nitrate and uranyl sulphate of formula U₂O₅, N₂O, and U₂O₅, SO₃, which are not anomalous compounds, as the formula N₂O, (U₂O₅)O and SO₃(U₂O₅)O show.—LEWIS ARUNDEL.

[45009.]—Liquefaction of Oxygen and Hydrogen.—M. Cailliet liquefied oxygen on the last day of December, 1877, and M. Pictet on the 11th of the January following. At the moment of liquefaction the pressure in the apparatus was no less than 505 atmospheres in conjunction with 140 degrees of cold. Hydrogen was liquefied at the same time under a pressure of 650 atmospheres, or 9,555lb. on the square inch.—SUNLIGHT.

[45010.]—Erecting Small Engine.—To "SUNLIGHT."—You will only be able, I see, to get a stroke of 2 1/2 in. Piston must be 1/2 in. thick, with either a brass or cast-iron ring, or a hemp packing; piston-rod should be 1/2 in. diam. and 4 1/2 in. long; bed-plate 1 1/2 in. by 4 in.; motion bars 4 1/2 in. long with surfaces 1/2 in. wide. Guide-blocks 1 in. by 1/2 in. Connecting-rod must be of the length to suit the distance of the crank-shaft from the motion bars. You do not say the width of the bars between the steam and exhaust ports; I am therefore unable to tell you the size of valve, &c., but will do so on getting size of bars. The valve-box, I would say, is very small for the size of engine. See also page 192, Vol. XXXII.—SUNLIGHT.

[45013.]—Electric Light for Workshop.—I very much question whether, from the present arrangement of your shop, the electric light could be advantageously applied. In fact, I think not. At any rate, you must not forget that the dynamo machine would cost you something like £250 to begin with, and it would be quite useless to think of making one, as it is a matter requiring special knowledge. If you bought a machine you might use the "Swan" lamp; but I doubt whether in the long-run you would do much good with it.—SUNLIGHT.

[45016.]—L. and N. W. R. Engines.—Trent, August, 1864; Condon, June, 1877; Planet, January, '66; J. Ramsbottom, March, '72; The Queen, April, '72; Blenkinsop, August, '73; Euxine, October, '74; Eolus, October, '51; Buffalo, March, '75; Bee, July, '64; Trevithick, August, '53; Airey, April, '68; Marlborough, November, '66; Sisyphus, May, '68; Livingstone, May, '68; North Western, August, '73; Pioneer, March, '72; Sultan, September, '61; Newcomen, May, '66; Byron, November, '66; Eamont, August, '70.—DIOMED.

[45016.]—L. N. W. Engines.—Herald, October, 1858; Trent, August, 1864; Condon, June, 1877; Condon, October, 1881; Planet, January, 1866; Eolus, October, 1851; Airey, March, 1868; Atlas, November, 1874; Marlborough, November, 1866; Livingstone, May, 1868; Pioneer, April, 1872; Sultan, October, 1851; Newcomen, May, 1866; Columbine, October, 1851. The following four, I am sorry to say, I only know the year they were built:—John Ramsbottom, 1872; The Queen, 1872; Sisyphus, 1868; and Latona, 1854. I hope the above will be of assistance to you.—FORTUNA.

[45016.]—L. and S. W. Engines.—Herald, Oct., '58; Hardwicke, Aug., '73; Trent, Aug., '64; Condon, June, '77; Condon, Nov., '61; Planet, Jan., '66; John Ramsbottom, March, '72; The Queen, April, '72; Blenkinsop, Aug., '73; Eolus, Oct., '51; Buffalo, March, '75; Trevithick, Aug., '53; Airey, April, '68; Atlas, Nov., '74; Marlborough, Nov., '66; Sisyphus, May, '68; Livingstone, May, '68; North Western, Aug., '73; Pioneer, March, '72; Sultan, Nov., '61; Newcomen, April or May, '66; Byron, Oct. or Nov., '66; Eamont, Aug., '70; Columbine, Oct., '51; Latona, April, '55.—HENRY T. ROBERTS.

[45027.]—Photographing the Moon.—If the eyepiece of the telescope be removed and a rapid symmetrical be inserted in its place, or a little, farther away from the focus of the object-glass you will then have converted your instrument

note-foot and other oil stains from floor of the "lathum."—C. O.

[45063].—Iron Mixture.—Will some reader kindly tell me the best cast pig-iron to use to mix with wrought iron, and what proportions in order to get castings fit for raising?—V. H. R.

[45064].—Finding the Moon's Position.—I am a loss to know how to find the position of the moon 4th regard to the earth at certain given times to within about an hour. For instance, the moon is full on November 5th, at 5h. 13m., declination at this time is 22° North. To what part of the earth's surface is she opposite at the time of full moon? Again, the moon crosses the Equator December 12, between 23h. and 24h. astronomical time (*Nautical Almanac*). In what longitude am I to look for her position when crossing the equator? There is not such a thing as a globe to be got in the town where I am, but I have some flat polar projections of the northern hemisphere (outline maps), and I believe it would be quite possible to arrange these so as to represent on them the position of the moon with regard to earth's surface at such times as new, full, when a equator, etc., when she is, of course, in Northern declination. The moon is in extreme N. declination on November 5th at 13h., full the same day at 5h. 13m. Now, it appears to me that at this time she should be opposite India, but whether I am right or not I have no certain means of knowing. Again, I should like to know that is meant by "upper and lower" meridians.—W. L. L., *Tharaka, Colo.*

[45065].—Chemical and Microscopical Test of Silk.—Can any of our readers tell me the best way of examining silk fabrics (1) microscopically, (2) chemically?—My object being to ascertain if there is any, and if so, what amount of admixture of cotton, wool, or other fibre? Also, any information as to the material used in dressing of silk, and the means of detecting same, and greatly oblige.—MUSCUS.

[45066].—Astronomical Question.—Will someone good enough to explain the following passage, which I see from Croll's "Climate and Time" (it refers to L. Drayson's theory of the cause of the Glacial epoch)? "Croll Drayson considers that the pole of the heavens describes a circle round a point 6° distant from the pole of ecliptic, and 23° 27' 47" from the pole of the heavens." I cannot understand the difference between the two poles. *WETA.*

[45067].—To Mr. Lancaster.—I wish to make an electro-magnet to sound a gong (Chinese) of 15in. diam. I shall be extremely obliged if you will kindly give me a working description of magnet, armature, and striker, the most convenient method of mounting the same to the best results from the gong. I should mention that it will only be rung once a day at dinner-time, and I would like to work it from same battery (four cells *Alcaline*, small size) that I use for the electric bells in my house. If this battery is too weak, please say most table, as I have several other kinds.—J. M. B., *St. John's.*

[45068].—Heating Railway Carriages with Sulfate of Soda.—Will "S. A." tell me whether the star is to have the acetate of soda dry or dissolved in water? I should like to make a small one for my own use at home, and I suppose there would be no objection my doing so. I suppose the heater should be filled with three parts full, to allow for expansion in heating. Should be glad of any other hints.—M. A.

[45069].—Fossils.—How is it that Owen, in his *Paleontology*, says that there are no barnacles until tertiary rocks, or that they are very scarce? I have found them in abundance in the Oolite, and I have one in Carboniferous Limestone. What species of Echini are aquatic spines, also hollow ones? I have one or two in Oolite and Bradford clay. They are not common, are they? Also, what species have long smooth-pointed spines? I have what appears to be a sea-urchin in Bradford clay. Are sea-urchins ever found in it? I found a one near Betws-y-Coed, N. Wales; in shape and outline surface just like a turtle, about 9in. by 7in. Is it a sea-urchin? And, if so, what?—M. A.

[45070].—Soap Frame.—Will any correspondent state the best method of constructing above either from or wood?—HADRIAN.

[45071].—East Anglian Passenger Engines.—Eight passenger engines were constructed by sharp, roose, and Co., Atlas Works, Manchester, in 1946, for the East Anglian Railway. Can any of "ours" give me any particulars as to dimensions of these engines (they were of same pattern), I think 5ft. 6in. driving-wheel?—EAST ANGLIAN.

[45072].—Percussion Action.—I have a harmonium with four rows of reeds, and I want to attach a percussion action. Can anyone kindly inform me (1) Where are the hammers placed? Are they fixed to the valve-board? Or, do they turn over with the action? (2) Are the hammers fixed to a frame that can be removed from the action of a piano? (3) How are the hammers connected to the keys? (4) How are they put in and out of gear by the stop?—APOLLO.

[45073].—Guitar Construction.—Could any rooster-reader give me any practical advice on the above subject—the best wood, varnish, &c., to use?—KUTAB.

[45074].—Pressure of Screw.—I desire to know how to ascertain the pressure of a screw in an ordinary oak-binder's standing press? The screw is 2 1/2 in. diam. and 2 ft. long; the leverage is 4 ft., by which the screw is rotated. By this I mean that the pin which is used to turn the screw, is 4 ft. long. Information on the subject will be found useful to—O. FRYER, Swansea.

[45075].—Armstrong's Combination Lathe.—Major Armstrong's description of his improved combination lathe is not very clear. If he would only give more detailed drawings I should be glad to add it to my lathe. Do not understand the arrangement of the gears on figs. 5 and 7. Separate drawings of the castings required with dimensions for a 5in. centre-lathe would be very acceptable.—W. S.

[Since sending us his drawings, Major Armstrong has been suddenly ordered out to India, so it is hardly probable that this query can be replied to for some little time.—Ed.]

[45076].—Palpitation.—Will Dr. Edmunds kindly advise me what to take or how to act? I am about 68 years of age, and for the last twenty years have been a total abstainer. About seven years ago I suffered from a like cause, but it wore off in about six months. I have now been more or less troubled with it for several months, and I am told it proceeds from indigestion and a weak heart. I can eat very well; but sometimes, when I go to bed, I cannot go to sleep for hours, nor keep still in bed, turning from side to side. I take a good deal of out-door exercise; of late I have felt at times giddy for a moment, and have to pull up as if I was going to fall down. I do not like to have recourse to patent medicine. I have been recommended tonic wine, hop bitters, and many other things. I have seen Dr. E.'s reply to No. 19308, but do not know if it will apply to mine.—A SIX YEARS READER OF "E.M."

[45077].—Water Tortoise.—Would some of our readers inform me as to the best means of keeping alive and healthy a water tortoise I have had sent me from the continent?—AN M. D.

[45078].—Salicylic Acid.—In No. 863 it is stated that the French Government has lately prohibited the use of salicylic acid for the preservation of articles of diet. Will Mr. Allen kindly say what injurious effects it produces on the health? It is used in this country for the preservation of wine, about three-quarters of a tray grain being added to one imperial pint of wine.—ITALY.

[45079].—Train of Watch.—Will any of "ours" kindly inform me how to calculate the train of a watch when you have only the centre-wheel to work from? I have seen several methods, but they all seem to take the number of teeth and pinions for granted, and from them deduce the number of vibrations of balance per hour. I can calculate that myself. What I wish to do is to calculate the train from centre or any other wheel. Any information would greatly oblige.—E. P. A., *Horsham.*

[45080].—Barometer by Henry Andrews.—I have a barometer bearing the following name and address—"Henry Andrews, Royston." Can anyone inform me if this is likely to be the noted astrologer? And, did he manufacture these articles? Is there a portrait of Andrews in existence?—J. H. W.

[45081].—Photographic.—Can any correspondent tell me why, if a print, fixed and toned, is immersed in protosulphate of iron, it is bleached, losing at the same time its bluish or reddish tint and turning grey. And, what the clear remainder of an old ferrous oxalate developer is, and, also, the red precipitate of the same?—W. E. K.

[45082].—Double Object-Glasses.—To "OBERON VITAL," "W. G. P.," AND OTHERS.—In the ordinary Huyghenian eyepiece two non-achromatic convex glasses, when of suitably-proportioned foci, and placed at a certain distance apart, correct the spherical aberrations, and, to a great degree, the chromatic aberrations as well. Is a similar arrangement in any way practicable in the object-glass? In other words, can two non-achromatic lenses of the same kind of glass, and neither of them a concave curve, be so proportioned and placed as to act as an object-glass, but with the spherical and chromatic aberrations materially reduced?—QUAER.

[45083].—Gas Regulator.—Can any reader of the *ENGLISH MECHANIC* inform me from personal experience of the advantage or disadvantage of a gas regulator, and whether the saving said to be obtained is worth the outlay, which amounts to a twenty-light meter to about £4?—EYE WITNESS.

[45084].—Distemper.—I want to add a frieze to the walls of a room now covered with a flat tint in distemper, and propose to do so with the same medium, in two or more shades, either by hand or by the use of stencil plates. I shall be much obliged if any of your contributors will kindly inform me what are the materials required, where obtainable, their price, the best kind of card or paper for the stencil plates, and any other hints on the process. Is there any small book published on the subject?—EYE WITNESS.

[45085].—L. N. W. Engines.—Thanks to "Diomed" for his promise. Could he, or some other correspondent, give a list of the "Precedent" class of engines, which were built the latter part of last year?—FORTUNA.

[45086].—Piano Query.—To one not in the trade, and not a competent judge, the prices of short iron grand pianos and cottage pianos appear disproportionate. For instance, an excellent cottage or upright grand can be purchased for £40, but for an ordinary short iron grand one is always charged £80. To me there does not appear to be that extra workmanship in the grand to warrant the 100 per cent. extra cost. Where is the superiority? I should also like to know how it is that several German manufacturers (notably Hagspiel, the Colard of the Continent) can sell in the English market a short iron grand for just half the money that a similar article by any of the eminent English makers would cost. The slight difference, if any, in the cost of labour does not entirely account for it.—LION.

[45087].—Proctor's Atlas.—Why has Mr. Proctor, in his atlas, drawn the precessional circle several degrees distant from the Pole-star? Everybody who is familiar with precession knows that it is less than a half-degree from it. He may have good reasons for it, but I protest against leaving things in the dark. Light is what we want.—WYOMAN.

[45088].—Leo Major.—When is this constellation best situated for observing? Is it ever visible before 10 p.m.?—CARLISIMO.

[45089].—Pulley Dimensions.—A shaft revolves 60 per minute, and has a drum 15in. in diameter. What size pulley will it need to turn another shaft at 180 revolutions? (2) A drum 15in. in diameter makes 60 revolutions per minute. How many revolutions will a pulley 5in. diameter make driven by the 15in. drum?—CARLISIMO.

[45090].—Telephones.—Would any of our able correspondents kindly describe the induction-coil used in connection with the microphone for transmitting articulation in the best manner? The sizes of the primary and

secondary wire, length, &c. Those at the Opéra in Paris no doubt are first rate, and a perfect description would much interest many. I am anxious to know whether that mode, which now seems much used, of connecting a number of microphones in parallel series, and having a large current through them, does away with the grating sound which is so annoying? Can anyone give details of the telephone mentioned by correspondent in Oct. 7th number as used in Paris exhibition?—F. E. T.

[45091].—Rendering Cotton Wadding Absorbent.—Can any one inform me how ordinary cotton wadding can be rendered readily absorbent?—BOX ACCORD.

[45092].—Silvering Goods by the Electro Process.—"Os" would confer a considerable benefit on a large number of men connected with various branches of the silver trade if he would give a clear description of electroplating, chemicals, apparatus, and modes operandi, and probable cost of same on small scale.—GUYOR.

[45093].—Shears for Sheet Iron.—I should be glad to know the simplest form of construction of shears to cut sheet iron, 18 to 30 gauge, easily.—J. W.

[45094].—Stereotyping.—A note on this subject appeared in last week's "*Scientific News*." Can anyone give information as to the nature of the quick-drying cement used for the matrix?—J. W.

[45095].—Shoe Finisher's Ink.—Will some of the readers of the "*E. M.*" give a recipe for a good shoe-finisher's ink, as most of the inks sold here are almost worthless and oblige.—OWS ORRIS IS A FIX.

[45096].—To Practical Watchmakers.—Would some one kindly direct me in the simplest way to fit and adjust balance springs, which are often exceedingly troublesome? I can turn in staffs, cylinders, jewels, &c., with ease. I have seen a fellow who could scarcely turn in a balance staff, a fair hand at springing.—GUYOR.

[45097].—Dissolving Gold and Silver.—If "Dunrod" will give full practical instructions in a plain, simple way how this is done, and restored to the metallic, I shall be exceedingly grateful. "With and without alloy" means will 9-carat and 22-carat gold dissolve by the same means, and when reduced to metal will they still be 9c. and 22c. respectively, or will they be pure gold, each done separately of course? Kindly describe the heating and proportion of acids. I have no back numbers.—S. GOLD.

[45098].—Resistance Coils.—I want to make a few resistance coils for educational purposes. Will one of your correspondents kindly tell me the size of German silver wire, suitable for this purpose, and the approximate length of it, which is equal to 1 ohm resistance? 2. The length and size of wire best suited for making a galvanometer for small thermopile. 3. Where can I find a table of tangents for use with tangent galvanometer?—EAST-ANGLIAN.

[45099].—Cochineal Colour.—I am employed in preparing large quantities of cochineal colouring used in the manufacture of a certain description of white paper by the following process:—To 24 gallons of boiling water is added 1lb. of pearlash, then I gently stir in 5lb. of powdered cochineal and simmer for one hour. After this I add half an ounce of alum, and finish by straining through a flannel bag. Can any of your kind contributors inform me of any process by which I can prepare it, so that it can be kept unchanged for at least a week?—as that I prepare, after about 24 hours, becomes gelatinous, loses some of its colour, and smells very disagreeable.—W. SITTINGBOURNE.

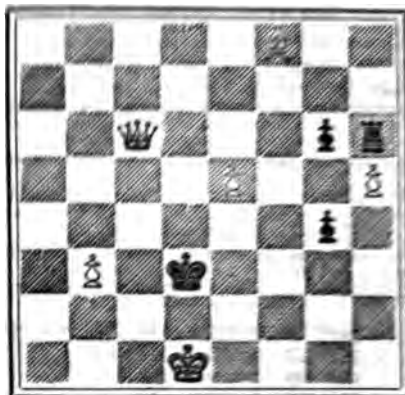
[45100].—Cube Numbers.—How can I ascertain whether any number is a perfect cube or not? What properties do cube numbers possess that no other numbers possess?—THE VILLAGE PHILOSOPHER.

The City and Guilds Institute.—The programme of technological examinations in connection with the City and Guilds of London Institute for the year 1881-2 has just been issued. It contains a number of new syllabuses of subjects, such as electric lighting and transmission of power; coal-tar distilling and spirit rectification; bread making; the manufacture of linen; linen bleaching, dyeing, and printing; weaving and pattern designing. A new feature in this programme is the grouping together of allied industries, and so arranging the syllabuses of instruction that subjects which are common to two or more branches of any industry are put under one heading. This arrangement further commends itself as offering suggestions for a curriculum of study to be pursued in such technical colleges as those of Bradford, Leeds, Huddersfield, &c., which are now being erected for the development of trade in those districts. The lists of works of reference attached to each syllabus are much more complete in this year's edition of the programme, and although many of the works recommended are out of the reach of the majority of artists and students, they will form valuable additions to the library of every mechanics' institute, and for this reason are wisely included in the programme. There appears to be a considerable increase in the number of registered teachers of the Institute, showing a satisfactory development in this part of its work. The conditions of the registration of teachers become much more stringent after March, 1882. Hitherto, owing to the lack of practical teachers, combining a knowledge of the principles of science and of the practice of trades, the teachers registered under the Science and Art Department have been permitted to hold courses in technology. After March next it appears that those only who have obtained honours at the Institute's examination in the subject to be taught will be registered as teachers.

CHESMAN.

All Communications for this department must be addressed to Chessman Editor, 42, Chancery Lane, W.C.

PROBLEM DCCL. By P. C. B.
Black.



White.

White to play and mate in three moves.

PROBLEM DCCLV. By Dr. S. Gold.

Black.



White.

White to play and mate in two moves.

SOLUTION TO 701.

- | White. | Black. |
|----------------------|--------------|
| 1. Kt to Kt 4. | 1. Any move. |
| 2. R to B 7. | 2. Anything. |
| 3. R or B mates acc. | |

SOLUTION TO 702.

- | White. | Black. |
|----------------------|--------------------------|
| 1. Q to R 7. | 1. P takes P or (A). |
| 2. Q to K 4 (ch). | 2. Anything. |
| 3. Q or R mates acc. | (A) 1. P to K 5 or (B). |
| 4. Q to R 4. | 2. Anything. |
| 5. Q or R mates acc. | (B) 1. P takes R or (C). |
| 6. Q to Q 1. | 2. Anything. |
| 7. R takes Kt mate. | (C) 1. Kt to R 4. |
| 8. Q to R 1 (ch). | 2. P to K 5. |
| 9. Q takes P mate. | |

NOTES TO CORRESPONDENTS.

Consent to publish in 701 by J. W. Jubb, W. W., and G. L., to read by G. L., to read by W. W.

Answer to Problem 700 is a two-mover, and not a three-mover. Please to continue.

J. W. Jubb. Have written you

CHURCH LITERARY.

On Saturday, October 20th last, was the occasion of a benefit given to the "Landing Light" of the well-known and successful Chessman Editor. There was a numerous attendance, including a great number of celebrated chess players. Some of the games played were most interesting, and the prizes for the best play were most valuable. The entertainment was a thorough success, and the success of the evening was a thorough success.

On Wednesday, October 19th last, Mr. Blackburne, the winner of the London Chess Congress, gave one of his masterly chess lectures to a large audience at the City of London. He was opposed to eight strong opponents, and the result of the evening was most successful. The prizes for the best play were most valuable. The entertainment was a thorough success, and the success of the evening was a thorough success.

ANSWERS TO CORRESPONDENTS.

All Communications for this department must be addressed to Chessman Editor, 42, Chancery Lane, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the answers refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where goods or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

* * * Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 19, and unacknowledged elsewhere:—

J. FRASER.—Venables and Co.—H. Milnes.—R. Mills.—J. B. Batterby.—Earl Russell.—E. P. Alexander.—Rev. N. S. Godfrey.—C. B. C. Hibbert.—Barnett, Son, and Foster.—Selig Sonenthal and Co.—D. Fraser.—J. E. Nogen.—Cutler.—C. J. E.—M. M. L. S. S.—Walter.—Ignoramus.—Yesth.—Angier.—Little Binks.—G. H. Wilkinson.—B. H.—Hot Water.—F. C.—A Young Observer.—R.—Birmingham.—J. J. H.—Nemo.—Poly-mathy.—Titterworth.—Mechanic.—W. Osbaldeston.—Glasgow.—Land Lubber.—P. D.—Tarnash.—An English Yeoman.—J. Stubbs.—W. H. Burt.—Guido.—L. E. J.—N. W., Ealing.—Dunrod.—Prismatique.—C. Taylor.—Dublinensis.—Plate Cleaner.—Vulcanite.—Lighter.—A. C. P.

WEATHER. (See p. 553, Vol. XXIX., and many other places. We believe you can get tables from the Meteorological Office, and they are given in the handbooks on the subject.)—W. A. (The question has been frequently answered, but you can make your choice of books by procuring Mr. Calvert's catalogue from 99, Great Jackson-street, Hulme, Manchester.)—A. L. C. Mix petroleum with a decoction of soapwort.—AN ENGLISH MECHANIC. (See p. 415, Vol. XXXII. It is a matter for experiment. I have tried it, and it is not so good as that described at place cited, and is on view at the Paris Exhibition.)—M. B. (A series of papers on "Examination of Living Objects Under the Microscope" appeared on pp. 262, 268, 283, 439, Vol. XXX. See also the indices of other volumes.)—JOSPH E. LYNDALL. (The capacity of haylofts is reckoned at 500 cubic feet per ton.—VOLUNTEER SERVANT. (See p. 334, Vol. XXXII. Have you tried pipeclay or citric acid? We are afraid you will have to send it to the dyer.)—S. J. (Make the hot, the clean, down with a flux, and rub over with solder. A shallow hole in a brick, into which solder and flux are put, is the usual thing. 2. See the index of the last volume under Balance, and refer to the articles on Watch Repairing.)—CHICK. (See p. 136, last week.)—THEAT. (1. You have omitted the word "whole." 2. Inserted. 3. Frequently answered. See p. 690, last volume.)—A. (The query is so indefinite that we can only refer you to the textbooks and other works on the subject.)—ZEALOUS. (A Leclanché is better adapted for such work than a Daniel, but for the construction of either you must consult the indices or refer to an elementary textbook.)—ELEPHANT. (Either a Daniel or a Smee. The former consists of a copper plate immersed in a saturated solution of sulphate of copper, and a zinc plate immersed in a solution of sulphuric acid, the plates being separated by a porous partition. The zinc consists of a plate of platinum silver between two zinc plates. Many forms of both have been described in back volumes. They are to be bought as cheaply as they can be made.)—MAGNET. (For a telephone, see the indices of the last four or five volumes, and you will be able to make a choice.)—H. G. B. (See p. 334, last volume, and the preceding answer.)—CARBON FATH. (You can stop them yourself with the prepared gutta serena, sold at the drug-gist's. We cannot discuss the fees of dentists.)—J. A. M. (See recent numbers. It is not possible to construct a small electric light at a moderate expense. A dynamo-machine is the cheapest method of producing the current.)—ALEXANDRA. (Gannister is a highly silicious fireclay, which is sometimes mixed with plastic clay. It is used for lining Bessemer converters, &c. Can be obtained at Sheffield, Middlesbrough, and other towns where steel is made. It makes a most refractory firebrick.)—ABRACADABRA. (The answer depends entirely on your personal tastes and capabilities.)—G. H. (See p. 73 about cleaning violin, and the indices for varnishing.)—SILVER. (They are probably not set properly; try lifting them up a little, or, if already high, press them down. See many replies in back numbers.)—LAD. (Glasgow or Belfast. The premium would be about £100 if a gentleman apprentice; if prepared to "rough it," you might find a situation, especially if you have had a little experience in a general engineer's shop.)—A DYSPEPTIC. (Rather beyond our sphere. Of course some have experienced benefit, or imagine they have.)—J. H. (See p. 94, last volume. You must buy the prepared rubber. It is mixed with sulphur, and is vulcanized by heat. Naphtha has nothing to do with the process.)—VOLUNTEER. (There is nothing better than camphor smoking. Do you not understand that if there were any permanent process, it would soon be known amongst ridemen.)—CIVILIAN. (Yes, all particulars can be had at any recruiting station.)—W. J. (Instructions for making small dynamo-machines in Vol. XXXI., pp. 116, 212, 236. Articles commenced in No. 851.)—ON MECHANICAL DRAWING COMMENCED IN No. 851.)—PUZZLED. (The ink is forced into the grooved lines, the

plate is cleaned, and then with the card over is subjected to the heavy pressure of a roller. The ink adheres to the card.)—C. S. B. (Culley's work is the most complete, published by Longmans; but Bond's "Handbook of the Telegraph," Crosby Lockwood and Co., Stationers' Hall-court, E.C., will suit you, as it is prepared for candidates for the service, price 3s. For the other subject you can have nothing better than our back volumes. There is no cheap and trustworthy book.)—C. O. (Rather too vague and rambling.)—PRICE. A water-clock was illustrated on p. 562, Vol. XXIX. See also Vol. XXXII., under heads Clepsydrae and water-clocks.)—NO GO. (In No. 820, but it has been much modified. 2. Shellac dissolves readily in methylated spirit. For your purpose use a smaller quantity of spirit, and apply heat.)—WYOMA. (Merely to simplify and render uniform. They are understood all over the world now, without so much liability to error.)—R. O. S. (See p. 442, last volume, and the numbers since.)—G. FARNS. (The two queries have been answered many times. Baking-powder is composed of tartaric acid, bicarbonate of soda, and farina. German yeast is prepared by squeezing out the moisture from the yeast obtained in the German method of fermenting. These are several limitations. We fail to find any information in the reply about the orguette, and cartridge-paper is too rough.)—H. G. B. (No. 846. If you use a patent for business purposes you are rendering yourself liable to an action for damages; if merely for experiment the damages are clearly so small that no patentee would bring an action.)—JOHN DAVIES. (We illustrated the Malden dissolver in No. 401.)—T. W. (Taking the example given on Oct. 7, T means time of perihelion passage, ϵ longitude of perihelion, Q longitude of ascending node, i inclination, and $\log. q$ log. of perihelion distance.)—CARLISLE. (The transit takes place a little after ten at night on Nov. 7, and lasts about five hours, but it is invisible here. 2. Quite possible to make such a clock; but it would be an awful waste of time.)—A. K. (Try soaking in melted paraffin, and for transparency generally see a discussion in Vol. XXXI.)—F. L. S. (For the fossils, you should possess some of the works published by the Palaeontographical Society, and Collins's books on Mineralogy will help you with the minerals.)—RASCULUS. (All that is known is that pilocarpin stimulates the growth of the hair, but it is doubtful whether in this country any experiments have been made with it.)—D. S. H. (You can make one with sheets of copper and zinc separated by blotting-paper damped with solution of sulphuric acid, but it will not do you any good. Take care to use the fresh air.)—R. W. (Yes; if the meters are accurate it will make no difference.)—WORKING TOX. (If you know the size they are, in the book, make your drawings twice, three times, or four times as large. For instance, if a foot is to be represented by half an inch, you might make your drawings two inches to the foot. Engravers easily reduce by 2, 3, or 4, but they don't like 1) or 2.)—RANDOLPH, POULTRY FARMER. (You want clock to drop a weight on a lever, and it would be preferable to use one of the lamps which are fitted with extinguishing contrivances.)—F. H. R. (Very probably it might be used for excluding frost from a glass frame if the glass was covered with mats. Particulars in the last two numbers, in which it is distinctly stated that the action is due to the salt passing from the solid to the liquid state and back again. The same is heated to render the salt liquid, and it gives out heat it returns to the solid state.)—MUSICAL. (You can probably get a new set of reeds at any music-shop, but an eight-keyed accordion is at best a toy.)—FRANK. (Use white wax. The acid eat through pinholes in your varnish.)—A. S. R. (The Sanders brake was illustrated on pp. 315, 397, Nos. 699, 692. See the indices of the last four volumes for more particulars.)—BRONZE. (Refer to recent indices. The press depends on the kind of metal.)—W. WARREN. (Sketch of silver.)—JUVENILE. (See p. 295, No. 768. It is done by using varnish to cement the ink, and then rubbing the paper away at the back; but perhaps you may find drawings which are split and then mounted on paper.)—T. MILLER. (Neither disease you mention is "a cancer." The last you name is generally curable, the first seldom so, but may be periodically relieved by not very severe operation. "Real cancer" is not curable, except, of course, when it can be totally removed from some accessible part by the knife.)—EXAMINE. (Their present value is about their weight as waste-paper.)—CONSTANT READER. (The word is "Sens," and the query has been asked before. See Replies 50th p. 398, No. 744, Vol. XXXIX.)—H. J. Y. (Many machines have been patented; you had better search the Patent Office Library, or get some one to do so for you.)—PRINTFIELD. (The makers of your telescope are still in business, and would doubtless supply what you want, their address is St. Paul's Churchyard, London.)—BAKER. (A brick oven would, we should suppose, serve your purpose best, but your query is a vaguer one: as to your second query, it is doubtless possible, but scarcely likely to be undertaken in these days of cheap railway communication.)—N. J. RUSSELL. (We have space to spare for directions for the perpetration of practical jokes.)—W. H. T. (We know nothing of it, and should certainly recommend Crossley's in preference.)—J. KYLE. (Poor soil and a late variety, no doubt; but potatoes never do well in confined spaces.)—S. A. STEWART. (In type; we will send proof, if you forward address.)

W. SERRIN.—A Brother Reader.—Geometricals.—Anti-Kindersley.—Poor Man.—Your queries can only appear in the "Sixpenny Sale Column."

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the publishers are requested to observe that the last number of the year for which their subscription is paid will be forwarded to them in a first wrapper, as an indication that a fresh remittance is necessary, if it is desired to continue the Subscription.

Holloway's Pills and Ointment.—Famous Remedies.—Cures, vomiting, and griping quickly yield to their potent properties. The death-like sickness passes away, and the flow of health returns as the friction of the ointment causes the irritated nerves to become soothed and calmed. In local inflammation they act like a charm.

English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, OCTOBER 28, 1881.

APERTURE OF MICROSCOPE-OBJECTIVES.—VII.

are now able to sum up, very briefly, the results of our consideration of it.

is important to bear in mind at the that there are two entirely distinct es of the question. The first relates definition of aperture, and the mode ch it is to be estimated; whilst the explains the proper function of re.

as been shown that:— he true definition of "aperture" microscope-objective must obviously its primary meaning of "opening"— capacity of the objective for receiving om the object and transmitting them image. If, all other things being one objective is found to receive and it more rays than another, it must arily have a larger aperture.

egard to the estimation of aperture, a mple consideration shows that as in a lens its aperture is determined by tio between the utilised opening of is and its focal length, so in a com- objective it is determined by the etween the utilised diameter of the back d the focal length of the objective.*

ratio is expressed for all media and s by $n \sin u$, where n is the refractive of the medium (air or immersion- , and u the semi-angle of aperture of jective, the values of $n \sin u$ for any lar case giving the "numerical" re, or true aperture, of the objective. ther we have an air, water, or oil ive, its angular aperture cannot, of , ever exceed 180° , $\sin u$ then 1.0. The indices of air, water, and oil he other term of $n \sin u$ are, however, 33, and 1.52. In the case of an air ve of maximum aperture, therefore, cannot exceed 1.0; while, with a simi- or oil objective it may be 1.33, or so that the apertures of water and oil ves may exceed those of air objectives er cent. and 52 per cent. respectively, eing in fact a progressive increase in re from the lowest air-angle to its um of 180° , and thence to the highest and oil angles.

xpress aperture by the angles of the t rays is, therefore, obviously mis- ; for even when the medium is the twice the angle does not represent he effect, while when the media are it we have two identical sets of hich, nevertheless, represent not al, but different, effects.

s simple considerations dispose of the s of controversy that were for years on the "aperture question," and the us supposition that the aperture of objective of 180° angle must represent eatest possible aperture obtainable,

herefore, two objectives have the same focal air apertures will vary with the utilised dia- the back lenses. Thus, if these are as 2:1, ure of one objective will be double that of the

two objectives have different focal lengths (as [in.] and different back lenses, then if the latter ratio of the focal lengths (i.e., 2:1), the aper- be identical; or if they are not in that ratio (say, apertures must be different (12:18 or 3:4). If cases are the same, the apertures will be inversely al lengths (i.e., as 1:2).

XXXIV.—NO. 866.

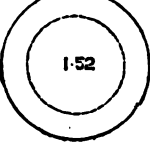
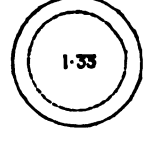
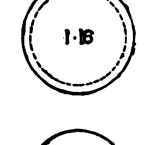
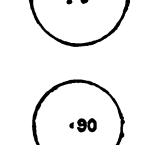
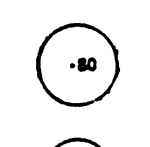
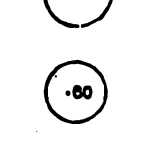
and one which could not be exceeded, but at most only equalled, by immersion ob- jectives.*

II. The second branch of the aperture question with which we have dealt—viz., the function of aperture, must, as we have said, be kept entirely distinct from the first. While even the tyro in microscopy cannot fail to recognise the fact of the increase in the aperture of objectives, when we pass from air to media of higher refractive index, it is otherwise with the second branch of the

The theory of microscopical vision pro- pounded by Professor Abbe may be sum- marised thus:—

Coarse objects are depicted by the micro- scope practically in accordance with the laws of ordinary vision, and the image corresponds with the object.

In the case of minute objects, however, those laws cease to be applicable, and the object is imaged by rays which in their passage through it are each spread out by diffraction into a fan or group, the smaller

Diameters of the Back Lenses of various Dry and Immersion Objectives of the same Power ($\frac{1}{2}$ in.) from 0.50 to 1.52 N. A.	Numerical Aperture. ($n \sin u = a$.)	Angle of Aperture ($= 2u$).			Illumi- nating Power. (a^2).	Theoretical Resolving Power, in Lines to an Inch. ($\lambda = 0.625 \mu = \frac{1}{16}$ in.)	Pene- trating Power. ($\frac{1}{a}$)
		Dry Objectives. ($n = 1$.)	Water- Immersion Objectives. ($n = 1.33$.)	Homogeneous Immersion Objectives. ($n = 1.52$.)			
	1.52	..	..	$180^\circ 0'$	2.310	146,528	.658
	1.50	..	..	$181^\circ 23'$	2.250	144,600	.667
	1.48	..	..	$153^\circ 39'$	2.190	142,672	.676
	1.46	..	..	$147^\circ 42'$	2.132	140,744	.685
	1.44	..	..	$142^\circ 40'$	2.074	138,816	.694
	1.42	..	..	$138^\circ 12'$	2.016	136,888	.704
	1.40	..	..	$134^\circ 10'$	1.960	134,960	.714
	1.38	..	..	$130^\circ 26'$	1.904	133,032	.725
	1.36	..	..	$126^\circ 57'$	1.850	131,104	.735
	1.34	..	..	$123^\circ 40'$	1.796	129,176	.746
	1.33	..	$180^\circ 0'$	$122^\circ 6'$	1.770	128,212	.752
	1.32	..	$165^\circ 56'$	$120^\circ 33'$	1.742	127,248	.758
	1.30	..	$155^\circ 38'$	$117^\circ 34'$	1.690	125,320	.769
	1.28	..	$148^\circ 28'$	$114^\circ 44'$	1.638	123,392	.781
	1.26	..	$142^\circ 39'$	$111^\circ 59'$	1.588	121,464	.794
	1.24	..	$137^\circ 36'$	$109^\circ 20'$	1.538	119,536	.806
	1.22	..	$133^\circ 4'$	$106^\circ 45'$	1.488	117,608	.820
	1.20	..	$128^\circ 55'$	$104^\circ 15'$	1.440	115,680	.833
	1.18	..	$125^\circ 3'$	$101^\circ 50'$	1.392	113,752	.847
	1.16	..	$121^\circ 26'$	$99^\circ 29'$	1.346	111,824	.862
	1.14	..	$118^\circ 00'$	$97^\circ 11'$	1.300	109,896	.877
	1.12	..	$114^\circ 44'$	$94^\circ 56'$	1.254	107,968	.893
	1.10	..	$111^\circ 36'$	$92^\circ 43'$	1.210	106,040	.909
	1.08	..	$108^\circ 36'$	$90^\circ 33'$	1.166	104,112	.926
	1.06	..	$105^\circ 42'$	$88^\circ 26'$	1.124	102,184	.943
	1.04	..	$102^\circ 53'$	$86^\circ 21'$	1.082	100,256	.962
	1.02	..	$100^\circ 10'$	$84^\circ 18'$	1.040	98,328	.980
	1.00	$180^\circ 0'$	$97^\circ 31'$	$82^\circ 17'$	1.000	96,400	1.000
	0.98	$157^\circ 2'$	$94^\circ 56'$	$80^\circ 17'$	.960	94,472	1.020
	0.96	$147^\circ 29'$	$92^\circ 24'$	$78^\circ 20'$	.922	92,544	1.042
	0.94	$140^\circ 6'$	$89^\circ 56'$	$76^\circ 24'$	.884	90,616	1.064
	0.92	$133^\circ 51'$	$87^\circ 32'$	$74^\circ 30'$	.846	88,688	1.087
	0.90	$128^\circ 19'$	$85^\circ 10'$	$72^\circ 36'$	.810	86,760	1.111
	0.88	$123^\circ 17'$	$82^\circ 51'$	$70^\circ 44'$	.774	84,832	1.136
	0.86	$118^\circ 38'$	$80^\circ 34'$	$68^\circ 51'$	.740	82,904	1.163
	0.84	$114^\circ 17'$	$78^\circ 20'$	$67^\circ 6'$	.706	80,976	1.190
	0.82	$110^\circ 10'$	$76^\circ 8'$	$65^\circ 18'$	.672	79,048	1.220
	0.80	$106^\circ 16'$	$73^\circ 58'$	$63^\circ 31'$	.640	77,120	1.250
	0.78	$102^\circ 31'$	$71^\circ 49'$	$61^\circ 45'$	.608	75,192	1.282
	0.76	$98^\circ 56'$	$69^\circ 42'$	$60^\circ 0'$	.578	73,264	1.316
	0.74	$95^\circ 28'$	$67^\circ 36'$	$58^\circ 16'$	.548	71,336	1.351
	0.72	$92^\circ 6'$	$65^\circ 32'$	$56^\circ 32'$	.518	69,408	1.389
	0.70	$88^\circ 51'$	$63^\circ 31'$	$54^\circ 50'$	.490	67,480	1.429
	0.68	$85^\circ 41'$	$61^\circ 30'$	$53^\circ 9'$	.462	65,552	1.471
	0.66	$82^\circ 36'$	$59^\circ 30'$	$51^\circ 28'$	.436	63,624	1.513
	0.64	$79^\circ 35'$	$57^\circ 31'$	$49^\circ 48'$	.410	61,696	1.562
	0.62	$76^\circ 38'$	$55^\circ 34'$	$48^\circ 9'$	.384	59,768	1.613
	0.60	$73^\circ 44'$	$53^\circ 38'$	$46^\circ 30'$	.360	57,840	1.667
	0.58	$70^\circ 54'$	$51^\circ 42'$	$44^\circ 51'$	.336	55,912	1.724
	0.56	$68^\circ 6'$	$49^\circ 48'$	$43^\circ 14'$	.314	53,984	1.783
	0.54	$65^\circ 22'$	$47^\circ 54'$	$41^\circ 37'$	.292	52,056	1.852
	0.52	$62^\circ 40'$	$46^\circ 2'$	$40^\circ 0'$	.270	50,128	1.923
	0.50	$60^\circ 0'$	$44^\circ 10'$	$38^\circ 24'$	.250	48,200	2.000

EXAMPLE.—The apertures of four objectives, two of which are dry, one water-immersion, and one oil-immersion, would be compared on the angular aperture view as follows:— 106° (air), 157° (air), 122° (water), 130° (oil). Their actual apertures are, however, as the numerical values:— .80 .98 1.26 1.34

subject, which depends upon much deeper optical and physical laws, and notably upon the phenomena of diffraction.

The first branch is wholly independent of any theory of diffraction. If diffraction phenomena did not exist, or if they were proved to have been misinterpreted, the fact of the increase of the apertures of objectives with the increase in the refractive index of the immersion fluid would still be beyond dispute.

* Much of the confusion can be traced to the fact that it was always tacitly assumed that the "angular aperture" of an objective represented its real aperture, and prior to Professor Abbe it apparently did not occur to anyone that the so-called "angular aperture" was only one of the factors that determined the true aperture.

the object the wider being the spread of the fan.

In order that the image should in this case exactly correspond with the object, all the diffracted rays must be gathered up by the objective. If any are lost we then get, not an image of the real object, but of one which would give just those diffracted rays which are actually taken up by the objective.

An experimental proof of this view is furnished by artificially shutting off from the image of a known object some of its diffracted rays, when various false appearances will be presented by the microscope, none of which could have been recognised as

spurious if we had not had the known object to check them by.

It is, therefore, impossible to determine by mere visual inspection through the microscope what is the actual structure of the minuter diatom valves and similar objects.

The theory furnishes an explanation of the increased power of vision obtained by increase of aperture in the case of minute objects. A small aperture can admit only a fractional part of the diffraction fan emanating from the object—to admit the whole or a very large part, and consequently to see the minute structure of the object, or to see it truly, a large aperture is necessary, and in this lies the value of a wide-angled immersion objective for the observation of very minute objects.

We append the very useful aperture table computed by Mr. Stephenson, which is printed with each issue of the *Journal* of the Royal Microscopical Society.*

REVIEWS.

Hydraulic, Steam, and Hand-Power Lifting and Pressing Machinery. By FREDERICK COLYER, M.Inst.C.E., M.Inst.M.E. London: E. and F. N. Spon.

THIS work will be found useful not only to engineers, but also to architects, as it will act as a guide in all cases where lifting or pressing machinery is to be erected. As the book is intended for practical men, the subjects have been treated very concisely, mere elementary description being entirely omitted, and discussion of the comparative value of certain machines limited to the minimum. Nearly all the apparatus described, with the exception of certain specially mentioned machines, have been personally examined, experimented with, or erected by the author. The volume is made up of 129 pages of text, and 73 plates of lithographs, and is well adapted as a suggestive textbook for engineers and others. Hydraulic power is now applied in so many cases, and is withal found so useful and so little trouble (except in very cold weather), that such a book as this will no doubt be welcomed by the profession, especially as it will enable them to decide where to prefer steam appliances. In high-pressure hydraulic lifting, the cost of pumping is about 10s. per 1,000 gallons, and the usual maximum pressure is 750lb. to the square inch; but on a small scale for supplying a few cranes, the cost may run up to 12s. and 14s. per 1,000 gallons. The cost of lifting, say at docks, and similar places, is about 1½d. per 100 foot-tons, if in constant work; but for railway goods stations it is probably 3d. per 100 foot-tons. Compared with hand-power, the hydraulic machinery costs 4d. a ton for labour, whereas the former is rarely less than 3d. per ton, and the speed of working is scarcely comparable. The work includes descriptions and plates of all the usual forms of hydraulic and steam-lifting machines, hand-power lifting machines, and hydraulic-pressing machines, with accounts of such appliances as Clark and Standfield's canal and railway lifts for shifting barges and trains bodily. The lithograph plates show the apparatus to a good-sized scale, and the text is in clear type, though disfigured by such printer's errors as "rivetted" and "desimant."

A Manual of Practical Assaying. By JOHN MITCHELL. Edited by William Crookes, F.R.S. London: Longmans.

THE fifth edition of this well-known manual

* It must be borne in mind in using the column of "penetrating power" (which is in inverse ratio to the numerical aperture n) that several other data besides n go to make up the light depth of vision of the microscope. See *Proc. Roy. Soc. Lond.*, [1881], pp. 381-2.

on the assayer's art has been revised and brought abreast with the progress of chemical science. The volume, therefore, contains a number of additions and improvements in processes, to make room for which the older methods have been omitted, the editor's object being not to fill his pages with descriptions of all the processes, but to present the reader with such as are found most useful in differing circumstances. The new chemical nomenclature and notation have been introduced in the present edition, which will no doubt meet with the same favour from practical assayers as was accorded to the previous editions. One objection will be made by some of those who really use the book, and that is both English and metric weights are used; but it may be urged that to convert all the weights and measures as given by the author in his original work would involve a great deal of labour, while to translate the metric measures into English whenever new matter is added, would be a retrograde step, and increase the risk of error.

Technical Vocabulary. By Dr. F. J. WERSHOVEN. London: Hachette and Co.

TECHNOLOGICAL dictionaries are of necessity very difficult works to compile, and it is not surprising that some of those already in existence contain numbers of errors which are not unfrequently amusing. Technical terms, especially those which are peculiar to a trade or to a workshop, are not usually found in dictionaries, and to accurately translate them into their equivalents in French, German, or other European languages necessitates a special research or the assistance of a large number of editors. Dr. Wershoven's little book makes no pretensions to the dignity of a dictionary, but it is an excellent vocabulary for the use of students who can read French and for visitors to technical exhibitions. The one objection to it is that from the arrangement adopted the terms require looking for, but the author has contrived to bring all the terms relating to one department together, so as to economise time as much as possible. Thus under the head of "Workshop," the various parts and tools connected with a lathe are arranged together, without, however, any order of sequence. Besides technical terms, the author gives phrases, and even whole sentences, descriptive of operations, which will undoubtedly be found useful; but the person who sets out to use the book should familiarise himself with its contents before he actually needs its services. In about 300 pages the book before us contains a number of words and phrases of constant occurrence in works on physics and mechanics, on gas-making, glass, pottery, paper, and beer manufacture.

Inorganic Chemistry. By WM. JAGO, F.C.S., London: Longmans.

THE multiplication of textbooks for the benefit of students in science classes may be taken as evidence of the popular interest in the study of scientific subjects; but if every "certificated teacher" of, say, chemistry, wrote a textbook, students would have some difficulty in deciding which to choose. Unless, then, we find a new textbook is in some respects superior to the existing works, or puts old facts in a better way, we are inclined to look upon it as a bit of professional advertising. We have already too many textbooks "specially adapted" to the wants of students connected with the Science and Art Department; but we can make room for Mr. Jago's volume, because although primarily designed for students of the science classes, it is really an elementary textbook of the science of chemistry that will be found useful by those who are not cramming for an examination, and have not the benefit of personal instruction from the teacher. The author is aware of the tem-

tation put before teachers to give their pupils just that information which they know is required to pass the examination, at the sacrifice, it may be, of that sound knowledge of principles which, for future work, is alone valuable, and he has contrived to present his subject in such a manner that the student who will carefully read through it, and make the experiments described, will be in a position to pass the examination, or to proceed at once to the standard works on the science. Laboratory hints are given here and there, and illustrations help to explain how the operations are carried out.

Elementary Treatise on Physics. Translated and Edited by E. ATKINSON, Ph.D. Tenth Edition, revised and enlarged. London: Longmans.

THE popularity of "Ganot's Physics" is attested by the fact that the tenth edition has been recently issued, although the ninth was published less than two years previously. That the new edition is not a mere reprint, is shown by the facts that it contains more pages than the ninth, and that the revision and enlargement commence on p. 2, in article 3. So on throughout the whole of the volume, which now comprises nearly 1,000 pages, illustrated by 844 woodcuts and four coloured plates, the work of revision and addition has been carried out wherever necessary or advisable. Such inventions and discoveries, for instance, as Hughes's Induction Balance, and Graham Bell's Photophone, are illustrated and described as fully as possible, consistent with the elementary character of the work.

A Pocket Guide to British Ferns. By MARIAN S. RIDLEY. London: David Bogue.

THE authoress having experienced a difficulty in determining the genera and species of ferns, because writers on the subject, while specifying the peculiarities in detail, omit the decided special features or characters which would guide the amateur botanist in his work, compiled this little book for the use of those commencing the study of ferns, who often give up the pursuit on account of the difficulties which this volume is intended to remove. The plan adopted by the authoress is to put down in a tabular form the characters of the different ferns; thus, in the book before us, the description of each fern occupies a page, the features being printed at the side in such a manner that its peculiarities can be taken in almost at a glance. In black type at the side we find "generic characters," "distinctive specific characters," "rhizome or caudex," "stipes and rachis," and so on, to "where found," and "general remarks," and opposite these we find the peculiar or special features briefly stated. The introductory and explanatory chapters, with glossary, key to the genera, and an index, will render this little book very welcome to those who are seeking to gain such a knowledge of British ferns as will enable them to class them in their respective genera and determine the species.

We have also received *The Unicorn*, by ROBERT BROWN, jun., F.S.A. (Longmans), a mythological investigation, and a contribution to the science of psychology, in which the author traces the origin of a number of old legends, and apparently arrives at the conclusion that the sun is the lion and the moon the unicorn.—*Hunter and the Stag* (Williams and Norgate) is a letter to Prof. Owen, by CHARLES ADAMS, in which the writer replies to the address which Prof. Owen delivered at the unveiling of the Harvey Memorial, and demolishes the argument of the vivisectionists based upon Hunter's alleged discovery.—*Practical Chemistry*, by J. HOWARD, F.C.S. (Collins, Sons and Co.) is a new and revised edition of one of the publishers' elementary science

—*Handbook of the Economic Stereotype Newtonian*, by A. J. S., is set by our well-known correspondent, who sets forth his system of making silver Newtonians. It is illustrated with engravings and a photographic piece.—*The Use and Adjustment of the on-Glass Reflecting Telescope*, by FAHRIG and Co., Southampton, is fully described by its title. The book also contains the price-list of the instruments.—*The Furniture Trade Catalogue* (Wyman and Sons) is a handsome volume of plates containing designs for description of modern furniture of all kinds in general demand. It is a volume which will be appreciated by furniture dealers and customers at home and abroad.

THE PARIS ELECTRICAL EXHIBITION.—IX.

Congress is closed, the awards have been distributed, the Exhibition is manifestly at its end, although the exact date of its closing is not known. The following decisions were taken by the Congress:—

The centimeter-gramme second system will be adopted for electrical measures. The ohm and volt remain as before.

The ohm will be represented by a column of 1 mm. square in section, at the temperature of 0°C. An international commission will be appointed to determine its length.

The ampère is the current produced by an electromotive force of one volt through a resistance of one ohm.

The coulomb is the quantity of electricity discharged in the current of one ampère for one second passing the section of a conductor.

The farad is defined by the condition that, a condenser, whose capacity is one farad, establishes between the armatures a difference of potential of one volt. The farad is defined by the British Association. It has been observed that the ampère is identical with the British weber. The name has been chosen in order to avoid confusion with the weber.

The following resolutions have also been taken by the Congress:—

Establishment of an international commission for the study of electrical units; for the study of atmospheric electricity; of lightning-conductors; are telegraph and telephone-wires a source of protection against lightning? All wires of telegraph wires to be designated in letters, without reference to any gauge; means of electric light to be made with the lamp; an international commission is to be appointed to study the unity of light; the Congress at steps will be taken by each Government in order to insure the inviolability of the cables.

Electric light has been experimented with with much success. The great staircase lit up by 32 Brush lamps, fed by a battery at the Exhibition. The total length of the cable was about 6 kilometres. The staircase was lit by gas and partly by electric light. It was very difficult to judge of the light in this way, but the moment the light was turned off it was very easy to see the thin threads of incandescent carbon at the best part of the light. The interior theatre was lighted by 54 Jablockhoff lamps; Maxim's lamps were very brilliant in small saloons on each side of the foyer; lamps were also mixed with the gas of the lustre. The buffet was very nicely lit by Jaspars's system, to which I have referred in a former article. The appearance of the electric light experiments at the Opéra are, certainly, much in favour of the electric light. The high awards to British exhibitors are as follows:—

1 diploma of honour to the British Post-Office; 1 diploma of honour: Society of Telegraphers and Electricians. Diploma of honour to the following establishments: Eastern Telegraph Company, Siemens Brothers and Company, and Submarine Telegraph Company; 1 diploma of honour to the British Post-Office Construction and Maintenance Com-

pany, Limited. Diploma of honour awarded to inventors: Sir William Thomson, Hughes. Diploma of Co-operation: King's College, Royal Institution of Great Britain. Gold Medals: Brush Electric Light, Bright, British Electric Light Company, Elliott Brothers, Indian Rubber and Telegraph Company; Latimer Clark, Muirhead, and Company, J. W. Swan.

C. Details.

ASTRONOMICAL NOTES FOR NOVEMBER, 1881.

The Sun.

Day of Month.	At Greenwich Mean Noon.			
	Souths.	Right Ascension.	Declination South.	Sidereal Time.
1	h. m. s. a.m.	h. m. s.	h. m. s.	h. m. s.
11	43 42.36	14 27 21.14	34 48	14 43 38.54
6	11 43 46.79	14 47 8.16	7 25	15 3 21.31
11	11 44 12.15	15 7 16.17	33 19	15 23 4.09
16	11 44 59.05	15 27 46.18	51 39	15 42 46.87
21	11 46 7.23	15 48 37.20	1 35	16 2 29.65
26	11 47 35.36	16 9 48.21	2 21	16 22 12.43

The method of determining the Sidereal Time at Mean Noon for any other station will be found on p. 388 of Vol. XXXII.

Spots, facule, &c., continue to develop on the Sun's disc.

There will be an Eclipse of the Sun on November 21st; but, as it will be invisible in this country, further reference to it is needless here.

The Moon

Is full at 2h. 29m. in the Early Morning of the 6th, and enters her Last Quarter at 1h. 11m. p.m. on the 13th. She will be new at 4h. 21.3m. p.m. on the 21st, and enter her First Quarter 1.3m. after noon on the 28th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	9.4	8 10.0 p.m.
6	14.4	12 29.4 "
11	19.4	3 56.3 a.m.
16	24.4	7 33.1 "
21	29.4	11 34.5 "
26	4.8	4 24.0 p.m.

The Moon will be in conjunction with Saturn at 8 p.m. on the 5th; with Jupiter at 6 p.m. on the 6th; with Mars at 11 p.m. on the 10th; with Venus at 1 a.m. on the 20th; and with Mercury at 8 o'clock the same morning.

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.				h. m.			
6	40 Arietis	6	2 7 a.m.	Bright.	145	177	2 59 a.m.	*Dark	239	277
6	ρ ⁴ Arietis	6	5 30 "	Bright.	89	130	6 25 "	Dark	285	324
6	ρ ⁴ Arietis	6	+6 10 "	S. by E.	7	46				
8	α Tauri	6	+9 7 p.m.	N.	185	143				
9	16 Geminorum	6	11 54 "	Bright.	78	39	1 9 "	Dark	274	246
10	ν Geminorum	4½	+1 10 a.m.	S.	355	326				
11	B.A.C. 2432	6½	2 4 "	Bright.	77	50	3 26 "	Dark	255	247
12	60 Cancri	6	+12 43 p.m.	S. by W.	344	305				
13	α Cancri	4	1 30 a.m.	Bright.	81	44	2 43 "	Dark	241	210
24	ξ Sagittarii	4	+4 53 p.m.	S. by E.	17	58				
24	ξ Sagittarii	6	5 5 "	Dark	128	151	5 30 p.m.	Bright.	264	290
26	8 Aquarii	6	7 36 "	Dark	61	89	8 13 "	Bright.	349	21
29	16 Piscium	6	5 15 "	Dark	101	82	6 24 "	Bright.	319	312
29	19 Piscium	6	11 28 "	Dark	111	147	12 27 "	Bright.	295	334

† Near approaches. * But apparently bright.

Mercury

Sets after the Sun for the first four days of the month, later on becoming a Morning Star. He comes into inferior conjunction with the Sun at

Jupiter

Is visible from sunset to dawn, and, coming into opposition to the Sun at 9 a.m. on the 13th, with very considerable North Declination, is about as

1 a.m. on the 8th, between two and three hours prior to which he will Transit the Sun's disc. As the last-named phenomenon, however, does not begin until 10h. 16m. 13s. p.m. G.M.T., it will obviously be invisible in this country. Mercury attains his greatest elongation West (19° 52') at 8 p.m. on the 24th. His considerable, and late in the month again increasing, South Declination, though, at this time, immerses him in the mists of the autumn horizon; and he is very indifferently placed for the observer. His angular diameter increases from 9.4" on the first to 9.8" on the 7th, and then decreases again to 6" by the end of the month.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	°	h. m.
1	15 20.1	20 30.3	0 36.4 p.m.
6	15 5.4	18 23.4	11 57.4 a.m.
11	14 37.9	14 18.5	11 15.0 "
16	14 27.4	12 19.3	10 44.8 "
21	14 33.5	12 28.4	10 31.3 "
26	14 51.3	14 2.3	10 29.3 "

The pendulum-like part indicated by the above Ephemeris is described wholly in Libra. The only conspicuous star, however, to which Mercury can be said to approach in that constellation is a Librae, rather more than 2° North of which he will be found on the morning of the 24th.

Venus

Is a morning star during the whole of November. She is an uninteresting object just now, presenting a very nearly circular disc, whose angular diameter decreases very slowly from 11.4' on the 1st of the month, to 10.6' on the 30th.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	°	h. m.
1	12 48.5	3 25.1	10 5.2 a.m.
6	13 11.5	5 47.8	10 8.4 "
11	13 34.7	8 8.0	10 11.9 "
16	13 58.2	10 24.2	10 15.7 "
21	14 22.1	12 34.7	10 19.9 "
26	14 46.4	14 37.7	10 24.5 "

Hence, it will be seen that Venus travels from Virgo into Libra. She will be very close to a Virginis during the Early Morning of the 4th, and will be seen 4° North of Spica on that of the 8th. After this, her path lies through a region void of conspicuous stars until the 26th, when she will be less than 1° North of a Librae.

well placed for the observer as he possibly can be. His angular diameter (which is 48" on November 1st), remains sensibly constant during the whole of the month. The remarkable details of the markings on his disc, and the numerous phenomena exhibited by his Satellites render him a noble and interesting object to every possessor of a telescope.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	°	h. m.
1	3 22.4	17 15.7	12 36.7 p.m.
6	3 19.7	17 5.9	12 14.3 "
11	3 17.0	16 55.8	11 52.0 "
16	3 14.2	16 45.7	11 29.6 "
21	3 11.5	16 35.7	11 7.2 "
26	3 8.9	16 26.1	10 44.9 "

The short retrograde arc thus indicated lies in a wholly barren region in Taurus.

Mars

Is a Morning Star as far as his Meridian passage is concerned; but, as he rises about 8 p.m. at the beginning of the month, and about 6 p.m. at the end of it, he is visible during a considerable portion of the working hours of the night. His great North Declination places him in a position peculiarly favourable for the observer, and his angular diameter increases from 13.8" on the 1st of November, to 17.3" by the last day of the month; thus rendering a considerable amount of telescopic detail visible on his surface.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	°	h. m.
1	7 0.5	23 51.9	4 18.2 a.m.
6	7 4.4	23 58.5	4 2.4 "
11	7 7.1	24 7.5	3 45.4 "
16	7 8.4	24 19.3	3 27.0 "
21	7 8.2	24 34.0	3 7.2 "
26	7 6.4	24 51.5	2 45.8 "

Mars thus oscillates through a very small arc in Gemini, but at a distance from any conspicuous star.

Saturn

Coming into opposition to the Sun, as he does, at 5 a.m. on November 1st, being visible all night long, and having, like Jupiter, considerable North Declination, is admirably placed, in every respect, for the observer. His ring system, which was last month as open as it will be during the present year, will not sensibly close during the present one. The angular diameter of the Planet imperceptibly diminishes from 18.2" on November 1st, to 15" by the 30th.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	°	h. m.
1	2 29.5	11 56.1	11 44.0 p.m.
6	2 28.0	11 48.7	11 22.8 "
11	2 26.4	11 41.6	11 1.6 "
16	2 25.0	11 34.8	10 40.4 "
21	2 23.5	11 28.4	10 19.3 "
26	2 22.2	11 22.5	9 58.3 "

Hence, Saturn will be seen to be travelling slowly away from the 5th magnitude star α Arietis.

Uranus

Has not yet come into view for the observer's purpose; but

Neptune

Neptune will be in opposition to the Sun at 10 a.m. on November 7th, and is now as favourably placed for telescopic observation as he well can be.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	I	Sh E	5	39	P.M.	12	II	Oc R	3	46	A.M.	21	I	Sh I	2	42	A.M.
1	I	Tr E	5	57	"	12	I	Sh I	6	18	"	21	I	Tr E	4	41	"
3	II	Sh I	3	31	A.M.	12	I	Tr I	6	21	"	21	I	Sh E	4	54	"
3	II	Tr I	4	5	"	13	I	Oc D	3	29	"	21	I	Oc D	11	39	P.M.
3	II	Sh E	6	8	"	13	I	Oc R	5	40	"	22	I	Ec R	2	2	11.30
3	II	Tr E	6	38	"	13	II	Sh I	7	26	P.M.	22	II	Oc D	4	32	P.M.
4	II	Ec D	10	34	18.30	13	II	Tr I	7	27	"	22	II	Ec R	7	33	41.30
5	II	Oc R	1	33	A.M.	13	II	Tr E	10	0	"	22	I	Tr I	8	55	"
5	I	Sh I	4	24	"	13	II	Sh E	10	3	"	22	I	Sh I	9	10	"
5	I	Tr I	4	37	"	13	I	Tr I	12	46	"	22	I	Tr E	11	7	"
5	I	Sh E	6	37	"	13	I	Sh I	12	47	"	22	I	Sh E	11	22	"
5	I	Tr E	6	48	"	14	I	Tr E	2	57	A.M.	23	I	Oc D	6	5	"
6	I	Ec D	1	35	28.30	14	I	Sh E	2	59	"	23	I	Ec R	8	30	56.30
6	I	Oc R	3	56	"	14	I	Oc D	9	55	P.M.	24	I	Tr E	5	32	"
6	II	Sh I	4	49	P.M.	14	I	Ec R	12	7	2.30	24	I	Sh E	5	51	"
6	II	Tr I	5	12	"	15	III	Oc D	4	58	A.M.	25	III	Tr I	10	0	"
6	II	Sh E	7	26	"	15	III	Ec R	6	36	24.30	25	III	Sh I	11	9	"
6	II	Tr E	7	45	"	15	II	Ec R	4	58	23.30	25	III	Tr E	11	26	"
6	I	Sh I	10	52	"	15	I	Tr I	7	12	"	25	III	Sh E	12	58	"
6	I	Tr I	11	3	"	15	I	Sh I	7	16	"	26	II	Oc D	5	38	A.M.
7	I	Sh E	1	5	A.M.	15	I	Tr E	9	23	"	27	II	Tr I	11	58	P.M.
7	I	Tr E	1	14	"	15	I	Sh E	9	28	"	27	II	Sh I	12	42	"
7	I	Ec D	8	4	14.30	16	I	Oc D	4	21	"	28	II	Tr E	2	32	A.M.
7	I	Oc R	10	22	"	16	I	Ec R	6	35	44.30	28	II	Sh E	3	19	"
8	III	Ec D	1	1	34.30	16	III	Tr I	6	47	"	28	I	Tr I	4	13	"
8	III	Oc R	3	0	"	18	III	Sh I	7	8	"	28	I	Sh I	4	36	"
8	I	Sh I	5	21	P.M.	18	III	Tr E	8	9	"	29	I	Oc D	1	23	"
8	I	Tr I	5	29	"	18	III	Sh E	8	58	"	29	I	Ec R	3	57	30.30
8	I	Sh E	7	34	"	19	II	Oc D	3	25	A.M.	29	II	Oc D	6	45	P.M.
8	I	Tr E	7	40	"	19	II	Ec R	6	16	1.30	29	II	Ec R	10	9	1.30
9	I	Oc R	4	48	"	20	I	Oc D	5	13	"	29	I	Tr I	10	39	"
10	II	Sh I	6	8	A.M.	20	II	Tr I	9	42	P.M.	29	I	Sh I	11	5	"
10	II	Tr I	6	20	"	20	II	Sh I	10	4	"	29	I	Tr E	12	50	"
11	III	Tr E	4	52	P.M.	20	II	Tr E	12	15	"	30	I	Sh E	1	17	A.M.
11	III	Sh E	4	57	"	20	II	Sh E	12	41	"	30	I	Oc D	7	49	P.M.
12	II	Ec D	1	9	36.30	21	I	Tr I	2	30	A.M.	30	I	Ec R	10	26	16.30

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon. The student should carefully observe the Transits of Satellite III. on the nights of the 18th and 25th, and note whether any (and if any, what) change of colour occurs in the Satellite as it crosses Jupiter's disc.

Neptune.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	°	h. m.
1	2 53.6	14 40.9	12 8.0 p.m.
6	2 53.1	14 38.5	11 47.8 "
11	2 52.5	14 36.1	11 27.6 "
16	2 52.0	14 33.7	11 7.4 "
21	2 51.4	14 31.4	10 47.2 "
26	2 50.9	14 29.2	10 27.0 "

This short retrograde arc is described in that very blank region of the sky to the East and somewhat to the South of α Arietis.

Of the minor planets,

Vesta

Is the only one visible; but she having (as stated in our "Notes" for last month) come into opposition with the Sun on October 30th, is now very conveniently placed for the observer. She may still be detected by a sharp eye as a smallish 6th magnitude star. Our short Ephemeris will suffice for her identification.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	°	h. m.
7	2 28.9	3 43.3	11 19.8 p.m.
17	2 19.7	3 25.6	10 31.3 "
27	2 12.3	3 24.7	9 44.7 "

Her limited path this month lies wholly in Cetus.

Greenwich Mean Time of Southing of Fourteen of the Principal Fixed Stars on the night of November 1st, 1881.

Star	Souths.
	h. m. s.
α Capricorni	5 26 58.30 p.m.
α Cygni	5 52 48.34 "
α Cephei	6 31 3.76 "
α Aquarii	7 14 54.10 "
Fomalhaut	8 6 10.28 "
Markab	8 13 54.46 "
α Piscium	8 48 48.72 "
α Andromedæ	9 17 8.90 "
α Cassiopeiæ	9 48 36.46 "
Polaris	10 31 8.54 "
α Arietis	11 15 3.80 "
α Ceti	12 10 29.85 "
α Persei	12 30 15.09 "
η Tauri	12 54 44.32 "

The Method of finding the Greenwich Mean Time of Southing of either of the Stars in the above List, for any other night in November, as also that of determining the instant of its Local Transit at any other station, will be found on p. 390 of Vol. XXXII. The rules there given, however, are not rigidly accurate when applied to Polaris and other circumpolar stars, although they are sufficiently so for all ordinary purposes.

Shooting Stars

There seems but little need to retell here the strange story of the great Meteoric stream through which the Earth travels from the 12th to the 15th of November, nor to repeat the history of Professor Adams's identification of this ring of aerolites with the little comet discovered by Tempel in 1866. Suffice it, then, to say that this annulus of discrete matter revolving round the Sun and intersecting the orbit of the Earth, possesses one region of exceptional richness; but, as it describes its path in 33½ years, that period must always elapse between two displays of extraordinary brilliance. As the last of these occurred in the year 1866 (oddly enough the

coal seems to retain, after absorption, all the gas it possessed before.

What form is the absorbed gas contained in the substance or the liquid? Physicists suppose that the sides of a solid body in the nearest molecules of gas with which it is surrounded an attraction resembling that in capillary phenomena. By virtue of action, absorbed gases are attached in layers of different density on the surface of porous substances. It has been found to determine approximately the thickness of gaseous layers covering the walls of bodies after absorption. Theodore Berthelot observed in 1812, that the absorption of charcoal is always accompanied by evolution of heat. This heat is evidently the effect of the condensation of the gas. It will be greater the greater the condensation, and the greater the quantity of gas; then compare this heat with that produced by liquefaction of the same gas. If it appear that the heat of liquefaction is greater than that of absorption, we conclude that the gas absorbed has for equal weight a density superior to that of the same gas.

That, by conclusive experiments, Favre and Berthelot found that carbonic acid, sulphurous acid, and other gases, condensed on the surface of porous bodies, have a density greater than the same gas.

Chappuis worked out a series of experiments which confirmed in all points the results of Berthelot. They were described at the recent meeting of the Helvetic Society.

He found that the heat liberated by absorption of a liquid, it is also constantly superior to the heat of liquefaction of the same gas, but it is inferior to the heat of absorption of a gas.

Chappuis recalls the fact that the elastic force of vapours of a mixture of two miscible liquids is never equal to the sum of the elastic forces of each of the liquids taken separately. Sometimes it does not even attain the sum of vapour of the more volatile liquid. This fact is in intimate connection with what we have in gaseous solutions. We have, in fact, in a mixture of two liquids, one of very great excess, while the proportion of the other, the liquefied gas, is very small. This shows the close relation of these phenomena somewhat overlooked.

The difference between the heat of absorption and liquefaction being pretty considerable, we thought it would be interesting to see if there was a direct manner. This was done, evidently, by putting the gas in contact with the liquid. One should then observe a liberation of heat equal to the difference between the heat of absorption and that of liquefaction.

What is the significance of the heat liberated at the establishment of close contact between the gas and the porous body? This liberation of heat evidently represents the work resulting from the contraction of the liquid to the walls of the pores.

From the compressibility of the liquid, it is clear that the experiments of M. Colladon and Regnault. The volume of liquid in contact with the porous body, and under the action of molecular forces, may be easily determined from the quantity of gas absorbed by the body. By means of these data, we may find in an approximate manner, the pressure which must be exerted on the liquid to produce an equivalent to the liberation of heat. We should thus obtain an approximate pressure to which the layers of liquid in the immediate neighbourhood of the walls of the pores are subjected.

By these considerations, M. Chappuis has measured exactly the liberation of heat when water is introduced suddenly into a tube filled with charcoal in equilibrium with the water. He used well as in the experiments previously the Bunsen ice calorimeter.

For tubes containing the charcoal at all its height by means of a hollow tube which connects with a Tappan pump. Thus vacuum can be produced in the charcoal chamber. A certain quantity is brought above the stopper, and till equilibrium of temperature is reached, the stopper is withdrawn, and penetrates the pores of the charcoal. The liberated fuses a certain quantity of

ice. The amount of heat observed is not so little as we suppose. Thus, two grammes of wood charcoal condensed about 350mm. of water during this condensation 15

calories of water, that the water adherent to the walls must have been under a pressure at least equal to 36,000,000 atmospheres.

This immense figure, indicating in some sort the order of magnitude of molecular forces, might awaken some doubts. But consider the results of thermochemistry, and surprise will no longer be felt. In fact, the heat liberated by formation of the quantity of water here employed amounts to 150 calories—that is to say, that the sum of work furnished by the chemical affinities of this same quantity of matter is ten times as great as the work furnished by adhesion of the liquid to the walls of the solid body.

COLOUR-BLINDNESS.—III.*

By R. BRUDENELL CARTER, F.R.C.S.

(Continued from page 165).

Mistakes of the Colour-blind in daily life

—Their methods of endeavouring to counteract the consequences of their defects—Modes of testing for Colour-blindness—Sources of error in testing—The actual prevalence of the affection.

THERE is nothing more difficult, even if it be in any way possible, than to realise to ourselves, or to make plain to others by verbal definitions, the nature of sensations of which we have no experience; and hence the precise appearance of the world to the colour-blind, and the difference between their sensations and those of the colour-sighted, must to some extent remain a matter of conjecture. For the purpose of illustration, however, and in order, in the words of old South, to employ those arts by which reason is wont to supply the deficiency of the reports of sense, we may assume what is not quite the case, namely, that white light is composed of red, green, and violet in equal proportions, and that the three colours are of equal luminosity. It would seem to follow, then, that to eyes which are incapable of seeing one of the colours, one-third of the total illumination of natural objects must be extinguished; and hence that the world, to the senses of the colour-blind, must be one-third less bright—one-third less luminous—than it appears to others. It follows, also, that the sensation which we call whiteness must be unknown to the colour-blind. Whiteness is the result of the combination of all three primaries, of which the colour-blind can combine but two. We have here an excellent illustration of the errors which are introduced into the question as soon as we begin to mix up facts with nomenclature. A child, who is, say, red-blind, sees white objects, is told by his elders that they are white, takes his idea of whiteness from their appearance, and would describe them as white to others. Their appearance to him, however, is the same that would be produced to the eyes of the colour-sighted by an admixture of equal parts of green and violet; and the same effect of such an admixture would be the same to him as whiteness, and forms the nearest approach to whiteness that he is capable of seeing or imagining. In the same way, the white of the green-blind is an admixture of red and violet; and the same principle applies to every other colour which may be presented to him. In other words, the colour-blind persons loses, out of every mixture, the effect which is produced upon normal eyes by the presence of the element of red, or green, or violet, as the case may be, which that mixture contains, and sees only the remaining elements. That which is invisible to him is practically non-existent for him; and hence, if we have the element of green and violet in a colour, and no others, the red-blind and the normal sighted would derive the same sensation from them. If we then add the red, the red-blind person would perceive no difference; while, to the colour-sighted, the colour of the mixture would be entirely altered. The former—the red-blind that is—would have no means of being sure at any time whether the colour at which he was looking was composed only of green and violet, or of those colours with the addition of red. The nearest approach which we can make to a discovery of the mode of vision of the colour-blind, is by ascertaining how such and such mixtures would look to ourselves, if one of the primaries were blotted out from them, leaving the others intact. For this purpose, we have a vertical wheel, capable of being made to rotate rapidly around a horizontal axis; and on this wheel we have three cleft discs of card, of the three primary colours, so contrived that we can expose more or less of any one of them. We will illuminate the surface by the electric light; and, with the three colours exposed in approximately correct proportions, will set the wheel into rotation. You no longer see a broad sector of red, a broad sector

of green, and a broad sector of violet, but simply a white surface. We will now abolish the red sector, filling the whole circle with green and violet, and then the rotation of the wheel will produce a mixture of those two colours, which most of us would describe as a sort of bluish grey, and which must nearly correspond with the appearance which white surfaces present to the red-blind. In like manner, we will next remove the green, leaving only red and violet, and the violet, leaving only red and green; and in each case the rotation of the wheel will produce some resemblance to the appearance presented by a white surface to the green-blind or to the violet-blind.

It seems probable that, before long, improved means of examining the conditions of colour-blind vision may be furnished to us by the discovery of persons who are colour-blind with one eye only, and who will be able to compare, under proper direction, the impressions derived from the colour-blind eye with those derived from that which is colour-sighted. Two such persons have been recently made the subject of experiment by Prof. Holmgren, and no doubt others will be found when looked for, as they will be now that attention has been directed to the fact that they may exist. [For an account of Holmgren's researches, see p. 509, Vol. XXXII., No. 828.]

If we turn now to the actual mistakes made by the colour-blind in daily life, as consequences of their defect, we shall find these to be less numerous and less remarkable than might have been supposed; inasmuch that nothing has come as a greater surprise to many persons than the recently acquired knowledge of the great prevalence of the condition. Dalton, the chemist, was totally red-blind; and when we hear that he said that the bright upper side of a laurel leaf was to him a perfect match for red sealing-wax, while the back of the leaf was an equally good match for the darker colour of a red wafer, we are at first sight inclined to think it impossible that such a state could escape recognition, even for a single day. He compared the colour of a florid complexion to a film of diluted ink spread over white paper; and said that blood was not unlike the colour which he heard called bottle-green. Although a member of the Society of Friends, he wore in the street, with perfect complacency, the bright scarlet gown of a Doctor of Civil Laws; and said, when asked by Whewell what it resembled, that it was of the same colour as the leaves of some evergreens outside the window, and that the lining, which was of pink silk, was undistinguishable from sky-blue. It would be tedious to enumerate errors of the same class which have been recorded of different colour-blind persons by various observers, and which depend, usually speaking, upon some unexpected test being applied to them in an unusual manner. I am acquainted with a family in which the father sent one of the sons, then a boy of nine or ten years old, into the next room to fetch him a book, which he described as of a green colour. The boy brought back a book like this (a red one), and his mistake led to an investigation, which disclosed that he and all his brothers were red-blind. In a general way, however, the colour-blind manage to avoid mistakes, because they soon learn to supplement their defective sense by the study of other peculiarities of objects. Among children bred in the country, the first thing which teaches a colour-blind to feel or suspect a difference between himself and other people is, usually, the difficulty which he experiences in seeing any difference between ripe fruit or red berries and the leaves which surround them. Even here, it must be remembered, he sees a difference, although not the difference; because the colour to which he is blind presents to him a surface which is deficient in luminosity when compared with others, although he conceives it to be identical in colour. Thus, to quote an illustration from Dr. Joy Jeffries, a child hears people speak of the flowers or buds of the corn poppy as red, and of the leaves and stems as green. He does not perceive any ground for this broad distinction; but, seeing that it is made by those around him, and that he is laughed at if he is mistaken with regard to it, he sets himself to work to study carefully the appearances of the flowers and of the leaves respectively, and to fix in his memory slight differences, such as an eye capable of perceiving the great difference might easily overlook, and which will, nevertheless, represent to him the former. Thus, he notices slight differences in apparent luminosity of surface, and interprets these as being the same things which others call differences of colour. Unless he happens to be accidentally tested, like the boy of whom I have spoken, with nearly pure red or green, he may not only for a long time escape the detection of other people, but he may even remain unconscious of his own defect. It must be remembered that he sees certain things, and hears them described as red; and that the appearance which they present to him will give him his notion of what it is that other persons mean when they call things red. He may only be detected when some

* The substance of a series of Cantor Lectures delivered before the Society of Arts.

casual event serves to render useless all the fine distinctions which he has acquired; as when the gentleman who was travelling wrote a letter to his family, commencing and completing it at different halting-places, half of it in red ink and half in black, without being himself conscious of the difference.

Another source of confusion in interpreting the descriptions of the colour-blind is the want of due appreciation of the different sensations that may be produced on their minds by modified hues of the same general colour. The normal-eyed person considers green, for example, as always green, whether it be yellow-green, blue green, or neutral green; whatever the particular "shade of green," as it is called, it still has, in his eye, the distinguishing character of greenness, which cannot be hidden or disguised by any predominance of blue or yellow which it may contain. But with the colour-blind this identifying characteristic of greenness is wanting; and hence several persons speaking of green may, by each having reference in his own mind to some particular hue of the colour, describe it in the most contradictory terms. One may say, with perfect sincerity, that green appears to him like red; another, that it looks yellow; a third, blue; a fourth, black; a fifth, orange; a sixth, violet; from which the normal-eyed examiner, impressed with the unity of greenness, may naturally infer that each person is suffering under a different species of the disorder; while, by proper interpretations, these anomalous descriptions would only convey the expression of one consistent truth, and one perfectly uniform defect of vision.

It will, I think, help us to understand the peculiarities of vision in question, if we endeavour to free our minds entirely from the influence of the phrase "colour-blind," and if we think of the subjects of the defect as of persons who are not "colour-blind" at all, but who are red-blind, green-blind, or violet-blind. The only really "colour-blind" people are those who are blind to all colours, while they still see light and shade and form; and of these a very small number of authentic instances have been recorded. The others, those who are red-blind, or green-blind, or violet-blind, in the words of Holmgren, perceive, in the main, the same kind of light as the normal observer, but they perceive part of it in another manner. In the system according to which they arrange their colours, they have fewer kinds than the normal observer; and this is why they are obliged to classify under the same denomination a portion of the colours headed by the normal observer under different heads. It results from this that they find resemblances between colours, or confuse others, which to the normal observer are quite different; for instance, red and green. These confusions naturally surprise and amuse the normal observer, who readily imagines that they arise from very great ignorance of colours, or from defective training. He ordinarily supposes that there is no limit to the mistakes the colour-blind might make in this respect. But this is not the case; for each variety of colour-blindness obeys laws quite as exact as those which govern the impressions of the normal observer. A colour-blind person can no more accustom himself to seeing colours as the normal observer does, than the red-blind can see colours in the same way that the green-blind does, or vice versa.

This view of the matter, which is based upon experience, explains to us how the colour-blind see colours; but, if we only rest our ideas upon the names given to colours by the colour-blind, we can be easily deceived. To judge correctly of colour-blindness, and of the various practical questions connected with it, it is of the highest importance distinctly to observe the difference between the manner in which the colour-blind person sees colours, and the manner in which he names them. The sensation is based upon the nature of the sense of colour in the organisation of the optic nerve from birth. The name, on the contrary, is learned. It is conventional, it depends upon exercise and habit. The names of colours are naturally the expressions of sensations; but, on the other hand, they are regulated by the system of normal sight, and cannot, consequently, agree with that of the colour-blind. They can, nevertheless, be learned by the latter, and even applied correctly in many cases. It is the want of a clear understanding upon this point which has given rise to the most serious embarrassments and errors. The normal use of colour names has been and still is one of the chief causes of our erroneous ideas on the subject of colour-blindness existing in the masses, because such use is the veil under which the defect usually conceals itself from our observation in every day life, and under which, even to the last moment, it will succeed in escaping discovery in cases where, as frequently happens, the methods of exploration employed are indecisive, or are based upon erroneous principles.

When we first think of the condition of the colour-blind, it is difficult to understand how they can fail to be immediately detected when in the

company of men endowed with normal sight; but daily experience shows us that they do escape. In testing the persons employed upon a railway, for example, who are required night and day to give attention to coloured signals, we usually find that a number of colour-blind are discovered, although their defective sense had not previously been suspected either by themselves or others, and the majority had correctly performed their duties. But, as I shall hereafter have to show, the fact of having avoided mistakes for some given period does not afford to the colour-blind signalman the slightest security for the future. His defect will some day surely find him out, and that at the very time when he is least suspicious of its influence. As a matter of fact, it is found that the number of colour-blind persons employed on the American railways has been diminished by the occurrence of mistakes on their parts which have been attributed to carelessness, or even to drunkenness, and which have led to their being discharged, not as colour-blind, but as bad servants. A recent American writer says that the colour-blind eliminate themselves from railway employment in this way in the course of a few years, and that they are never found among the old servants of any company. Unfortunately, in the process of eliminating themselves, they have often eliminated other people also.

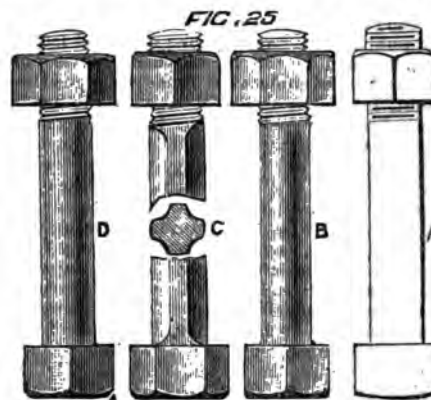
(To be continued.)

MECHANICAL DRAWING.—VIII.*

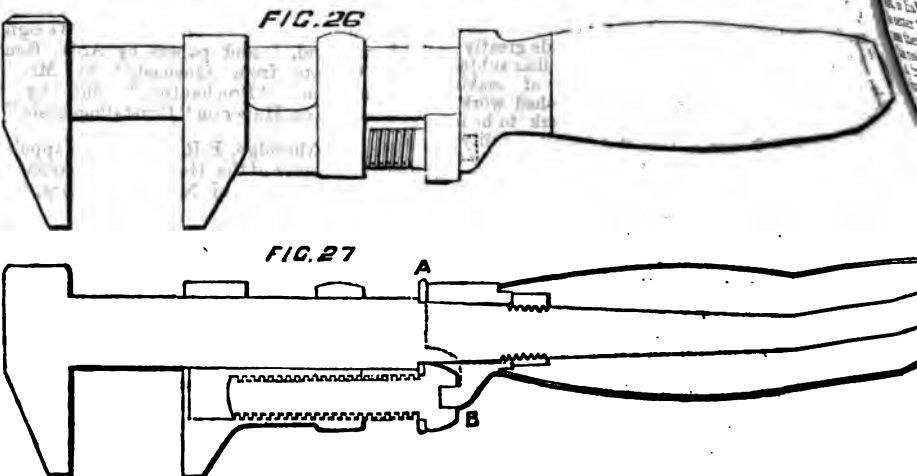
By PROF. JOHN E. SWEET.

Selecting Work from the Workshop.

FOR another change of work, or to give the student a bit of experience here and there out of the great variety of work with which he will meet, both in the drawing and the work itself, I offer the following suggestion, as a lesson well



worth his best exertions: Go into the workshop or factory, and select some apparently simple, well known and well-worn subject—line shaft hangers, oil cans, diastocks, pulleys, bolts, or anything of that nature. Settle upon which you will make a



drawing of, and then study the subject as you progress. While you may or may not make the drawing to represent the subject you have selected, study every part by itself. Reason out why it is made as it is, why the different ones are not alike, which you consider the best, and why. Even to change the shape and size, to better come to your

ideas, will in this case involve no loss, for the lesson in drawing is none the less valuable, while the lesson in thought is immensely more advantageous.

Never lose sight of the subject you are studying to think of the drawing, and never lose sight of your drawing lesson, and imagine some little contrivance you may hit upon in an invention and so forsake your good intentions, and go back the passport to poverty—a patent. It is the business of the draughtsman, as well as the workman, to strive to improve both his work and his processes. When the student has his subject, he may—in fact, is—tolerably sure to be at a loss as to how to represent it. A good deal he can find out for himself. Suppose it to be a pulley that he has in hand. An example might be given him, but he can see how other draughtsmen do it, and how the engraver does it; then he can take his choice. Either way is good enough; one way is exactly as good as another if the thing produced by the workman is the thing wanted, and the drawing is one that explains itself. If the subject is a bolt, the various ways that figured so conspicuously a few weeks ago in the *Machinist* will give the student abundant variety from which to select, and I fail to see why any of them were open to very serious objection. From either a man of ordinary sense would be likely to produce the thing wanted. If no dimensions were given, the draughtsman would be justified in making the bolt as long and as large as the drawing itself.

It will be better to study the bolts themselves and their uses and weaknesses, than to stick to the best way to represent them. The weakest point in all ordinary bolts, such as shown at A, Fig. 25, is at the bottom of the thread below the nut, and a bolt subject to sudden shocks or severe punishments will stand much longer if reduced along its whole length below the thread, so as to be of the same strength as at the part threaded. All Fig. 25, is shown Parsons' bolt, which is simply turned down from the thread to the head. Bolts so turned down proved to stand for securing armor plate, when bolts left full size would not stand at all. And, two bolts of this form will outwear a dozen common bolts in the tool holders of planing machines. There is shown at C a Palliser bolt, simply another form of reducing the strength of the bolt and yet have it fill the hole, but more expensive to make than the Stroudly bolt, shown at D. This is only an ordinary bolt with a hole about half its diameter drilled down its center to the ending of the thread. (See dotted lines in cut.)

Bolts of either of these patterns are better in certain places than the common kinds, and among other advantages is the one that the nuts will never shake loose. If the subject selected be a line shaft hanger, and the article cannot be taken to the drawing stand, make rough sketches, and from the dimensions in a sufficient number of places to enable you to complete the drawing, without going again to look at the original. This will require making of many cross sections and views in two more directions. Avoid the usual mistake of making the sketches too hastily or incompletely. The man who can make a first rate sketch is worth half a draughtsman.

As an example of what the lesson above suggested is likely to lead to, the following study of the monkey wrench subject may be suggested.

And if the student finds nothing better good as any for a subject to make a drawing of, use some real article, instead of copy here represented. As this drawing was the engraver entirely by the use of a triangle, French curve, pencil and ink, student will need no tools but such as he has.

If you have an opportunity to roam the shop of any considerable size, you will

* From the *American Machinist*.

Houzeau finds in it a series of luminous plates or masses, to the number of thirty-three, each diminishing in brightness outwards from the centre. These are arranged almost exactly along a great circle of the celestial sphere. The solar system is nearly in the plane of this "equator," and probably near its centre.

A series of experiments with certain cultivated plants was lately made by Herr Weiss, with reference to the comparative value of manuring with nitric acid and with ammonia. The plants were grown in pots in a soil of artificial humus, and received, besides the necessary mineral salts, either no nitrogen, or nitrogen in various forms. Herr Weiss's results are as follows: (1) There are plants which in the first period of life can take nitrogen only as nitric acid, and others which can take it only as ammoniacal salt. In the second life-period, nitric acid must also be furnished to all plants. (2) Buckwheat, oats, peas, beans, and Soja beans, are proved to be nitric acid plants, while maize and tobacco are ammonia plants. (3) The poppy is probably an ammonia plant, but barley, rape, and potatoes are probably nitric acid plants. (4) In general it will be found more advantageous to manure with nitrogen in the form of nitre (in the case of ammonia plants, naturally not). If ammonia salts are used, they should be applied in autumn.

In the departments of France the destruction of hurtful and dangerous animals is encouraged by money awards. Last year, in Seine-et-Marne, there were killed as many as 3,598 vipers, paid for at the rate of 25 centimes per viper, the total amount being 899f. 50c. The great bulk of these vipers were killed in the arrondissement of Fontainebleau.

In a French journal devoted to textile industry, M. Bordier has lately pointed out the advantages derivable from a plant indigenous in South America, and known in France by the name of the *fufetone*. It abounds in the wild state in France, and in other parts of Europe, especially Italy, where there are several varieties of it. It is an *Asclepias*, with opposite leaves, and simple stem, and the flower, composed of two oblong petals inclosing the seed, is crowned with an aigrette of white silky hair. In Italy, several attempts have been made to utilise these hairs, but with little success; for, it is said, they are too short and brittle to be spun and woven alone, and in mixture with other fibres, they weaken the stuff. Now, according to M. Bordier, it is not these hairs that should be treated, but the stem—from which an excellent fine white resistant fibre may be obtained capable of replacing silk. M. Bordier says the fibre is superior to that of jute, of which French commerce imports annually, by England, a quantity valued at sixteen to eighteen million francs. The stem of *fufetone* has the advantage of being incorruptible by water. These important statements by M. Bordier will doubtless be fully tested.

For some years back, various species of eucalyptus growing thickly over extensive areas in New South Wales have been dying off, and in a manner so regular as to appear to have been caused by human agency. The trees do not die over any large area simultaneously, but become affected in the first instance in one particular spot, and gradually die off, in a direction from north to south, and in belts of more or less width, leaving those growing on either side of such belts entirely unaffected. It is supposed that this destruction is caused by a fungus at the roots; but why it does not spread laterally is at present an enigma.

Starting from the idea that the coloured reactions in alkaloids are caused by subtraction of water from the reagents used, Signor Czampelitz recently devised a method of distinguishing alkaloids, and successfully used chloride of zinc for the purpose. The substance to be examined is perfectly dried, and then moistened with two or three drops of chloride of zinc solution (one gramme of chloride of zinc, 30cc. of hydrochloric acid, and 30cc. of distilled water); then the substance is dried anew in a water-bath. In this way strychnine is coloured vermilion, thebaine yellow, narcotine olive green, delphine brown red, berberine yellow, veratrine red, quinine pale yellow, digitaline chestnut brown, salicine violet red, santanine violet blue, cubebine carmine red.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-offices Orders to be made Payable to J. PARKMORE EDWARDS.

* * * In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physics: a vice from whence great inconveniences derive their origin." —Montaigne's Essays.

LUNAR PHYSICS.

[19316.]—UNDER this title I propose occasionally to refresh my memory, and those of my readers, with such notices of lunar formations which have engaged my own attention, or those of lunar observers with whose results I have become acquainted. When I call to mind the extent of the Moon's surface, the number of years, from the time of Hevelius, it has been under observation; the successful attempt of Riccioli to specify certain portions of the Moon by naming them, and the slow progress that has been up to the present time made in our knowledge of the constitution and condition of its surface, it may appear singular to some that so little is known of the nearest body to us in the solar system; but when we consider that the Moon has been studied as a whole, and not separated for distinct investigation into the formations which have been named by Hevelius, Riccioli, Schröter, and others, our wonder may in a measure cease, for to find a *terrestrial analogue* with which to compare the Moon, we must take a much larger body, the earth, and of this the Moon has been said by a great authority to be "no copy of the earth." Controversy is very seldom of much use, rarely results in conviction, and the good it produces is often obtained in other ways by which unpleasant feelings are frequently prevented, for it is difficult to convince a mind that has a settled view based on what it conceived to be good premises, and therefore I shall not attempt to controvert the idea embodied in the quotation within the inverted commas, but shall attempt to show that we have within our reach a method of reasoning by analogy by which we can compare certain processes on the earth with certain appearances in the Moon.

THE MARE CRISIUM.—One of the easiest and most compact formations on the Moon's surface suitable for examination is the *Crisium Sea* situated near the north-west limb or circular edge of the Moon. It can generally be examined about the third day of the Moon's age soon after sunrise upon it, and also about two days after full when the Sun is nearly setting upon it. This is one of the lunar formations that is most conveniently situated for observing both sunrise and sunset upon it. It should be examined with reference to four classes of objects—*first*, the mountain border; *second*, the ridges that traverse its surface principally from north to south; *third*, the craters that are opened on its surface; and *fourth*, any objects or none, as the case may be, that exist on the plain portions of the surface bounded by any well-marked objects forming angular points of the boundary inclosing the space examined. This formation is an object that has been described by most selenographers, but it is referred to here because more than 15 years ago a list of craters was drawn up and published in the report of the British Association for the Advancement of Science, 1865, pp. 292 and 293, and it is very desirable that the existence or otherwise of the craters that may now exist upon it may be ascertained by observation. With an aperture of more than 10in. a list of craters as seen at the present epoch would be very valuable.

AN OBSCURING MEDIUM.—"A point of great interest in reference to a lunar atmosphere arose during the Plato observations, and showed very conclusively the value of co-operation in such studies. On more than one occasion an observer of skill and experience reported a *local haziness* over a part, which strongly suggested to the mind the idea of a cloud or mist, as it did not extend to the whole of Plato, but occupied a portion of it only. This was an observation of such importance that one cannot help regretting that it so happened that this appearance has not hitherto been seen by two independent observers at the same time; and a completely satisfactory confirmation of the reality of the haze is more likely to be obtained by two or

more observers giving their undivided attention to a formation, than in any other way. Every individual is liable to error, and every eye to fatigue, and consequent untrustworthiness; but, if such an appearance were seen and noted by two observers, who witnessed it independently at the same time, its validity could not be doubted."—"Lessons in Selenography," *Astronomical Register*, June, 1881, p. 146.

The examination of the *Mare Crisium* has been selected, partly because it has been the scene of a somewhat similar observation in the shape of "a white spot on the moon," which was seen to the west of the principal crater, "Picard," about twenty years ago, its superficialities being a little larger than "Picard"; and it was sufficiently plain to attract attention, so that a notice of it appeared in an early number of the *Astronomical Register*, under the heading "White Spot on the Moon." It was observed for several months, and, if it be allowable to consider that it was of the nature of a cloud or mist, upon its clearing away two very small craterlets were found on its site.

In letter 19272, Oct. 7, 1881, p. 110, col. 3, it is stated that the initial phenomenon presented by vapour ejected from a volcanic vent would be "a spot" more or less persistent in a certain locality, and a dense cloud hanging and persisting over a volcanic orifice on the earth for many days was adduced as its *terrestrial analogue*. This is precisely the phenomenon presented by the white spot on the Moon. The overhanging cloud so often seen over volcanoes on the Earth, there is reason to believe, was in this instance seen on the Moon to the west of *Picard*, and when the two small craterlets afterwards found in its site are taken into consideration, it may not be unlikely that the material of the "white spot" emanated from them, and while the spots remained in view it concealed the true surface in that locality in which the craterlets were situated. Taking these facts together—the persistence of the white spots for some months with a similar phenomenon observed on the Earth over volcanoes—it appears very likely indeed that the *terrestrial appearance* is the "analogue" of the lunar.

Leytonstone, E., October 17.

W. E. Birt.

SELENOGRAPHICAL.

[19317.]—LETTER 19322, p. 159, col. 1, by "M. A.," bears so immediately on an Obscuring Medium in the Moon, and is so well illustrated by the following extract from a letter addressed to me by A. T. Williams, Esq., dated October, 17, 1881, which also bears so pointedly on the same subject, that I have requested Mr. Williams's permission to publish it:—"I have been very much interested lately in the letters which have appeared in the 'E. M.' on Selenographical matters, and the suggestion of Julius Schmidt, quoted by you in letter 19272, 'E. M.' seems of considerable importance. As examples of little objects situate just where the wall begins, spots 20, 22, 26, and others in Plato, seem undoubtedly to have evidenced a decided change of brightness, and above all, spot 20 has shown the greatest change, ranging from invisibility to one of the brightest spots. There are many things to be taken into consideration, that it seems difficult at present to determine what has caused a change in the brightness of a spot. Thus a diminution in brightness might be caused by exhalations from the crater or spot obscuring it; by being covered with any aqueous vapour that may remain in the depths of the crater; by obscuration by the vapours of any mineral substances that might be vapourised by the intense heat of the sun (sulphur, for example, might be mentioned), or by the crater cone getting choked up, and perhaps surrounded and covered by ashes. In like manner an increase in brightness might be caused by removal of any of the above substances, or by the welling up of hot streams of lava, or by the action of solar heat upon the substances of which it is composed, not to mention many other causes, such as the change which might be produced by the chemical combination of the aqueous or mineral vapours and gases with the matter erupted, or in course of eruption, by the crater cone, and the total obliteration of a spot by a stream of lava. All these causes acting, either singly or in combination, must render it a matter of the greatest difficulty to determine what real change has happened, and many other conditions may also exist, for a spot lying close under the wall might be obliterated by a landslide, and if the substance which covered the spot were of little reflective power, the result might be the total disappearance of the spot without any apparent cause."

"The attentive study of the minute detail of the Moon's surface is as yet in its infancy, so that it is nearly impossible to determine which of the above causes, if any, will most probably cause a change in a spot, and yet it must be evident that for every change that must arise in any large object enough to attract immediate attention, probably hundreds arise in the small crater cones and other minute objects" [that can only be detected by the most

unremitting attention and the constant observation of the small details of the Moon's surface].

If a "Poor Student" will write to me (query 15045), I shall have much pleasure in assisting him in identifying lunar objects. W. E. Birt.

4, Leyspring-terrace, Cowley-road,
Leytonstone, E., Oct. 24.

TIDAL EVOLUTION OF THE MOON.

[19348.]—In answer to "Paugul's" question in letter 19302, I beg to state that though the retardation of the Earth's rotation by the lunar and solar tides and the recession of the Moon from the Earth, in consequence of the action of the lunar tides, were originally pointed out, the former by Kant, and the latter by Delaunay, before G. H. Darwin attacked the question of the tidal evolution of the moon, yet, that he, Darwin, has added a great deal of original matter thereto. In the first place he has investigated the question with elaborate mathematical calculation of details, which had not been done before. But, besides, he has shown what had not been known before—the effect of the tidal action and reaction on the plane of the Moon's orbit, on the eccentricity of the Moon's orbit, on the nutation of the Earth's axis, and on the inclination of that axis to the plane of the Ecliptic. He has pointed out that whereas Delaunay and Adams, in their treatment of the tidal retardation of the Earth's rotation, considered only the ocean tides, it is necessary to do as he has done—viz., include the consideration of the bodily tides in the Earth. He has also pointed out that one effect of the said tidal retardation must be a screwing motion in the surface of the viscous earth, always small but formerly much greater than at present; the equatorial parts of the earth must be dragged westwards relatively to the ground north and south thereof. He has also considered the heat produced by the tidal disturbance in the earth's body, which, if it had been applied all at once, would have raised the temperature enormously. And finally he has pointed out, beside these two geological points of small importance, others of great importance—e.g., the fact that geological denudation and deposition must have been vastly more active in former times than at present.

Dublinensis.

DOMESTIC SANITATION—NEXT-DOOR NEIGHBOURS.

[19349.]—Among the difficulties against which the responsible workman has to contend in matters relating to drainage and general sanitary work, the difficulty requiring the most patience and forbearance, and sometimes the display of ingenious plausibility, very nearly allied to lying for other persons' benefit, is with next-door neighbours, and I would rather excavate a hole 8 ft. deep, and alter or remove an obstruction from a drain, than have the task of proving that his or her affairs are injuring the person or property of the neighbour in the next house. I was sent for to account for the flooding of a cellar of a large house in a street of large houses, whose inhabitants are all Mr. and Mrs. Somebody; in fact, the next-door neighbour was one of the guardians of the parish, one of the foremost at the Local Board, and chairman of the Board of Health of the united parishes over which our Local Board has control. I examined the faulty cellar, and concluded it was sewage-matter percolating the brickwork, making the cellar a danger to the inmates of the house, for long strings and stripes of black ooze festooned on the brickwork, over and out of which a green-hued liquor trickled down, and stood in small pools in every indentation and undulation of the cellar. I examined the drain arrangements of my employer's premises, and found these to lead quite another way. I decided at once that the fault, with its consequences, lay with the neighbour's drain next door, the whilom chairman of the Board of Health to the Local Board, &c. My employer sent him a courteous letter. I went to him with my explanation, to which he condescended not to listen. Then it was proposed to send for the officers of the Local Board; but as I knew nothing could be done against the next-door neighbour unless we had some proof, I took the affair in my own hands and cut a hole through the party-wall, and discovered the drain laid in a side passage, higher than the level of the cellar-floor, and out of the drain the sewage was leaking, finding its readiest way into the premises of my employer. Having thus discovered the actual cause of the mischief, the next thing was to propose a remedy. One suggested legal proceedings, another proposed a drastic order to the local board, so as to arouse the sleeping officers and compel them to act; but my employer being one of the very few I have met to whom I can honestly apply the term "a gentleman," at once said if I could suggest any real and practical remedy I should do so, and not have any more bother. I have a manner of mixing Portland cement, so that if the cement be good, it will "set" as hard as a stone in a quarter of an hour, even if under water. I sug-

gested rendering the cellar-wall, and did so render it with Portland cement. This affair happened some few years ago, but it is not three months since the gentleman expressed to me his pleasure and great satisfaction with the very effectual manner in which his cellar had been kept free from pollution, and himself and family saved from the disgust and annoyance from the drain of the neighbour next door all the time he remained in that house. Pardon me as I digress to apologise here for the so frequent use of the "great I"; but as these are actual experiences, I find no other way of showing my personal knowledge than by the use of it, and I here at once say that in showing some of the difficulties in the way of practical work, and how these difficulties have been got over, strict reliance may be placed on any statement to which the great "I" is attached as having been of my own way of doing the work, and of the attending success or failure as it may have happened. After about a fortnight, as the sewage could not find an outlet nor an exit, the area next door gave a very disagreeable indication as to what was the matter, and the drain was cleared for a time, but not for long. The next-door neighbour was at that time in a flourishing way of business, and employed a number of labourers, and first one of these and then another was sent to "do the drain," until the drain could be done no longer: it was no sooner unstopped than stopped again, so therefore the builder came in for a large share of abusive blame, the plumber was also a duffer, and everybody having had any hand in any of the sanitary arrangements of the house knew not their business; but the poor drain-layer must have been an idiot, so the blame was laid on without stint on the wrong parties, and without reason either, for when I was sent for I localised the fault in the drain with my rods; and opening down to the drain, I found 4 ft. of iron rod bent zigzag across the drain, which one of the labourers (sent to do the drain) had left in the drain, and which nothing short of digging out could remove.

Some ten years ago, a young man, well qualified, started in business as a chemist and druggist in a large shop in a recently-built house in the main road, with means sufficient, and with a good reputation, and above all, with plenty of friends, both to hinder him and to help him. After some time he got married, when it became convenient to make some alterations to the premises, including the adding of a dining-room on the ground-floor, on a level with the business part of the premises. Now, pray, good reader, do not think I am trying to set up myself as a moral of any sort. I am not so good-looking as many people, and am no better in good qualities than any, yet I do not

"Compound for sins I am inclined to,
By condemning those I have no mind to."

—BUTLER.

But in making preparations for this room I very carefully examined the drains; and every precaution I could adopt, and whatever true friendship could suggest, was attended to, *con amore*, for I was interested in the well-doing of both parties. Some twelve months after the room had been occupied, the landlord had some new arrangements effected with the main drain, which did not interfere with the dining-room; but in the end and finish, left the dining-room the most cosy and the most agreeable room of the house. Four years or so went away thus; then arose complaints of a disagreeable odour, and illness followed, until matters reached the extreme, and the room was unbearable. I was ordered at any cost to find out the cause of this. The flooring was taken up, the joists removed, and again the drain, which laid across deep under the floor, was examined, but nothing could be found to account for such reports as were presented about the state of the room. That rats had been under the floor was evident, but this house being surrounded by old houses in which rats "do congregate," and Mr. Chemist being somewhat expert with poisons, and having pleaded guilty to past and present acts of verminicide, it was concluded that the worst of the trouble was buried; therefore, having filled in with glass and other debris all the places suspected of yielding access to the straight-tailed vermin, the floor was relaid and the room assumed its usual aspect in and for its wonted use. Three months passed, and the room became as foul as it ever was; the diners were driven from the table, so that the room had, in a manner of speaking, to be shut up. Again I had up the floor, when, underneath where the dining-table stood, I saw a very smooth round hole up which the rats had travelled, and up which I at once judged the foul smells came, also a ventilating-shaft to the sewer. I trusted no man this time with any part of the examination, I did it myself; I followed the hole and traced it across the floor under the ground, and down and under the footings of the party-wall, into the premises of the next-door neighbour; having gone so far, and having no right on other premises, and, one would think, not having occasion to go on or in any other place to remedy defects which were annoying this, but having sent for next-door neighbour, and having

actually shown him that the disease of and damage to the room came from faults which he could control, it was expected of him to see to the matter. He did nothing. That rats had burrowed from his place he could not dispute, but he disputed his responsibility; the sanitary inspector went to him with the supposed authority of the Local Board, and exhausted all the forms of the Board upon the obstinate next-door neighbour. Thus matters remained for about a fortnight, with nothing done and with no appearance of anything being attempted, until the chemist became quite disheartened, and I got spiteful at the procrastination, and determined at all or any risk to find out the cause and apply a remedy. I cut through the brickwork of the party-wall, cut the footing clean away to tunnel under the stone floor of the kitchen next door, having caught up the trail, and following it for about 3' t. under the floor of next door, I came upon a broken drain, up which the rats had come, and out of which the sewer-gas had come, with all the trouble, to the man of business, all the suspension of domestic peace, and to the death of every animating wish for good-fellowship for next-door neighbours from the heart of the chemist, for even respect for the next-door neighbour was buried in the tunnel I made under his floor. The hole in the drain was very effectually stopped, nor rats nor sewer-gas have been in that room from the hour I relaid the floor to this.

A block of five houses was erected on some property next to a smaller unattached house and property, belonging to a private owner. In building the block, it was convenient to excavate the ground and lower the basement, so that the basement-floor of the block was some 6 ft. lower than the lowest floor of the private property owner; but the block standing on the gravel and surrounded by deep sewer-cuttings, which are supposed to cut off all springs, it was not expected that any serious inconvenience could arise from any dampness to cause damage, either to a tenant or to the property, nor were any complaints made, or cause of complaint discovered for some ten years after the buildings were finished; then in one house of the block next the private owner, the back-room of the basement, used as a store-room, became unbearable; everything put into the room got mildewed, the flooring was perishing with dry-rot, and under the floor a pool of stagnant water. One expert was called in, and suggested a land-spring, another suggested surface-drainage. I cut through the outside wall, and a stream—a constant stream of water, came through from the premises of the private property owner. The water company was sent to, and could do nothing. The Local Board was sent to, and was powerless, or pusillanimous. The Water Co. had no power to act unless there was proof of waste of water, and has not the liberty to dig up ground to see for the proof on any person's premises. The Local Board, under Section 82 of the Management Act, may send in men to find out a nuisance, but under Section 84 Management Act, the Local Board is liable to an action for damages, provided the nuisance could be proved against the owner or tenant, and as the person mostly responsible for the giving of orders, is the Surveyor to the Local Board, that gentleman is generally very cautious in giving orders, for a surveyor always in litigation would not be a useful servant to some of the local magnates, who some of them are not loth to take a rough shaving or two off the law before applying a remedy for an intolerant grievance which concerns themselves in domestic sanitation. My advice in this matter was not followed. A gentleman was sent from somewhere, where people know all about these sorts of things, and can advise you by intuition upon the danger of a "breakneck fall," and can demonstrate on the tip of a silver pencil-case the value of intercepting manholes, that is, if Mr. So-and-So's plans are used. On my arrival at my appointment the gentleman of the house and the gentleman sanitarian were discussing this affair over port-wine, of which the smell came to my share, nor had I spoken a dozen words before I plainly understood I was only Jo Boomer the drainer, and my duty was to receive orders; knowing exactly my position, and knowing also if I did not obey, some other person would. My orders were to put in a drain with an open mouth from the drain in the area, under the floor and out through the wall I had cut through, to drain away the water from the premises of the private property owner. I did so; but if any sanitary gentleman having given such orders should read this, I give my opinion upon such orders as having been one of the worst pieces of sanitary arrangement I ever had in my hand, and the gent who paid for such advice was imposed on. I know not if anything, or what, has since been done, as the tenant who paid for all that was done left the neighbourhood shortly after what I did, under orders, and the private property owner has gone the way of all flesh, which is carried feet-foremost out of the front door, to heaven, where 'tis pity but room could be quickly found for all such ungentlemanly gentlemen, for this earth is made the worse in

every respect by, and with, such cantankerous, unneighbourly next-door neighbours.

Jo Boomer.

SPIRAL-TURNING.

[19360].—As it appears that Mr. Evans is about to describe, in the pages of the *ENGLISH MECHANIC*, the mode of attaching the spiral apparatus to the left end of the mandril, as originally arranged for me by Messrs. Kennan, of Dublin, I do not think there can be any use in my having the apparatus photographed, as suggested in letter 18328 by Dr. Skues, and probably the Editor would consider an engraving from such photograph superfluous; but if Dr. Skues should still require further information, or wish to see how the whole is put together, I shall be glad to take a photograph of my apparatus and send him a copy, if he will advertise his address in the Sale Column of the "E. M." The only professional photographer in these parts died last year in the poorhouse.

With respect to Dr. S.'s proposed plan for fitting a traversing mandril to his present lathe-head, Mr. Evans is much better qualified than I am to give an opinion as to its feasibility, and perhaps he will answer that part of the letter; but it must be remembered that, in all probability, none of the chucks for ornamental work, such as the eccentric, oval, and other chucks, fitted to the old mandril, will run smooth upon the nose of the new one.

G. C. C.

IMPROVED COMBINATION LATHE: III.

[19351].—THE following arrangements for adapting the slide-rests of small lathes as shaping machines are included in the patent combination lathe lately illustrated and described.

Fig. 11 represents a small table-lathe. The main slide A of the slide-rest is box-shaped, and

The modifications suggested in Figs. 12, 13, and 14 are added to adapt to existing lathe patterns. Thus, the adapter and bracket, H H, has the rack cast on one side, and a face to hold the upper slide vertically; it could be bolted to the lower slide of any slide-rest, and the form of support for the wheel and lever shown in Fig. 13 could be fitted under and round the bed of most slide-rests, and between the ways of the lathe-bed. If the ways were inside bevelled, it might also be fitted so as to hold down and guide the slide-rest without shake. Brass screws, with heads projecting below the bottom of the slide-rest bed, may be also fitted, so as to steady the slide-rest against the outside edge of the lathe-bed, and conical heads will hold on to, and adjust to, a bevelled bed edge.

If not convenient to provide a hinge-plate on the upper slide to clear the tool on the back stroke, the hinged tool-holder shown in Fig. 15 will be found useful. It consists of a bar, J, with the end bent down, and butting against a stirrup K, hinged at N. The stirrup foot is bored through to contain a bolt L, which is slotted through the head, so as to embrace the steel-cutting point M, and hold it tight to the stirrup by the nut on the other side.

J. A. Armstrong.

LIME-LIGHT JETS.

[19352].—MANY readers will no doubt remember a description by "Antares" some months ago, of the good effects on lime-light work of some gas-regulators, with his suggestion that by their aid a "mixed" jet might be used with gas from the main. "Antares" was kind enough to lend two regulators and accessories to me for experiment on this point, and the result, which is worth recording, would have been reported before this but for more pressing work.

In my suburb the gas-pressure, as shown by the V-tubes, only equals 2½ in. to 2½ in. of water (i.e.,

the lime focussed on the screen by the condenser alone, the shadow of the jet occupied from one-eighth of the visible area.

Under these conditions, all I can say is that the mixed jet used with the regulators gave about as much light as the best blow-through jet at my command. Sometimes I thought it a little less; but since so large a portion of light was kept from the screen, it is difficult to say more exactly. It may be taken, however, that the light is equal, or rather, more than equal, to that of a blow-through, while the adjustments were all uniformly maintained, and there was not the slightest hitch from first to last. It is also to be observed that I am far from certain this particular jet gave a perfect mixture of gases. Even so far there appears some advantage; since it is manifest that an operator need only use one kind of jet where any gas is obtainable; obtaining with it either the power of a blow-through jet with gas from the main, or when required using the higher power with both gases under pressure.

But one advantage there was of a startling kind. The oxygen lasted double the usual time. My bag is 36 by 24 by 24, and will keep a lantern going with a blow-through jet, with care, for about two hours. It kept this mixed jet going for four hours. About this result there could be no doubt, and this is, therefore, by far the most economical method of using oxygen gas, while the lantern is far less heated. Putting aside any question of slight superiority in light, therefore, the net result is that a mixed jet, with these regulators and house-gas direct from the main, gives a light about equal to that of a good blow-through jet, with only half the consumption of gas. Such a result seems worthy of being placed upon record, that others may benefit from the suggestion of "Antares."

In closing, I should like to ask if any reader can give information as to the cost and weight of a secondary "store" battery sufficient to supply an electric lantern of say 600 candle power for two hours, and any particulars as to places where such a battery might be charged from dynamo machines, and on what terms. I need not refer to the advantages of being able to use the electric light without the inconveniences of batteries or machines, simply by transporting a somewhat heavy piece of luggage, which, after all, would go in a cab, and could scarcely weigh more than bags and weights for limelight work. Whatever improvements may be made, it seems to me these batteries are already amply perfected for this purpose, and, I should think, must already have been used for it. None of us probably need theoretical statements as to the power of a given battery, which are accessible to all of us; but no rough and ready practical statement of what would be needed, and its cost, or as to what practical arrangements could be made in London for charging such a battery, have come under my notice. It would seem to me that even already some country "business" might be done in this way.

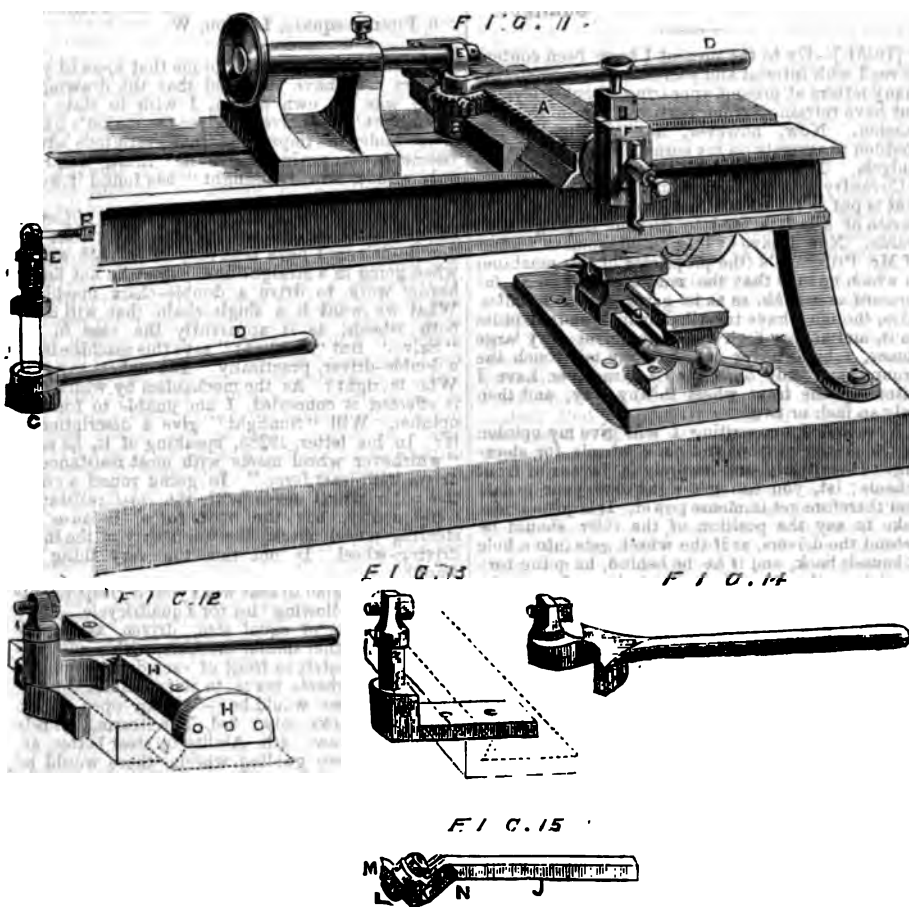
Lewis Wright.

TRICYCLES.

[19353].—REPLYING to "J. H." on this matter, and with all kindly feeling, I must certainly say that I hardly think that at this interval to call at statements made so long ago as your issue of Sept. 9th, is certainly very much like waste of time and space, which would be, in my opinion, better occupied in bringing forward some new point of general interest. I therefore propose to reply but briefly, and to his first paragraph I would reply that I am still fully convinced that a 40in. wheel, even if geared up to 50in., will ascend a hill easier than a 50in. ungeared machine. And I should at any time be very pleased to show him a practical demonstration of the statement I have just made being perfectly correct; and bearing on this subject, I would refer him to my letter, page 135. If our friend, "J. H.," is going to tell me that a 40in. wheel, the circumference of which is 10ft. 5½ in., does not make more turns per mile than a 50in. with a circumference of 13ft. 1in., and that a given point in its tire of the 40in. wheel is not revolving faster than a similar spot on the 50in. wheel, I can only say that our friend must have a tile loose somewhere.

In regard to paragraph 2, I am not arguing against myself. But I am sure he will admit that 2ft. 7½ in. of tire and rim would not weigh many pounds, and that I wish to be perfectly fair in my statements, not taking advantage of minor matters, but keeping well within the facts. In other words, by no means taking the outside advantage of a gain of a pound or two of weight, but rather the reverse. Therefore, I cannot accept his hypothesis as correct, if he still states that a small wheel makes the same number of turns per mile as the larger one, or that any part on the rim of the smaller one would not revolve faster than a similar part on a larger wheel, the two machines travelling a mile in the same period of time.

To his fourth statement I would in the same spirit say that a small wheel, running faster, goes



has a rack cast on one side; the bed of the slide-rest has a projecting lug, B, to which can be bolted a stout stud, E, on which works a toothed wheel, actuated by the handle, D, and gearing with the rack on the main slide. The upper part of the stud E is capable of attachment to the moving spindle of the back centre, when turned round to face it by the set-screw F, and the slide-rest can thus be traversed along the bed by the left hand and back centre, and the shaper lever be actuated by the right hand. It is necessary to fit the slide-rest so as to slide on to the bed without shake. The upper slide, F, is screwed to the face of the lower box-slide, and G represents a parallel vice, blocked up on the table to suit the work to be operated on.

half that in each limb of the tube). To have a little spare pressure behind, I was therefore obliged to adjust the regulators to 2in., and with this pressure neither my own expectations nor those of "Antares" were very great. The jet was also lent me by the same kind correspondent, had a platinum nozzle, and had been, since its purchase, carefully bored out to a diameter of one millimetre (1-25th of an inch). It had, however, one great defect; the nozzle was set at far too flat an angle. I have seen this fault so often in jets otherwise well made, that I mention it particularly; the consequence, of course, being that the jet "stands in its own light," and casts a considerable shadow. In this case, with the light carefully centred and

ver a small obstacle quite as easily as a large wheel lumbering slowly round. Therefore, if we come to strict opinions, I see no contradiction between the lines quoted, only a wish to speak without bombast or dogmatism.

Then, as to his last paragraph I am quite content in the knowledge that the large majority of persons who, from riding machines, or desiring to do so, peruse the letters on the subject are not the scientific ones entirely, and that a man who reads his paper need not be one fully up to all phrases used in scientific or mathematical terms. In fact, I am well assured from actual knowledge that many bicyclists and tricyclists have taken the "E. M." lately since this discussion has been on foot. And as the majority of these are not probably aware of the true meaning of angular momentum and other like terms, it certainly appears to me that it is decidedly best to express one's self in terms that are most widely understood. If the subject were a purely theoretical scientific one, then by all means use strict terms. As I take it, the great aim of this paper is to instruct all, and how is this to be done if terms are used that they do not fully understand? No instruction is thus imparted. On the contrary, it is making a show of imparting information, whilst really such words are used that the true meaning is lost to all but men of the highest education. Therefore, in his last statement, I cannot at all agree with "J. H." Neither do I consider it the least insulting to the readers of the "E. M." to say so in all honesty and good feeling. I never could flatter, I never have done so, and I never intend to do so. Therefore, those who do not take what I say, as it is meant with the best of wishes, are quite at liberty to reject my advice.

I welcome the remarks of "C. J. H.," as they are the outcome, not of theory, but of practice, although there are points on which I somewhat differ from the opinions he expresses. Let me say, from actual experience, that his having the machine built 2in. wider is certainly a gain in stability. The ordinary machine would very easily turn over in turning a corner. Two tracks, where the machine is of the type he names, are an advantage, and to meet the idea the "Queen" Bicycle Company introduced the "Duchess" and "Queen" Tricycles, both of which were two-track machines, and later still the National Company, No. 2, which is an open-front machine as well. But, in my opinion, the two-track machine is bad unless in the form of the "Coventry" or "Duchess," and even then there is a decided tendency to turn over too easily unless built of special width. Still our friend would find a good open-front machine with rotary action easier to run, and unless he has the rack-and-pinion steering-gear which is fitted to the Coventry rotary machine, he would find that another improvement. For the machine to beat a "Rudge" means that there must be either something wrong with machine or rider, as it (the Rudge) is much lighter and should go far easier up hill. On the question of two tracks, I am strongly of opinion that although very well with a "Coventry," it is a decidedly bad arrangement with an open-front machine.

In the matter of brakes, I am myself busy experimenting in odd moments. I fancy, however, I somewhat misunderstand the description in letter 19288. As I read it, the brake would be applied at the level of the frame or thereabouts. And he would find that two spoon-brakes properly fitted to the round of the tires would hold him on any hill, and in the last pattern of Hillman and Herbert's "Dutchman," there is a dodge on the brake that I consider a fine idea. We all know that descending a hill one has to hold the brake on. This is very trying, and is liable on long hills, such as I have to ride, to cause cramp in the hand. Such might produce some unlooked-for results in the way of suddenly swerving across the road, owing to the cramp closing the rider's hand on the brake-lever too hard. In their latest pattern the brake-rod is made to slide up the stem of the fast handle, thereby putting on the brake, and by a frictional device holding it on without further care on the rider's part. To release the wheels, it only needs pushing down, when it is instantly taken off. It can, therefore, be applied with any force, which is an advantage on slight inclines. And this brake, which is of the spoon kind, on both large wheels is certainly another improvement to chronicle.

Mr. Steel's remarks would not apply but very little if the spoons are anything like a fit on the rubbers. This is a point generally overlooked. But the attention to it means that it takes off the liability to hold badly on a greasy road. The principle of the one spoon coming hard on before the other has, I see, been recognised by the makers of the "Royal Mail," in which the spoon on the one wheel is adjustable to keep the pressure as it should be. Both this and the plan to obviate the unequal bite of the brake, when the wheel is out of truth, I have now perfected to my satisfaction, and I am next going to apply a modification of the self-holding brake to a machine.

I have had a little to do with the Ground Brake,

but the only one I have found of any use was one fitted to the "Devon." Still, it is not perfection by any means if the road be rough. One point of great importance on the brake question is, that riders enter a hill at full speed, and of course the machine begins to bolt. They then, most unreasonably, apply the brake hard, with not always a satisfactory result. If persons would only do as I do on coming to a hill—slacken speed, so that the machine does not run over the brow of the gradient with a rush, but at a moderate pace, and then at once apply the brake gradually, and so prevent going into so fast a rate of speed—there would be fewer "spills" from all causes attributable to brakes, and we should not hear of such inquiries for more and more powerful ones.

I have been also trying some dodges in the direction of a seat on Mr. Westropp's plan; but so far I can't satisfy myself that it is on the whole better than my last plan, as described at page 131. The seat itself I have found an advantage, as the yielding canvas suspension plan decidedly makes it easier to sit on for a considerable time. There are two matters I want to get rid of: one as to the seat causing one to feel a soreness at the bottom of the spine. This I think Mr. Westropp's canvas plan will do away with. The other, that if I ride for some hours on the stretch, the vibration of the machine, as transmitted through the treadle, causes a stagnation of the circulation in the feet, that I feel as if mine were numbed, as on a cold day. I am going to try to abolish this by the use of large rubbers; but, until tried, do not feel certain of succeeding.

Between this and the next issue of the "E. M." I will see what the weight required is to move myself and machine on a level, and will let Mr. Steel know the result. I consider the idea, as put forward by him, as a very practical and sensible one, and, if the same test could be applied to several different machines of varied types, some useful, and, I expect, unlooked-for, results would appear.

Sunlight.

[19354].—Up to the present I have been content to read with interest and sometimes amusement the many letters at present appearing about tricycles, but have refrained from participating in the discussion. Now, however, as "Sunlight" has trodden so severely on my corns I must take up the cudgels. I refer to his statement about the "Coventry Phoenix"; that in the last pattern the seat is put as far back as possible, so that a clumsy device of a tail is used to prevent tipping backwards. Now I have at the present moment a letter of Mr. Pritchard's (the proprietor of this machine) in which he says that the saddle should be as far forward as possible, so as to get over the treadles. Also, though I have travelled many hundred miles on it, and at very high speeds and over very large stones, I have never once had my tail touch the ground, and only once that I remember have I lifted up the front wheel in any way, and then only an inch or two.

Now that I am writing I will give my opinion on the matter of front and back wheels for steering. It is utterly and entirely in favour of front wheels; 1st, you can get right over your pedals and therefore get immense power. It is quite a mistake to say the position of the rider should be behind the drivers, as if the wheel gets into a hole it bounds back, and if he be behind, he going forward jams the wheel into the hole, and gets the whole shock of a recoil that will nearly stop the machine. If, however, he be in front of the wheel he has already passed over the hole, and the wheel bounds back without disturbing the momentum of the rider which drags the wheel past; it is the same as if you put out one finger and force your hand forward over some rough surface, when it will catch in every obstruction, but if you drag your hand towards you it glides over them comparatively easily. 2. You can descend hills at any pace without the slightest danger of being thrown even by large stones. I was a short time ago staying with some friends near Godstone, and was asked to rush and post a letter, there being only just time to get to the office on my machine. Having got there, I turned to return down the hill, and was going down it at an immense pace without any brake on when suddenly the steering-gear broke off short at the small front fork. I jammed down the brake with all my force, expecting to be thrown out at once; but the machine stopped very quickly and exactly in the middle of the road, and in its steepest place. Had my machine been a single driver, I should have had my head broken, and perhaps might not have known that the breakage had occurred till I was thrown out. This brings me to the value of a double-driver, which in this machine is perfect; it does not swerve if one wheel is caught by a stone, and I have often travelled for miles without either hand on the handles, smoking contentedly, with only a slight touch at the handle every now and then as the arch of the road inclines my machine to the gutter.

Now as to the brake. I pin my faith to the band-

brake applied to the chain-wheel of a double driver, as it acts perfectly equally on both wheels, and does not impede the steering. It is, I think, the most powerful, and certainly does not loosen the tires, as all spoon-brakes do more or less. I have just taken my machine to pieces for the first time since I have had it, and I find the brake smothered in grease, yet I have never noticed it fail when I have wanted it, as it has always answered perfectly. As to bearings, balls are certainly the best, not only for wheels but also for pedals and crank-shafts, if you know how to adjust them, but not otherwise. The sizes of the driving and chain-wheels are questions not for the machine but for the rider. Now, as to travelling, I am not at present very strong, having been under the physician's hands for last winter and spring, and most of summer for excessive weakness and lassitude, yet I have lately done on a "Phoenix" from Pall Mall to beyond Godstone Station, 24 miles in 2½ hours, with 20lb of luggage, and everyone knows the bad state of the Brixton-road, &c., and the not very level road all the way, not to mention the streets of Croydon. Also, a few Sundays ago, I went 25 miles on the Bagshot-road, and coming back in the evening after dark we did the last 13 miles to Hounslow in 1 hour and 2 minutes, including the hill this side of Virginia Water, Egham-hill, I believe it is called. This speaks volumes for the machine, and but for my front wheel I should not have dared to run down the Egham-hill without a brake on. I may say, in finishing this inordinately long letter, that it would be an exceedingly good idea for all the writers in this paper on this subject to meet together shortly some Sunday morning, when we might exchange machines, and see if we shall also change our opinions, for hitherto, although I have tried nearly every make, it has always been at the riding-schools, and not on the road. If any gentleman would like this, if he will write to me, I will see if we can arrange a day suitable to us all for the experiment.

A. H. Dicksee.

6, Fitzroy-square, London, W.

[19355].—As it appears to me that some of your readers may have supposed that the drawing in 19227 was my own design, I wish to state that "Sunlight" has correctly given the maker's name. I was under the impression that gratuitous advertisements were not inserted in the "E. M.," and I can only wonder how "Sunlight" has found it worth his while to give one.

"Sunlight" is certainly right in the objection he makes to single-driving machines; but all double-drivers I have seen only drive both wheels when going in a straight line. Does he not find it harder work to drive a double-chain machine? What we want is a single-chain that will drive both wheels, as is apparently the case in the "Salvo." But "Sunlight" says this machine is not a double-driver, practically. The makers say it is. Who is right? As the mechanism by which this is effected is concealed, I am unable to form an opinion. Will "Sunlight" give a description of it? In his letter, 19285, speaking of it, he says, "whichever wheel meets with most resistance, it drives with least force." In going round a curve the outer wheel meets with the least resistance, consequently, has the most force, because the steering-wheel checks the full liberty of the inner driving-wheel. Is not this the very thing we want?

I should be glad to hear what your correspondents think of the following idea for a quadricycle:—Two driving-wheels of equal size, driven as in the "Salvo," or other similar machine, with a guiding-wheel immediately in front of each driving-wheel; the guiding-wheels made to steer simultaneously. The advantages would be:—1st. An open front. 2nd. Two tracks only. 3rd. The steering-wheels would be in view. 4th. Ability to steer better, as, there being two guiding-wheels, there would be less liability of their slipping, which is the great drawback in tricycles with the steering-wheel behind. 5th. The lamps could be placed on the guiding-wheels; thus a good light would be thrown ahead, and no shadows cast by the tires or pedals. 6th. The pedals could be placed so that the rider could sit right over them, and yet distribute his weight in just proportion between the wheels, so that there would be no liability of the machine tilting backwards. 7th. More stability. A four-legged stool stands more firmly than a three-legged one. Such a machine would be a very little, if any, heavier than a tricycle.

Charles F. Steel.

[19356].—In the illustration to my last (19327), the engraver has omitted the reference letter (a) at lower end of line of thrust.

In the third line of second paragraph for "pedals" read "pedals," and in the eighth line of same for "overroad" read "over road."

In the figures the seat is too horizontal. I should have sketched the blocks upon which the spiral springs rest somewhat longer. In Mr. Blood's own machine the seat is so much tilted up, when climb-

ing hills, he almost stands upon the pedals, and merely leans against the seat, and the line of thrust approaches more nearly to the perpendicular than I have drawn it.

I omitted to state the more that pressure is applied to the pedals the greater is the tendency of the seat to rise, and throw rider more over his work.

The flat bars upon which the cushion-substitute rests are made of steel.

Will "Sunlight" kindly explain the mechanism by which double driving is attained in the "National," of which he speaks so highly?

I do not understand "Sunlight's" reasons for stating that the seat in a front-steerer must be placed behind a vertical line drawn through driving-axle.

Is it not a fact that in several front-steerers of merit—e.g., the "Perfection," "Centaur," and "Omni-cycle"—the seat is in front of the axle, and that these machines require no safety back-stay?

"Sunlight's" opinions upon sizes of driving-wheels appear to be very undecided. In 19173 he argues strongly in favour of small wheels geared-up. In 19289 he appears to incline to my view, that medium-sized ones, geared level, are best for general purposes; and now (19333) he seems to be veering round to the opinion that "a large wheel speeded down gives a very fine-looking machine, and one easy to ride—far more so than the level-gear machine." What next?

Oct. 22. W. H. Stacpoole Westropp.

SMALL CHAIN-WHEELS FOR TRI-CYCLES.

[19357].—I CRAVE a little space to answer my critics. First as regards the pressure on the bearing of driving-wheel from an undue tension or pull on the driving-chain. It will be remembered I was supposing circumstances giving a 400lb. pull—viz., a 100lb. pressure on crank, and a ratio of 1 to 4 between crank and chain-wheel. "D. H. G." forgets that there must be an abutment to withstand this pressure. The abutment is the framework of tri-cycle, by means of which a powerful upward pressure is conveyed to the bearing of driving-wheel, which, in the case mentioned, would be 300lb., and far exceed the weight of an average rider pressing the bearing downwards, especially as 100lb. of his weight is supposed at the moment (say, at starting) to be on the pedal. The case supposed is an extreme one, and I am quite willing to waive the question of friction on this bearing, and even to suppose it eliminated as "Paugl" suggests (end of 19302, p. 134). There still remain the following disadvantages attending the 3in. as against 6in. chain-wheels:—1. Double double strain on chain, necessitating greater strength. 2. Double strain on chain-wheel teeth, and only half the number of teeth taking it—quadruple strain per tooth, both crank and driving-wheels. 3. Double back-pressure on crank axle-bearings, which means double friction, the number of revolutions being always the same, and if their thickness is as it should be, increased, it means still greater friction. 4. Double strain on chain means that double friction will occur in bending it through the same angle. But it must be bent through twice the former angle—ergo, with quadrupled friction. However, as only half the former number of links will pass over for each turn of crank, we must halve this result and say only double friction for bending chain. 5. As regards friction between chain and teeth, it is not easy to predicate any exact statement, but clearly a quadruple strain per tooth (see above) combined with a double angle between teeth (supposing teeth same size as in the larger wheel) must make the friction at least double on these grounds; while the fact of only half the number of teeth passing can only halve it; so, if we cry quits on this point (generous on my part), I have still a long balance in my favour.

There is nothing to be said against taking one point—viz., that of full power of crank, for the purpose of making a comparison of this sort. To do otherwise would render the problem complex. At present it is simple. What holds good at one point would hold good, as regards the comparison, at any other point in the travel of the crank. The ratio of the strains would still be equal, though the amount was quite altered; and, therefore, the ratio of the total strains of a full revolution would still be equal.

Supposing I admit with "Paugl" that an increase or decrease of the number of teeth that pass, and consequent friction, is exactly balanced by a corresponding decrease of pressure, I have still in my favour the more unfavourable angle at which the teeth engage the double friction due to bending of chain (see 4 above), the double back-pressure on crank axle-bearings, and the double strain everywhere.

Though I shake hands with "Sunlight" over the chain-wheels, I can not see what he means by greater rotary force or momentum in a small than in a large wheel. The number of revolutions will be greater; but the weight in motion will be less, and the distances of corresponding parts of wheel

from centre less in the same proportion. This last just nullifies the greater number of revolutions, and renders the absolute velocity of corresponding parts exactly the same, e.g., absolute velocity of centre, say, ten miles in each case, that of the machine itself. Point touching ground is at rest. Top of wheel is travelling double or 20 miles an hour in each case, and the average velocity of rim is ten miles in each case, just the same as if they were revolving with equal peripheral speeds suspended in air. The advantage, therefore, as regards momentum, is only in weight, and remains with the large wheel, as also does its easier running over obstacles. Anything which appears to contradict this must be due to some other cause.

Has no one, amongst our readers, seen, heard of, or tried the Otto Safety Bicycle? It seems to me a very quick trotter, and a first-rate ladies' horse.

Guido.

ADJUSTMENT OF MIRRORS.

[19358].—THE problem at present under consideration is one on which theoretical and practical men may with advantage join their forces for its complete elucidation. The mathematics of amateurs and the rule-of-thumb practice of the shop, if brought into unison, would both gain a good deal.

It is pleasing to find that T. Westlake does not intend to desert the problem he has opened.

"A. J. S.," in letter 19278, has well pointed out that the exact adjustment of the flat is as necessary as its fine optic surface and figure. It must be placed exactly at 45° with the axis of the cone of rays from the mirror, and whatever alteration is needed in its position must be obtained by moving the whole flat bodily, and not by tilting it on its support.

T. Westlake is rather difficult to follow in letter 19301, where he says "if the eye draw-tube is taken out altogether." This appears only to apply to the form of eyepiece which has been figured and described by "A. J. S." in these columns, and has given great satisfaction to those who have tried it. What does he mean by saying there is no point where the rays meet? Surely the essential principle of the telescope is that rays are brought to a focus?

—If we look through the concave lens of the "A. J. S." eyepiece, we get the same result given by looking at the flat from a considerable distance; if we look at the flat with our eye near the focus, we notice, by a curious optical illusion, a different appearance altogether; and what was a central adjustment in one case appears eccentric in another. T. Westlake cannot clear this up by involving it in a cloud of words, like his distinction between mechanical and optical adjustments.

What are optical adjustments but a means of perfecting that which we have mechanically adjusted as nearly as possible?

In the adjustment numbered (2) "T. W." does not say how we are to adjust the flat. Tilting is obviously inadmissible. Did "T. W." ever adjust a mirror and flat?

In the next paragraph (which deserves to be framed and glazed as a specimen of the utter irrelevancy of "now's" and "therefore's") we are tempted to ask whether the cone makes the angles or the angles make the cone.

Is "T. W." sure that, as stated in his second paragraph, the diagram previously given shows eyepiece, flat, mirror, and reflection of flat in mirror, all concentric? And is this the case when viewed at arm's length through a concave, or seen from close to? Ploni Almoni.

THE ORGAN.

[19359].—In "L. R. D.," letter 19312, will refer to the "Musical Standard," Vol. III., No. 70, May 1885; also to No. for July 30, 1881; and to ENGLISH MECHANIC, Vol. IX., p. 549, he will find that I have anticipated the inventions for opening the swells of organs by pressure of the back and the double sharps of the pedals, by about thirty years.

N. S. Heineken.

ELEMENTARY MATHEMATICAL OPTICS.—X.

Aberration (continued).

[19360].—I MUST now return to the simplification of the focal equation containing the correction for spherical error. By referring to eqn. (8), page 68, Vol. XXXIII., it will be seen that the expression for the aberration value is long and intricate; and unless it can by some means be very much simplified, the computation of the small quantity required would be a very laborious task. Coddington employs the following simple and elegant method, by which the equation is at once rendered suitable for calculation. It will be noticed that the equation contains two pairs of reciprocals—those of the conjugate foci and those of the radii. These four terms can be represented by two, and the equation put in a quadratic form by the subjoined artifice.

Considered with reference to the conjugate foci, we have:

$$\frac{1}{d} + \frac{1}{F} = \frac{1}{\phi}. \quad \text{Let } \frac{1}{d} = \frac{1+a}{2\phi}, \text{ then } \frac{1}{F} = \frac{1-a}{2\phi}. \text{ Thus}$$

a takes the place of d and F .

Secondly, with reference to the radii, we have—

$$\frac{1}{r} + \frac{1}{s} = \frac{1}{\phi(\mu-1)}. \quad \text{Let } \frac{1}{r} = \frac{1+x}{2\phi(\mu-1)}, \text{ then } \frac{1}{s} =$$

$$\frac{1-x}{2\phi(\mu-1)}. \text{ Thus } x \text{ takes the place of } r \text{ and } s. \frac{d}{F}$$

$$= \frac{1-a}{1+a}, \text{ which gives } a = \frac{F-d}{F+d}. \text{ Similarly } x = \frac{s-r}{s+r}.$$

If the conjugate foci be equidistant from the lens, $a = 0$, and if the incident rays be parallel, $s = \infty$.

If the lens be equi-convex, $x = 0$, and if the first surface is a plane $x = -1$. In the first place, we will substitute these values in the expression for the correction due to thickness. By reference to section VII., page 359, the variation of the reciprocal of f is $\frac{\mu t}{f^2} = \frac{t}{\mu} \left(\frac{\mu-1}{r} - \frac{1}{a} \right)$ since $\frac{1}{f} = \left(\frac{\mu-1}{\mu r} - \frac{1}{\mu d} \right)$. Substituting for r and d , we

$$\text{have } \frac{t}{\mu} \left(\frac{x-a}{\phi^2} \right). \text{ To obtain the real value of the correction, we must of course multiply this expression by } F^2.$$

We must next take the expression for the correction for aberration, and by similar substitutions, the final equation is:—

$$\frac{1}{\mu(\mu-1)} \left\{ \frac{\mu+2}{\mu-1} x^2 + 4(\mu+1)ax + (3\mu+2)(\mu-1)a^2 + \frac{\mu^3}{\mu-1} \right\} \frac{y^2}{8\phi^2} \dots (9).$$

Representing by A the coefficient of $\frac{y^2}{4\phi^2}$, and by

B , that of $\frac{y^2}{8\phi^2}$, the complete expression for the focal length becomes:—

$$\frac{1}{d} + \frac{1}{F} = \frac{1}{\phi} + A \cdot \frac{t}{4\phi^2} + B \cdot \frac{y^2}{8\phi^2}. \text{ And the}$$

correction for thickness is $-\frac{A \cdot t}{4 \cdot \phi^2}$, and for

aberration $-\frac{B \cdot F^2}{8 \cdot \phi^2} \cdot \frac{y^2}{\phi^2}$. With regard to the last factor, it has been shown in a previous article that when $\mu = 1.5$, the thickness of the lens is $\frac{y^2}{\phi}$; so that in general, both corrections

may be expressed in terms of t ; or $-t \left(\frac{A}{4} + \frac{B}{8} \right)$

F^2 . For parallel rays, F and ϕ are equal, which still further simplifies the expression.

In section VIII. it has been shown that the greatest concentration of light takes place on a plane situated in front of the first approximate focal point, at a distance equal to $\frac{1}{2}$ of the aberration; and that the diameter of the luminous disc is $\frac{1}{2}$ the lateral aberration. Therefore, the distance of the circle of least confusion from the first approximate value of ϕ is $-t \left(\frac{A}{4} + \frac{3}{32} B \right) \frac{F^2}{\phi^2}$;

and its diameter is $\frac{B F^2}{16 \phi^2} \cdot \frac{y^2}{\phi^2}$.

Some general results may be obtained from eqn. (9) before it is put in its proper numerical form. First, by differentiation, we find that its value is a minimum when $x = \frac{-2(\mu+1)(\mu-1)}{\mu+2} a$. Also,

it appears that for certain values of a and x , the equation may be reduced to zero; thus showing that in some cases a single lens may be aplanatic. It is evident that the first and third terms will always be positive, whatever may be the signs of a and x , for the square of a negative quantity is positive; but the second term is negative if either x or a be so. If, therefore, the equation can be reduced to zero, the second term must equal the sum of the other three.

To render this possible, both a and x must have considerable values, and one of them must be negative. If x be $-$ and a be $+$ the second radius s must be negative; that is, the lens must be a deep meniscus, and the first conjugate focus d , must be on the same side as F , that is, converging rays must fall on the lens. If we reverse these, making x $+$ and a $-$, we must have a diverging pencil, incident on a deep concavo-convex lens.

There is another point worthy of notice: if we solve the quadratic equation with respect to x , we obtain two values of x for one of a ; or if we solve with respect to a , we obtain two values of a for one of x . This indicates that generally two ratios of curvature can be free from aberration for the same conjugate foci, or conversely, that the same lens can generally be aplanatic for two positions of the conjugate foci. I believe this is Mr. Lister's law of the aplanatic foci, as it was discovered experi-

mentally by him many years ago. I have never seen a complete account of his investigations, which I suppose are published in the *Phil. Trans.*, at I presume his experiments were made with combined convex and concave lens. It is, however, immaterial whether we correct a convex curve by a concave one, as in a single lens; or whether we use a concave lens to balance the positive error of a convex one: the law holds good in either case.

There is one value of a for each refractive index, which has only one corresponding value of x . When the index is 1.5, by replacing μ by this number, our equation becomes (omitting the factors outside the brackets) $7x^2 + 10ax + \frac{13}{4}a^2 + \frac{27}{4} = 0$ (if the lens be free from aberration), or in

a more convenient form, $x^2 + \frac{10}{7}ax = -\frac{13}{28}a^2 - \frac{27}{28}$. The solution of this quadratic gives:—

$$x = -\frac{5}{7}a \pm \frac{3}{14}\sqrt{a^2 - 21}.$$

Now, in order that x may have a real value, a^2 must be equal to, or greater than, 21; for if it were less, the quantity under the vinculum would be negative.

When $a^2 = 21$ or $a = 4.58$, x has only one value = 3.27, for the second part $\sqrt{a^2 - 21} = 0$; but if $a = 5$, then $x = -\frac{25}{7} \pm \frac{3}{7} = -\frac{22}{7}$ or -4 .

Hence, if $d : F :: 358 : 553$, or say as 9 : 14, the lens is aplanatic only when $r : s :: 227 : 427$; the second surface being concave—and both the conjugate foci on the emergent side. But when $d : F :: 2 : 3$, the lens is free from error if $r : s :: 15 : 29$, or as 3 : 5.

By solving the equation with respect to a , it appears that when $x = 3.12$, a has only one value, viz., 4.8; but when $x = 4$, the values of a are -5 and -95.

Hence if $r : s :: 212 : 412$ we must have $d : F :: 19 : 29$, but if $r : s :: 3 : 5$ the ratio of d to F may be either 2 : 3 or 41 : 54.

In this case the lens is a concavo-convex, and both the conjugate focal points are in front of the lens.

The value of the equation is a minimum when $x = -\frac{2(\mu^2 - 1)}{\mu + 2}$: which if $\mu = 1.5$, gives $x = -\frac{5}{7}$.

When the incident rays are parallel, $a = -1$, and eqn. (9) then becomes $\{7x^2 - 10x + 10\}$; also the minimum value of x is $\frac{5}{7}$, which gives $r : s :: 1 : 6$. Hence, for parallel rays, the best form of convex lens has the back radius six times that of the front surface. Also, if the emergent rays are to be parallel, the same form of lens should be used, but its position must be reversed.

It may be useful, if we calculate the variation due to the thickness and spherical error, in several common forms of lenses for parallel rays.

For the first correction we have: since $a = -1$ and $F = \phi, \frac{t}{6}(x + 1)^2$: and for the second, $\frac{1}{6}$

$\{7x^2 - 10x + 10\} \frac{t^2}{\phi}$, or we may put t for $\frac{t^2}{\phi}$.

1. For a plano-convex lens, $x = -1$; therefore, the first correction is zero, and the second or spherical error is $\frac{27}{6}t$, or $4\frac{1}{2}$ times the thickness.

2. For a convexo-plane lens, $x = +1$; therefore, the first correction is $\frac{1}{3}t$, and the spherical error, $\frac{7}{6}t$.

3. For an equi-convex lens, $a = 0$; correction for thickness is $\frac{1}{6}t$, and for spherical error $\frac{5}{6}t$.

4. For the best form of convex, that is, the crossed lens, $x = \frac{5}{7}$; therefore, correction for thickness = $\frac{24}{49}$ or, say, $\frac{1}{2}t$; and for spherical error $\frac{15}{14}t$.

For these lenses, the distance of the least circle of confusion from the first approximate focus, and its diameter, are:—

	Distance.	Diameter.
1. Plano-convex	$(0 + \frac{27}{8})t = 3\frac{3}{8}t$	$\frac{9}{4}\phi^2$
2. Convexo-plane	$(\frac{1}{3} + \frac{7}{6})t = \frac{13}{6}t$	$\frac{7}{12}\phi^2$
3. Equi-convex	$(\frac{1}{6} + \frac{5}{6})t = \frac{1}{2}t$	$\frac{5}{6}\phi^2$
4. Crossed lens	$(\frac{1}{2} + \frac{45}{56})t = \frac{17}{56}t$	$\frac{15}{28}\phi^2$

Orderic Vital.

SILVERING PROCESSES.

[19361].—Mr thanks are due to Mr. Bell, Mr. Wassell, and others who have so kindly noticed my inquiry re Brashear's silvering process. I, however, cannot obtain a sufficiently dense film with it. In the original letter 17404 it is said, "the deposit is so hard it will stand the severest usage." "It is also very bright." Now the deposit I obtain is not hard—it is powdery; and it is not bright, or, at least, not such as can be described as very bright, having a rather milky appearance. I have been careful in the quantities of each solution, and am unable to account for the failure, only, after the testimony of the last few weeks, I am sure it must be my fault. I find I cannot get the solution perfectly free from suspended particles by ammonia after the addition of potash. Although it becomes transparent, it is full of small specks. I think I must revert to Martin's process again and report progress. Being temporarily in possession of a 6 in. reflector, which is in good condition, I am rather surprised, after the drawings which have appeared at divers times in the "E. M." of Jupiter, Saturn, Mars, etc., to see how very far short of such detail my gazing is. I can see what I take to be four satellites of Saturn, but am quite unable to detect Ball's division in the ring. I fancy I ought to see this quite easily. The belts of Jupiter are not nearly so well defined as some possessors of 2 in. refractors appear to see them in our paper. 13 Messier is a hazy patch, and the annular nebula in Lyra is a very faint object, the darker centre being scarcely distinguishable. The companion to Vega is steady with 5 in. on a night when ϵ Lyra is only just visible to the naked eye and ϵ Lyra, both pairs are separated with 120. I do not know if my failures are sufficiently accounted for by my position, the air being generally boiling and seldom steady enough for 200. I should much like a look through some other instrument of approximate size, if I knew anyone who would oblige me so far. I consider a telescope of any power in London is an apparatus for observing the unsteadiness of the atmosphere rather than anything else. Is it possible that with a power of 300 the satellites of Jupiter are visible as discs? They appear minute discs to me.

Edwin Holmes.

GRINDING AND POLISHING GLASS SPECULA.

[19362].—I WILL suppose that the concave surface is roughed out, and that the speculum is "up" to within $\frac{1}{16}$ in. of the edge, which marginal ring will come up in the truing process, which I will describe. But it is well to make a bruiser: procure a 3 in. circle of ordinary plate-glass; cement a convenient lump of wood on one side with pitch, and rough this out the same way as the speculum. It will now be necessary to separate the used emery; stir this well up, breaking all lumps if it is lumpy; and strain through a piece of strong muslin distended drum-head fashion over a large jar. Two jars of equal size are best. Quantity of water unlimited in this process. When the emery is all strained through, stir well up, and divide equally between the two vessels, and fill nearly full, so that there is room for the hand and arm to stir up without running the water over the top. Let these settle for one hour, then pour the water off the top gently to within an inch or so of the emery visible at the bottom of the jars. Repeat this, stirring up each time and filling with water, until the dirty yellow appearance of the standing water is gone, and it looks a nice chocolate colour. This will show when all the glass is floated away. When this point is arrived at, put all together in one jar, stir well up and quickly; before subsidence, pour off, leaving a small quantity of coarse emery at the bottom; wash this out and put in a smaller jar. Repeat this three times, pouring quicker each time. All the emery settled in these three pourings will do for one size, and will not be required for the speculum in hand. Now for No. 1 truing. Be sure to wash all the coarse emery out of your jar, stir up as before, and let stand about ten seconds, repeat this twice, adding and mixing what settles down. Call this 1. Repeat in all ways, except standing time for No. 2; let this stand 30 seconds. No. 3 the same, except standing time; this must stand two minutes after subsidence. I presume there will be very little of this; but if it is carefully got will be enough for truing a 12 in. speculum, supposing that size has been ground and edged.

The truing process is a repetition of the former process, only that the surface must be well "bottomed," all the coarse holes left by the roughing out must be got out with No. 1. The holes of No. 1 got out by No. 2, and so on. Ten minutes is long enough to rub down the truing emery's up to three, which may be doubled. That is, when it has been worked 10 minutes, wipe the tool very clean with a wet sponge, place the speculum on quickly while the tool is wet, and rub down again the emery that remained on the speculum: the speculum of course would not be wiped. To

ease the grinding with L, after No. 3, do not sprinkle with water, but spray a little spittle through the lips over the exposed part of the tool as you move the speculum from you. This is very essential, water causing the surface to "bite." The speculum should, in No. 3, "float" over the tool until the emery is very black, when it bites a little and should come off. Slide the speculum off towards you, holding one hand under the surface to prevent accident. Three "wets" of each sort of truing emery is generally enough; after each "wet," it is essential to wipe tool and glass perfectly clean, but not dry; this must be attended to through the smoothing process as well. When the speculum is trued up it should present one uniform appearance of fine grain. A good test is to hold it in the direct sunlight, when any holes not seen by ordinary light are shown up. Attention to details in truing is time saved in smoothing. The tools should be ground up with No. 3 now, rubbed down black, and unless the operator can get round the post or bench, the tool should be frequently turned round. The tools, when ready for smoothing, should be perfectly black, as though they had been bronzed by chemical action, and should be considerably reflective; so that by measuring the solar focus of the concave tool the length of the speculum focus may be known, and the mount correctly arranged in the mean time. I will describe the bulb and candle test, if possible, in my next; also proceed with the smoothing. Will H. A. Wassell fully give us "Foucault"? I use it, but I think I have unwittingly modified it. The book I read it in was foggy about it. I use it for testing prism surfaces, according to my light, and find it effective. Prismatique.

THE FUNICULAR POLYGON.

[19363].—THERE is a question of some interest connected with this, which I shall presently offer to the consideration of "our" readers, and shall ask their opinion about it. In the mean time, I may state that the problem of finding the position of equilibrium when there are two weights attached to the cord resolves itself into this: "To construct a trapezium: given the four sides, and the segments into which a line drawn perpendicular to the base from the point where two opposite sides produced meet each other, divides the fourth side." For the condition of equilibrium is that the line so drawn shall pass through the centre of gravity of the weights.

Let AB be the extremities of the chord, C and D the points of suspension. Let AC = a, BD = b, CD = c, AB = d. Join BC, then BC² = a² + b² - 2ab cos. A = b² + c² - 2bc cos. D, or cos. D = $\frac{a^2 + b^2 - c^2}{2ab}$. Suppose (1)

In like manner cos. C = $\frac{a^2 + b^2 - c^2}{2ab}$. Suppose (2)

Let γ be the angle which CD produced makes with AB. Then, since AB is made up of the projections of these sides upon it, we have a cos. A + b cos. B + c cos. γ = d (3)

But cos. γ = cos. A + c = a cos. C - sin. A sin. C = cos. A cos. C - $\sqrt{1 - \cos^2 A} \sqrt{1 - \cos^2 C}$.

Let cos. A = x, cos. B = y, and put for cos. C $p + qy$, and we shall have, after clearing of radicals, an equation of the form $py^2 + qy + s = x^2$ (4), where p and q contain powers of y lower than the third.

Also if E be the point where the sides produced meet, and K the point where the perpendicular meets CD, we shall find from the triangles whose verticals are at E, $\frac{CK}{DK} = \frac{\cos. A \sin. D}{\cos. B \sin. C} =$

$\frac{h}{k}$ suppose $\therefore h \cos. A \sin. D = k \cos. B \sin. C$, $h^2 \cos^2 A (1 - \cos^2 D) = k^2 \cos^2 B (1 - \cos^2 C)$.

Put for cos. D its value from 1 and for cos. C, &c., and cos. A = x, we get at equation of the form $ay^4 + by^3 + cy^2 + dy + e = x^2$, $x^2 + \beta, x^2 + \gamma, x^2 + \mu$ suppose. If, now, we eliminate y between these, we get an equation of the 12th degree. The elimination is not difficult; however, I have not sent the result. It will suffice to show that it is of this degree, which may be done very simply, thus:

Suppose p to be 0 in (4), we have $y = \frac{x^2 - s}{p}$, which

if put for y in the equation last found, gives an equation of the 12th degree, and it would not have been lower, nor can it be higher, than this if we had taken the complete equation 4.

"E. E. B." however, gives an equation of only the 6th degree. I am able to follow him quite well till he gets to the two equations of projection. These are easily seen to be true; but on trying to make use of them I make the final equation to rise to still higher dimensions than the 12th.

What I would now invite his and others of your correspondents' attention to is this: the equation for determining cos. A has evidently one real root; but as it is an equation of an even number of dimensions, it must also have a second real root. Now, what is the meaning of this? It must certainly mean one of two things—either that there are two possible forms of equilibrium, or else that the equation has two equal roots. It must be the latter.

ing hills, he almost stands upon the pedals, and merely leans against the seat, and the line of thrust approaches more nearly to the perpendicular than I have drawn it.

I omitted to state the more that pressure is applied to the pedals the greater is the tendency of the seat to rise, and throw rider more over his work.

The flat bars upon which the cushion-substitute rests are made of steel.

Will "Sunlight" kindly explain the mechanism by which double driving is attained in the "National," of which he speaks so highly?

I do not understand "Sunlight's" reasons for stating that the seat in a front-steerer must be placed behind a vertical line drawn through driving-axle.

Is it not a fact that in several front-steerers of merit—e.g., the "Perfection," "Centaur," and "Omnicycle"—the seat is in front of the axle, and that these machines require no safety back-stay?

"Sunlight's" opinions upon sizes of driving-wheels appear to be very undecided. In 19173 he argues strongly in favour of small wheels geared-up. In 19239 he appears to incline to my view, that medium-sized ones, geared level, are best for general purposes; and now (19333) he seems to be veering round to the opinion that "a large wheel speeded down gives a very fine-looking machine, and one easy to ride—far more so than the level-gear machine." What next?

Oct. 22. W. H. Stacpoole Westropp.

SMALL CHAIN-WHEELS FOR TRICYCLES.

[19357.]—I CRAVE a little space to answer my critics. First as regards the pressure on the bearing of driving-wheel from an undue tension or pull on the driving-chain. It will be remembered I was supposing circumstances giving a 400lb. pull—viz., a 100lb. pressure on crank, and a ratio of 1 to 4 between crank and chain-wheel. "D. H. G." forgets that there must be an abutment to withstand this pressure. The abutment is the framework of tricycle, by means of which a powerful *spring* pressure is conveyed to the bearing of driving-wheel, which, in the case mentioned, would be 300lb., and far exceed the weight of an average rider pressing the bearing downwards, especially as 100lb. of his weight is supposed at the moment (say, at starting) to be on the pedal. The case supposed is an extreme one, and I am quite willing to waive the question of friction on this bearing, and even to suppose it eliminated as "Paugul" suggests (end of 19302, p. 134). There still remain the following disadvantages attending the 3in. as against 6in. chain-wheels:—1. Double double strain on chain, necessitating greater strength. 2. Double strain on chain-wheel teeth, and only half the number of teeth taking it; quadruple strain per tooth, both crank and driving-wheels. 3. Double back-pressure on crank axle-bearings, which means double friction, the number of revolutions being always the same, and if their thickness is as it should be, increased, it means still greater friction. 4. Double strain on chain means that double friction will occur in bending it through the same angle. But it must be bent through twice the former angle—ergo, with quadrupled friction. However, as only half the former number of links will pass over for each turn of crank, we must halve this result and say only double friction for bending chain. 5. As regards friction between chain and teeth, it is not easy to predicate any exact statement, but clearly a quadruple strain per tooth (see above, combined with a double angle between teeth (supposing teeth same size as in the larger wheel, must make the friction at least double on these grounds; while the fact of only half the number of teeth passing can only halve it; so, if we cry quits on this point (generous on my part), I have still a long balance in my favour.

There is nothing to be said against taking one point—viz., that of full power of crank, for the purpose of making a comparison of this sort. To do otherwise would render the problem complex. At present it is simple. What holds good at one point would hold good, as regards the comparison, at any other point in the travel of the crank. The ratio of the strains would still be equal, though the amount was quite altered; and, therefore, the ratio of the total strains of a full revolution would still be equal.

Supposing I admit with "Paugul" that an increase or decrease of the number of teeth that pass, and consequent friction, is exactly balanced by a corresponding decrease of pressure, I have still in my favour the more unfavourable angle at which the teeth engage the double friction due to bending of chain (see 4 above), the double back-pressure on crank axle-bearings, and the double strain everywhere.

Though I shake hands with "Sunlight" over the chain-wheels, I can not see what he means by greater rotary force or momentum in a small than in a large wheel. The number of revolutions will be greater; but the weight in motion will be less, and the distances of corresponding parts of wheel

from centre less in the same proportion. This last just nullifies the greater number of revolutions, and renders the absolute velocity of corresponding parts exactly the same, e.g., absolute velocity of centre, say, ten miles in each case, that of the machine itself. Point touching ground is at rest. Top of wheel is travelling double or 20 miles an hour in each case, and the average velocity of rim is ten miles in each case, just the same as if they were revolving with equal peripheral speeds suspended in air. The advantage, therefore, as regards momentum, is only in weight, and remains with the large wheel, as also does its easier running over obstacles. Anything which appears to contradict this must be due to some other cause.

Has no one, amongst our readers, seen, heard of, or tried the Otto Safety Bicycle? It seems to me a very quick trotter, and a first-rate ladies' horse.

ADJUSTMENT OF MIRRORS.

[19358.]—THE problem at present under consideration is one on which theoretical and practical men may with advantage join their forces for its complete elucidation. The mathematics of amateurs and the rule-of-thumb practice of the shop, if brought into unison, would both gain a good deal.

It is pleasing to find that T. Westlake does not intend to desert the problem he has opened.

"A. J. S." in letter 19278, has well pointed out that the exact adjustment of the flat is as necessary as its fine optic surface and figure. It must be placed exactly at 45° with the axis of the cone of rays from the mirror, and whatever alteration is needed in its position must be obtained by moving the whole flat bodily, and not by tilting it on its support.

T. Westlake is rather difficult to follow in letter 19301, where he says "if the eye draw-tube is taken out altogether." This appears only to apply to the form of eyepiece which has been figured and described by "A. J. S." in these columns, and has given great satisfaction to those who have tried it. What does he mean by saying there is no point where the rays meet? Surely the essential principle of the telescope is that rays are brought to a focus?

—If we look through the concave lens of the "A. J. S." eyepiece, we get the same result given by looking at the flat from a considerable distance; if we look at the flat with our eye near the focus, we notice, by a curious optical illusion, a different appearance altogether; and what was a central adjustment in one case appears eccentric in another. T. Westlake cannot clear this up by involving it in a cloud of words, like his distinction between mechanical and optical adjustments.

What are optical adjustments but a means of perfecting that which we have mechanically adjusted as nearly as possible?

In the adjustment numbered (2) "T. W." does not say how we are to adjust the flat. Tilting is obviously inadmissible. Did "T. W." ever adjust a mirror and flat?

In the next paragraph (which deserves to be framed and glazed as a specimen of the utter irrelevancy of "now's" and "therefore's") we are tempted to ask whether the cone makes the angles or the angles make the cone.

Is "T. W." sure that, as stated in his second paragraph, the diagram previously given shows eyepiece, flat, mirror, and reflection of flat in mirror, all concentric? And is this the case when viewed at arm's length through a concave, or seen from close to?

Floni Almondi.

THE ORGAN.

[19359.]—If "L. R. D." letter 19312, will refer to the "Musical Standard," Vol. III., No. 70, May 1885; also to No. for July 30, 1881; and to ENGLISH MECHANIC, Vol. IX., p. 549, he will find that I have anticipated the inventions for opening the swells of organs by pressure of the back and the double sharps of the pedals, by about thirty years.

N. S. Heinzen.

ELEMENTARY MATHEMATICAL OPTICS.—X.

Aberration (continued).

[19360.]—I MUST now return to the simplification of the focal equation containing the correction for spherical error. By referring to eqn. (8), page 68, Vol. XXXIII., it will be seen that the expression for the aberration value is long and intricate; and unless it can by some means be very much simplified, the computation of the small quantity required would be a very laborious task. Coddington employs the following simple and elegant method, by which the equation is at once rendered suitable for calculation. It will be noticed that the equation contains two pairs of reciprocals—those of the conjugate foci and those of the radii. These four terms can be represented by two, and the equation put in a quadratic form by the subjoined artifice.

Considered with reference to the conjugate foci, we have:

$$\frac{1}{d} + \frac{1}{F} = \frac{1}{\phi}. \quad \text{Let } \frac{1}{d} = \frac{1+a}{2\phi}, \text{ then } \frac{1}{F} = \frac{1-a}{2\phi}. \quad \text{Then } a \text{ takes the place of } d \text{ and } F.$$

Secondly, with reference to the radii, we have:

$$\frac{1}{r} + \frac{1}{s} = \frac{1}{\phi(\mu-1)}. \quad \text{Let } \frac{1}{r} = \frac{1+x}{2\phi(\mu-1)}, \text{ then } \frac{1}{s} = \frac{1-x}{2\phi(\mu-1)}.$$

Thus x takes the place of r and s . $\frac{1-a}{2\phi(\mu-1)}$, which gives $a = \frac{F-d}{F+d}$. Similarly $x = \frac{s-r}{s+r}$.

If the conjugate foci be equidistant from the lens $a = 0$, and if the incident rays be parallel, $s = -1$.

If the lens be equi-convex, $x = 0$, and if the first surface is a plane $x = -1$. In the first place, we will substitute these values in the expression for the correction due to thickness. By reference to section VII., page 359, the variation of the reciprocal of f is $\frac{\mu^2}{f^2} = \frac{t}{\mu} \left(\frac{\mu-1}{r} - \frac{1}{a} \right)$, since $\frac{1}{f} = \left(\frac{\mu-1}{\mu r} - \frac{1}{\mu d} \right)$. Substituting for r and d , we have $\frac{t}{\mu} \left(\frac{x-a}{\phi} \right)$. To obtain the real value of the correction, we must of course multiply this expression by F^2 .

We must next take the expression for the correction for aberration, and by similar substitutions, the final equation is:—

$$\frac{1}{\mu(\mu-1)} \left\{ \frac{\mu+2}{\mu-1} x^2 + 4(\mu+1)ax + (3\mu+2)(\mu-1)a^2 + \frac{\mu^3}{\mu-1} \right\} \frac{y^2}{8\phi^2} \dots (9).$$

Representing by A the coefficient of $\frac{y^2}{8\phi^2}$, and by

B , that of $\frac{y^2}{8\phi^2}$, the complete expression for the focal length becomes:—

$$\frac{1}{d} + \frac{1}{F} = \frac{1}{\phi} + A \cdot \frac{t}{4\phi^2} + B \cdot \frac{y^2}{8\phi^2}. \quad \text{And the correction for thickness is } -\frac{A \cdot t}{4} \cdot \frac{F^2}{\phi^2}, \text{ and for}$$

aberration $-\frac{B}{8} \cdot \frac{F^3}{\phi^2} \cdot \frac{y^2}{\phi^2}$. With regard to the last factor, it has been shown in a previous article that when $\mu = 1.5$, the thickness of the lens is $\frac{y^2}{\phi}$; so that in general, both corrections

may be expressed in terms of t ; or $-t \left(\frac{A}{4} + \frac{B}{8} \right)$.

F^2 . For parallel rays, F and ϕ are equal, which still further simplifies the expression.

In section VIII. it has been shown that the greatest concentration of light takes place on a plane situated in front of the first approximate focal point, at a distance equal to $\frac{1}{2}$ of the aberration; and that the diameter of the luminous disc is $\frac{1}{2}$ the lateral aberration. Therefore, the diameter of the circle of least confusion from the first approximate value of ϕ is $-t \left(\frac{A}{4} + \frac{3}{32} \cdot \frac{B}{\phi} \right) \cdot \frac{F^2}{\phi^2}$.

and its diameter is $\frac{B F^3}{16 \phi^2} \cdot \frac{y^2}{\phi^2}$.

Some general results may be obtained from eqn. (9) before it is put in its proper numerical form. First, by differentiation, we find that its value is a minimum when $x = \frac{-2(\mu+1)(\mu-1)a}{\mu+2}$. Also,

it appears that for certain values of a and x , the equation may be reduced to zero: thus showing that in some cases a single lens may be aplanatic. It is evident that the first and third terms will always be positive, whatever may be the signs of a and x , for the square of a negative quantity is positive; but the second term is negative if either x or a be so. If, therefore, the equation can be reduced to zero, the second term must equal the sum of the other three.

To render this possible, both a and x must have considerable values, and one of them must be negative. If x be $-$ and a be $+$ the second radius s must be negative; that is, the lens must be a deep meniscus, and the first conjugate focus d , must be on the same side as F , that is, converging rays must fall on the lens. If we reverse these, making x $+$ and a $-$, we must have a diverging pencil, incident on a deep concavo-convex lens.

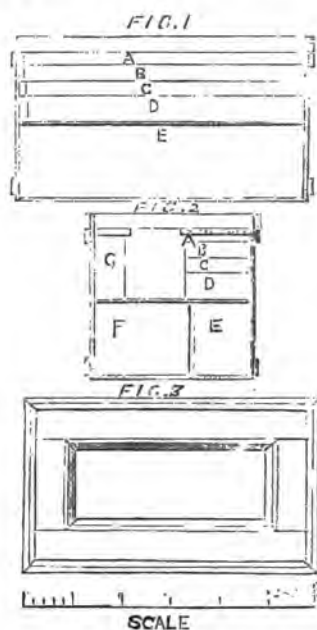
There is another point worthy of notice: if we solve the quadratic equation with respect to x , we obtain two values of x for one of a : or if we solve with respect to a , we obtain two values of a for one of x . This indicates that generally two ratios of curvature can be free from aberration for the same conjugate foci, or conversely, that the same lens can generally be aplanatic for two positions of the conjugate foci. I believe this is Mr. Lister's law of the aplanatic foci, as it was discovered exper-

a steady light, should be placed, and then have a thin metal chimney, say, 12in. high, put round the glass one. In the metal chimney make two holes exactly opposite the bright and clear part of the flame; one hole, to act as a "finder" to the other, may be made by a very fine bradawl; the other, which is the testing light, is to be on the same horizontal line, but quite a quarter of an inch away, and can be made by scraping the metal thin and driving just the point of the finest steel needle through it, placing the thin part on a smooth block of lead or hard wood. Next take a strip of sheet tin or zinc lin. by 8in., make both long edges straight and parallel, and stick it upright in a small block of wood smooth on the bottom surface—this strip forms the cutting-off screen. Let the flat of the flame, the two holes, and the observer, face the mirror exactly, put the lamp on the right hand on a table, close to the right cheek, place the cutting-off screen against the chimney just in front of the right eye. The lighted lamp and mirror must be so adjusted as regards each other that, on using the candle test before mentioned, when the candle is just in front of the two holes and the right eye placed against the chimney, the mirror shall be entirely illuminated; shifting them gradually will effect it, and great pains should be taken with this in the later stages of one's work, as it is an important point, the best results being obtained when the reflected rays come to a focus on the same line as, and as close as possible to, the original source of light. Now extinguish the candle, and on stepping forward, about half-way between the lamp and mirror, a small, bright star should be seen in the latter if you do not hide it by getting in the line of sight. Step gently backwards to the lamp, keeping the star in the centre of the mirror; you will soon learn the adjustment necessary. When this is perfect, first find the illumination from the larger hole and gently shift the eye till you perceive the paler light from the small hole; then draw the cutting-off screen very gently across the pupil of the right eye in the direction from the right eye towards the nose, and a shadow will, at the same time, appear to pass across the face of the mirror. If this shadow appear on the edge of the mirror opposite the left eye, the screen and lamp are probably too far off, unless the mirror be what is termed "spheroidal." There is one point where the bulk of the rays cross, and where putting the screen forwards or backwards a $\frac{1}{2}$ in. or less will cause the first appearance of the shadow to change sides. Now just in advance of this point (nearer the mirror) is the proper place to put the screen to ascertain the true figure. Perhaps you may know that the apparent shadow is caused by the screen intercepting the rays of light from that part of the mirror which appears darkened, and thus preventing them from entering the eye. I can only recommend you to persevere, and try again and again as I have done, and you will gradually master it as you become more experienced. I have a lot of MS. and diagrams which I will lend you on the terms proposed at page 111 by "Cotswold," to whom I should feel greatly obliged for the loan of his when I advertise. You should also obtain No. 780 for the sake of Mr. Bell's diagrams, as a kind of index to the shadows. This is a long letter; but I trust the Editor will excuse it, as no detailed account has appeared in the "E.M." for more than eleven years at least, and the subject is very interesting, but very puzzling to beginners. I will just explain one plan I adopted to find the exact place on the mirror of a faulty zone or ring. Take a strip of thin blue paper, in length equal to three-eighths of the mirror's diameter, cut coarse triangular teeth on one long edge, the points a half-inch apart, wet it slightly, and stick it horizontally on the mirror, commencing at the edge, but leaving the centre free from paper. Be careful to do this about half an hour previous to testing, if possible. When a hyperbolic or other shadow appears, you can count the points from the end.—J. C. L.

[44979].—**Brass Springs.**—Brass spiral springs are made out of hard-drawn brass wire of the required size, coiled around a mandril slightly smaller than the intended diameter of the spring. Flat springs are made out of strips of brass made hard by hammering. Both the wire and the sheet are sold by makers of electrical instruments.—EDWIN.

[44980].—**Carpenter's Tool - Chest.**—In answer to "Woodenhead," I send sketch of carpenter's tool-chest: The ordinary size is, length, 3ft.; width, 1ft. 8in.; height, 1ft. 8in. Fig. 1 is front section, showing drawers and other compartments; Fig. 2 is end section, showing drawers and other divisions. The first drawer A is 1 $\frac{1}{2}$ in. deep, B 2in., C 2in., D 3in. deep; E is 10in. deep, and is used for holding beads, casements, &c., to stand endwise; F is for holding anything, a sliding piece of wood $\frac{1}{2}$ in. thick is placed for a lid; G is for holding saws, and is made $\frac{1}{2}$ in. wide, the lids for drawers are $\frac{1}{2}$ in. thick, and are better clamped. The runners for drawers are oak, each one being $\frac{1}{2}$ in. thicker than the other. Fig. 3 shows the lid of chest, it being clamped; a moulding is planted round the inside of lid as shown. The carcase should be lin. wood, plinth round bottom $\frac{1}{2}$ in.

thick and $\frac{1}{2}$ in. wide, capping round top 2in. wide $\frac{1}{2}$ in. thick, and is kept down $\frac{1}{2}$ in., the capping on lid being kept down $\frac{1}{2}$ in. to correspond. If I have



not made it plain enough, I shall be glad to give further information if asked.—TARNASH.

[44981].—**Chemical Analysis.**—For silica, the method I adopt is somewhat different to that employed by a "Self-taught Countryman." I take a portion of the ironstone, weigh it, and heat it in H gas until no more water ceases to be evolved; the iron so reduced easily dissolves in strong HCl. I then evaporate to dryness, and saturate the residue with HCl, apply heat, dilute with H₂O, and, when settled, filter into a suitable flask; the residue in a dish is again heated with H₂O, allowed to settle, and the clear liquid poured through the filter, repeating the process until all the silicious residue appears quite white, and free from Fe, then wash with H₂O, which should be distilled. I then proceed to determine the amount of Si in the usual way. Titanic acid is sometimes present, and requires separating. (a) You don't want to reduce it: you want to dry it, and before you can do this you must remove any organic matter that may be present, and for this purpose you must add to the alkaline solution a few crystals of KClO₄, then concentrate in a porcelain basin, add NH₃ in slight excess, boil until turmeric paper is no longer turned brown, filter, dry, ignite over blowpipe in platinum-crucible, gently, then, with the lid on, to bright redness. To explain fully all that "A Self-taught Countryman" wants to know, would occupy far too much of our valuable space; there are plenty of books that might be profitably consulted, such as Valentin's "Qualitative Analysis," Fresenius, Thorpe and Muir, Jones, &c. I notice also, some rather curious symbols, such as CaOX, which I suppose means CaC₂O₄, calcic oxalate, and KMnO₄, which should be K₂Mn₂O₈, potassic permanganate.—G. H. WILKINSON.

[44981].—**Chemical Analysis.**—(a) The only way of reducing an iron alumina precipitate to smaller bulk is to evaporate to dryness after adding the ammonia, and heat the residue so as to drive off the water contained in the precipitated hydrates. On redissolving in warm water, the iron and alumina will be left in a granular condition, and may be washed on the filter with rapidity and ease. (b) By titrating the calcium oxalate at 120° F. or over it, with addition of a little sulphuric acid, the end of the reaction should be perfectly sharp and distinct. If the quantity of precipitate be not great, ignition at a bright red heat for fifteen minutes will thoroughly convert it into CaO. As a check, it may be drenched with sulphuric acid, ignited moderately, and weighed as CaSO₄. The only method of insuring its complete conversion into carbonate is to drench after over-ignition with strong solution of ammonic carbonate; evaporate very gently to avoid spitting, and drive off the excess of Am₂CO₃ by carefully heating to a temperature just short of redness. Adding a small piece of solid ammonic carbonate and then slowly volatilising it with the crucible covered, would be a more speedy method, and probably as efficacious. (c) Any precipitate obtained here must arise from impurity in reagents, or be dissolved out from the dishes used in evaporation. It has no business there, and should not be added to the weight of the first ammonia precipitate. (d) Have your solutions warm, with a considerable

excess of ammonia and sal-ammoniac, and shake vigorously. If this does not make your precipitate crystalline, there is something radically wrong somewhere.—DUNROD.

[44981].—**Analysis of Minerals.**—It seems the "Self-Taught Countryman" does not understand the analysis, and I will, therefore, make a few remarks as to his errors. 1st. It is not necessary to alter the modification of Al₂O₃ since very accurate results are attainable in the gelatinous form. 2nd. Perhaps he takes too large a quantity of the mineral, and, therefore, gets such a quantity of Al₂O₃ that it cannot be properly washed. 3rd. It is not necessary to boil the Fe and Al to expel the NH₃, since the solution will have to be rendered alkaline before precipitating the lime. 4th. You evidently do not add an excess of NH₃; that is why you get a little Fe and Al precipitated. I should, therefore, advise you to proceed as follows:—Take a portion of the mineral, and, having first pulverised it in an ordinary mortar (if possible), and, finally, in an agate one, weigh accurately 2 grammes into a porcelain crucible, and add 4 grammes of fusion mixture, made by mixing together 53 grammes of Na₂CO₃ and 69 of K₂CO₃. It is heated for some time over a good Bunsen burner till the whole is in tranquil fusion, when it is allowed to cool; put into a beaker with about 30cc. of water, and HCl gradually added, and, covered with a glass plate to prevent the loss of drops occasioned by the escaping CO₂, which are afterwards to be returned to the beaker along with the washings of the crucible. The contents are finally heated to expel the remaining CO₂, evaporated to dryness, gently ignited to 220° F., moistened with HCl and water, washed into a beaker; allow to stand for half an hour; and filter: the white precipitate is silicic acid; ignite strongly, and weigh. To the filtrate add NH₄Cl; this, however, is not necessary if the solution is very acid; then ammonia in excess, and collect the Fe and Al₂O₃, thoroughly wash, ignite, and weigh. The iron may be estimated by two methods: 1st. By permanganate of potash or by boiling the Fe and Al₂O₃, after having weighed in potash; this dissolves out the Al₂O₃, consequently the loss is Al₂O₃; or if NH₄Cl is added to the potash solution the Al₂O₃ is precipitated in the hydrated state. To the filtrate, which, if it is not alkaline, is rendered so, add an excess of NH₄OH, collect the precipitate of oxalate of lime, ignite at a low heat, and weigh as CaCO₃, or it may be heated before the blowpipe, and weighed as CaO (lime). The latter method is very well where the precipitate does not exceed a few milligrammes; but when $\frac{1}{2}$ of a gramme is reached it is better to weigh in the state of carbonate. In the latter case, to make sure no CO₂ has been expelled, add a little (NH₄)₂CO₃, dry and ignite gently, and again weigh. If no CO₂ has been expelled, the precipitate will be neutral. Evaporate the filtrate to dryness with a little HNO₃, ignite gently to volatilise the NH₄Cl, dissolve the fused mass in a little water, add NH₃, then phosphate of soda in excess; allow to stand for twelve hours; filter, wash, ignite, and weigh as pyrophosphate of magnesia. Should you not succeed, I shall be glad to give you any information.—J. C. BELCHER.

[44982].—**Rope-Driving.**—There is an article on this subject on p. 425, Vol. XXV.—NUN. DOB.

[44983].—**Mineral-Oil Stoves.**—I have recently inspected a system of heating small greenhouses, halls of mansions, offices, and private apartments, which promises to be most economical and free from objectionable fumes. The products of combustion are mixed with a small quantity of steam, and are made to pass through an iron flue passing through the greenhouse, or made into an ornamental coil for an apartment, before they are passed into the open air. The most objectionable fumes seem to be taken up by the steam, and condensed with it, for oil or gas can be burned in the apparatus without giving out bad smells. The system is patented, but the maker and patentee is selling the apparatus at a low price. I send his address for insertion under "Addresses" in the "Sixpenny Sale Column."—EDWIN.

[44984].—**Sulpho-Carbonate.**—This is made by shaking up a solution of sulphide of sodium with bisulphide of carbon, and on a small scale is the simplest operation possible. The difficulty is either to make or buy the sodium sulphide at a moderate cost, as it is a most troublesome thing to manufacture in large quantities, and would never pay the erection of special plant for its production. It is not a commercial article, and as far as I know, there is only one English firm who make it a spécialité. If "Italy" will advertise his address, I will send him particulars, or refer him to the firm mentioned, who will give him every information as to cost, &c.—DUNROD.

[44985].—**Gas-Fire in Bedroom.**—See my reply to 44983. I may add here that the inventor of the apparatus is constructing a splendid gas-stove heated by his system, which will be shown at the forthcoming Smoke Abatement Exhibition at South Kensington.—EDWIN.

it is easy to see that the cut-off point may be much earlier, if we want a final pressure of 3lb. only, than if we have to provide for back-pressure of 15lb. This means, of course, less steam at the same pressure with a diminished consumption of coal. Unfortunately, there are many other points of consideration, such as condensation, and these tend to reduce our theoretical pressure at the end of the stroke, so that when we ought to have, say, 15lb. in the case of a high-pressure engine, owing to condensation, &c., we find by the indicator that it is, for instance, but 12lb. In such case the valve requires to be shifted, so that the admission be slightly longer, so that we obtain, in spite of condensation, our required pressure. When the case of a compound engine is taken, the pressure of the steam on the low-pressure piston is supposed to be the back-pressure against the high-pressure one. On these questions the data given in a mere query are such that I should not care to hazard a positive statement without carefully considering indicator diagrams. In your case, are the narrow parts of the high-pressure engine amply strong enough to stand the increase of pressure you propose? It is a serious matter to more than double the pressure on the piston. It is true that, if it were practicable, then you might naturally count on a reduction of the coal burnt; and, further still, it would enable the pressures throughout to be so varied that mere work could be done. But I would not advise on such a matter until after full particulars of the engine and being fully satisfied that the plan was safe. In other words, I do not care to try the advice of the genius of Ballycarron, who, desiring to get more power out of a portable engine, recommended a pulley half the existing size to be fitted to the crank-shaft, with the addition of a couple of pothooks or so being hung in the blast-pipe to reduce the area of the blast-nozzle, and then drive the engine at double the speed. This, stated the oracle, would double the power; but he forgot it would also quickly destroy the engine at the same time.—SUNLIGHT.

[45042].—Burning China Paintings.—Your best course to pursue is to purchase a Fletcher's muffle furnace. It would in the long run be far better than attempting to construct one, and would cost you less. His draught furnace is one of the best things you could possibly get for the purpose. To erect a small kiln would cost more money, and then, being built on a different system, would need skilled attention to manage it.—SUNLIGHT.

[45042].—Burning China Paintings.—If "Artist's Colourman" will purchase an old cast-iron oven, as strong a one as he can get, and build it so that the fire will make it red-hot as equally as possible, he will then have a small enamel kiln that I think would suit him if he has only a few small articles to "fire"; if he wants a larger kiln, it would have to be specially constructed of firebrick, and kilns of this description are expensive.—J. N. O.

[45043].—Photography.—If I were going to fit up a motion for a camera I should prefer the rack-and-pinion form. My reason is that the screw motion is very slow in focusing, whilst the rack is quite good enough for the fine adjustment necessary, and works far quicker than the screw. In addition, it is easier to fit. In the case you mention the rack should be let in flush with the base-board on each side near the edge, the hinges going between. These must have their centre line exactly to correspond with the upper surface of the base-board, or it will not allow of folding up properly. The pinion is simply a piece of pinion-wire cut to length, and parts of it turned off in the centre, to clear the knuckles of the hinges, and also for the bearings. The base-board is easiest made rigid when in use by fitting two sliding-pieces inside the framework, to slip into the fore part when the camera is in use. I am afraid you have started your camera-making without fully seeing your way through each detail, and therefore it will be somewhat difficult most likely to design an easy way of bringing in existing parts. The horizontal swing-back you have, you say, made. Well, the vertical is best fitted as the American cameras are; that is, the bottom of the back end is carried on a pivot, which is in turn bored in by the actual sliding base; and this, if the tail-piece is made right, would slide between the bars, so that anything like increasing the height is avoided. This motion need not be much. By "reversing" frame do you not mean "focusing-frame"? Well, that may be made in several ways. But the most compact plan I know is that adopted by Messrs. Atkinson. The focus-slide is a frame of the size of the interior of the camera, and is allowed a motion to and fro equal to the thickness of the dark slide. In its normal position it is just right to focus with; but when the dark slide is inserted it is pushed down between the focusing-slide and the inside of the camera, the slide moving towards the back, and two light steel springs again throw it forward into the correct position for use, when the dark slide is again withdrawn. By this plan the focus-slide

cannot be thrown down and broken, as it is always inside the camera, and protected by the tail-board when travelling. Further particulars if desired.—SUNLIGHT.

[45044].—Oxy-Hydrogen Microscope.—The ordinary binocular microscope is perfectly useless unless you added to it costly lenses and arrangements similar to the plan used by Mr. Browning. The usual lantern microscope is simply a short focus objective, which, together with a stage to hold the slide, screws on to the place of the usual objective, the requirements being to place the slide very much farther forward on the cone of rays, where they will nearly all pass through the aperture of the slide. But, unfortunately, the placing of the ordinary micro. slide in that position places it just where the heat is intense, and therefore the slides are very likely to be damaged. Therefore, I would advise you to be careful, or you are likely to spoil good slides. What you require to show such is a modified form of lantern microscope as described and mentioned by me at p. 334, No. 794. Hence this defect has caused many lecturers to use what are termed photomicrographs, or photographs of minute bodies as seen through the microscope and photographed direct by it to fill a 3in. slide, and these are to be used just as ordinary views are, and need no alteration of the lantern lenses. I have a fine series of subjects of both kinds, and could possibly help the querist if he liked to advertise his address.—SUNLIGHT.

[45045].—Maps of the Moon.—These are not usually intended to represent the appearance of the feature of the moon's surface. They would not be maps if they did, but pictures. They only show the positions and sizes of the various objects. If your map is that of the entire surface, visible at full moon, you must just guess whereabouts the terminator would be on your map, and then try to identify the craters, &c. By this means you may be quite certain of the identity of an object, even though it may not much resemble the drawing in the map. I expect this, "Student's" chief difficulty, has been indicated in the first part of this reply.—PAULGUL.

[45045].—Maps of the Moon.—The map in Webb's "Celestial Objects" is not intended for an accurate drawing of the objects given, but merely an outline sufficient to identify them. The querist should first get Tycho, and one or two of the principal craters and the "seas" well into his mind. He will then soon learn to take bearings from these, and find any object wanted. If he will send his address to me, I shall be happy to lend him a little book which may help him to start. He will find in the "Scientific News" of No. 865 of the "E.M." a notice of a series of lunar maps, which I can highly recommend, if the rest are as good as the first.—JOHN B. SHIPLEY, Gas Works, Burnley.

[45046].—The "Rocket."—If you refer to the *Engineer* for October and November of 1879, you will find illustrations and description of this and other pioneer engines, under the heading of "Links in the History of the Locomotive Engine."—SUNLIGHT.

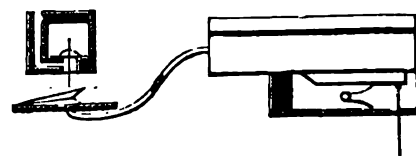
[45047].—Steam-Pipes.—I have heated several large rooms in the way you propose. You should fix a back-pressure valve close to the boiler, and let the returning steam pass through it into boiler again.—LABOR OMNIA VINCIT.

[45047].—Steam-Pipes.—Carry a pipe from the top of the dome of the steam-boiler (or the highest part if there be no dome), and the return-pipe to the bottom at the end nearest the chimney. No valves are required unless you want to send the current through two or more different channels, when you would want middle-valves to close one set and open the other range of water-pipes.—SUNLIGHT.

[45051].—Model Loco.—If "Novice" can refer to back numbers of the *MECHANIC* about December last, he will find instructions for making a boiler about the size he requires. A boiler of the dimensions given would drive a pair of 3in. by 1 1/2in. cylinders well, but the latter are rather small for 5 1/2in. wheels. I should use nothing less than 1in. by 1 1/2in. Also, 3in. from underside of boiler to ground is not sufficient if you intend to use wheels of the size given, as there is not enough space to clear the eccentrics; it should be at least 3 1/2in. If you cannot give more space than 3in., and you also wish to employ 1in. cylinders, I should advise you to reduce the size of driving-wheels to 5in., and then you will find it very close work.—E. L. P.

[45055].—Organ.—I do not well see how the action for both kinds of chests is to be combined; but a separate chest may be used for the front Open Diapason, and worked by a tube pneumatic action; the tube conveying the wind to the small pneumatic bellows is 3/4in. gas-piping. I inclose a sketch which shows the whole arrangement. I have lately enlarged two organs on this plan successfully. In one case it was a Bourdon added to

a manual chest where there was neither room nor wind sufficient. The pneumatic bellows should be about 4in. by 2in., and rise 1/4in. Where the pipe



are too close to allow the bellows room they may be arranged in two or three tiers; the gas-pipe may be led anywhere, and "C. W. S." can arrange his front as he likes, irrespective of the interior of the organ.—J. DZEMSK.

[45056].—Pumping.—You should have an air-vessel on the rising main of your pump, by all means. It will relieve the valves, and probably the engines; but unless you have some means of increasing the power of the engine, the air-vessel will not, itself, force the water any higher.—LABOR OMNIA VINCIT.

[45056].—Pumping.—The addition of an air-vessel close to the delivery-valve on the pump would not in any way assist you in forcing the water to a greater height, as that has nothing to do with such arrangement. The only question really is whether you have sufficient power to work the pump if the column of water on the delivery is increased in height. An air-vessel would only do good in providing an elastic buffer really to take away the shock of the column, and also in making the flow on the delivery more uniform.—SUNLIGHT.

[45060].—Fossil Birds in Delabole Slate.—If there is no doubt about the discovery of Mr. Charles Barrett, he is a fortunate man, and I should advise him to make his discovery known at the head-quarters of Geology, Jermyn-street, or authorities at the British Museum, who would take the subject up.—DIDYMOGRAPHS.

[45061].—Three-throw Pumps.—The data you supply are not quite clear. What do you mean by "a piston speed of 80ft. per minute?" Is each piston to make 80 strokes a minute, or, if double-acting pumps, 40 strokes; or what? Supposing you mean to use double-acting pumps, 12in. diameter by 24in. stroke, making 40 strokes a minute; these would each deliver, allowing for loss by leakage, &c., about 250 gallons per minute; the three, therefore, delivering 750 gallons, which is more than you want. To raise 670 gallons per minute, the pumps must make 34 strokes per minute. The three-throw crank will therefore make 17 revolutions per minute. As to power, theoretically the horse-power of engine would be $670 \times 100 \times 10 = 670,000$. As this does not allow for

friction in the pumps and engine, I should not use an engine of less than 25 h.p. An engine with 7in. cylinder, 15in. stroke, cutting off at half-stroke, and making 170 revolutions per minute, should do this with a boiler-pressure of 70lb. This allows for a loss of 10lb. pressure between boiler and engine. The engine-shaft making 170 revolutions per minute, and the pump-shaft only 17 revolutions in the same time, gear-wheels will be required to drive the latter at the proper speed.—GLATTON.

[45064].—Finding the Moon's Position.—As our friend seems to have the *Nautical Almanac*, he can easily get the moon's R.A. for the times given; then he can find the difference in R.A. of the moon and sun; then finding the position of the sun at the time, he can easily find the moon's position. Thus, on Dec. 6, 1881, at 5.13 p.m., the moon has 12h. less R.A. than the sun, and as the sun is 5h. 13m. west of Greenwich, the moon is 6h. 47m. east of Greenwich, or on the Meridian in longitude 102° East, i.e., in Siam and the Malay Peninsula. I see I have not allowed for the equation of time, which will bring it to about 99° East—the longitude of Tenasserim. If the querist looks at p. 401, *Nautical Almanac*, 1881, he will find his question answered, for in the middle of the eclipse, at 5h. 8' 3m., the moon is in the zenith in East long. 100° 42', lat. 22° 10' N.—PLOWY ALMONY.

[45065].—Microscopical Test for Silk.—Silk, under the microscope, is quite amorphous, whereas cotton, wool, and other fibres show cellular structure. I should fray out a few threads of the fabric suspected, untwist same, put them in a little clean water, and examine by transmitted light; if you are not conversant with the structure of cotton, &c., &c., do the same by it, you will soon perceive the difference. A typical slide of each mounted permanently would assist you. I know of no chemical test; but this will be quite conclusive.—DIDYMOGRAPHS.

[45066].—Astronomical Question.—The pole of the heavens is the point in the zenith of the pole of the earth; as the querist will know, it is at 90°

530; a table for each minute may be found in some books on trigonometry.—J. BROWN, Belfast.

[45008].—**Resistance Coils.**—German silver varies so in its properties that it is quite impossible to give even approximate sizes and lengths. As to galvanometer, about the same resistance as the pile; therefore, a wire of good size, such as No. 18; but how easy it is, and how much more is to be learnt by just trying for oneself such little matters. All that is wanted is to wind a few turns of wire and watch the effect produced; then you know something; you ask and take the advised lengths, &c., and you have learnt nothing. Tables of natural tangents are to be found in almost every textbook of science or in every engineer's pocket-book, such as Molesworth's. If you obtain No. 283 of this paper you will find a table of tangents, also proportional values of degrees and of work, drawn up by myself.—SIGMA.

[45100].—**Cube Numbers.**—I believe there are tables of cube numbers published, but I know of no properties they possess except the following. A number ending in one or two ciphers cannot be a cube; there must be three ciphers, or a multiple of 3, or none at all. If a cube number ends in 1, its cube root ends in 1 also. If a number ends in 2, cube root ends in 8; number ends in 3, cube root in 7; number in 4, cube root in 4; number in 5, cube root in 5; number in 6, cube root in 6; number in 7, cube root in 3; number in 8, cube root in 2; number in 9, cube root in 9. To get cubes of any number from the cube of the next lower number, multiply the two numbers together, and the product by 3, add 1, and then add to the cube given. Thus, cube of 70 = 343,000; find cube of 71: $3 \times 70 \times 71 = 14,910$; add one more than this to the given cube, $343,000 + 14,911 = 357,911$, the cube of 71.—PLONI ALMONI.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

- Since our last N. W., Ealing, has replied to 4450; Elawick, 44678; Clatton, 44937, 44701.
44562. Question for Chemists or Others Acquainted with the Manufacture of Bread or Cake, p. 581.
44561. Perambulator, Folding, 581.
44564. Ferret, 581.
44514. Paper-Making, 581.
44518. Tangent Galvanometer, 582.
44536. Waterproof, 582.
44510. Getting on in the World, 582.
44543. Electric Lighting Apparatus for Gas, 582.
44721. Cloth Finishing, p. 47.
44722. Old (H.W.R.) Engines, 47.
44723. Leather-Drying House, 47.
44725. Glass Bending, 47.
44726. Na Cl, 47.
44737. Hughes' Type-Printing Telegraph Pendulum, 48.
44746. Heating Model Boilers, 48.
44749. Soap-Making by the Cold Process, 48.
44750. Hard water Soap, 48.
44752. Chloride of Zinc Battery, 48.
44754. Cambrian Engines, 48.
44758. Immersion Paraboloid Condenser, 48.
44760. Fitter's Bench, 48.
44761. Ratchet Brace, 48.
44770. Boiler Tube Stopper, 48.

An Elastic Lacquer.—A patent has been taken out in Germany for a new description of elastic and flexible lacquer, which will not peel off, and which is suitable for the coating of carriage-cloths, plans, and other articles to be folded up, as well as for wood and ironwork, walls, &c., but which may also be employed as an isolating layer for damp rooms, as a means against dry-rot, and in rendering stuffs waterproof. To produce the lacquer, 50 kilogrammes of linseed-oil varnish are heated up to boiling point. In another vessel about 15 kilogrammes of lime are slaked in 20 kilogrammes of water. As soon as the lime boils, about 50 kilogrammes of hot melted raw caoutchouc are added to the lime-water, and the whole is then stirred until it has become thoroughly mixed. This composition is poured into the boiling varnish, the whole being stirred all the time. Further stirring takes place until a homogeneous mass is formed, which is afterwards strained or filtered, and left to cool. After cooling, the lacquer has a pap-like consistency. To apply the lacquer, it is diluted with the desired quantity of varnish, and put on with brushes, either in a warm or cold state; but it is said to be better to apply it warm, as then no varnish is required for diluting it. In rendering linen waterproof, the lacquer may be put on by means of brushes or rollers. After treatment, the linen or other stuffs, paper, &c., are hung up to dry. Stuffs are perfectly dry and ready for use in two days. The product is stated to be lustrous, elastic, not sticky, and perfectly waterproof.

QUERIES.

[45101].—**Zinc Vapours and Soot.**—I read that a piece of zinc placed on the live-coals in a stove will effectually clean the stove-pipe, the vapours of the zinc entering into combination with the carbon. Will Mr. Allen kindly give the reaction, if it is true?—S. M.

[45102].—**Emigration for Assayers.**—Will anyone who knows inform me which is the better place for Assayers, Colorado or the Cape of Good Hope? and, what the prospects are in each?—EMIGRANT.

[45103].—**Steam-Gauge.**—Will someone tell me whether I can get the parts in the rough to make a steam-gauge for 1 h.p. boiler, like Smith's or Bourdon's?—A POOR AMATEUR.

[45104].—**Cement for Iron and Wood.**—What I require is something that will hold iron and wood firmly together, not to cause rust, not easily affected by heat or acid, and not expensive. I have tried various combinations of pitch, tar, rosin, beeswax, &c., but without success.—LONG TOM.

[45105].—**Dynamo-Electric Machine.**—To Mr. R. KENNEDY. Kindly say if the machine described by you in Vol. XXX, p. 576, will work equally well if the dimensions are increased so that it can be used for electric lighting, and be driven by steam-power. What size of wire should be wound on the armature? And, which is the best way to make large permanent steel or cast-iron magnets?—A. S. R.

[45106].—**Equatorial.**—In adjusting the declination circle of an equatorial, I am puzzled to distinguish the errors that may be in the adjustment of the Polar axis and those of the circle itself. It seems to me the error might arise from the circle's want of adjustment or from that of the Polar axis. How is the hole bored in the cap and slider of the now common Chinese yachts sold for sixpence? It is in the thickness of the cap, and the string is passed through it to hold the ends of the ribs. How is this hole made, and the string passed through?—J. F. E.

[45107].—**Screw-Cutting.**—What are the best shape of tools for using in the slide-rest of a lathe-acting lathe for above purpose, specially a tool for cutting the female screw? A sketch of tool would be a great help. What is the easiest method for calculating the proper change-wheels to use?—SCREW-CUTTING.

[45108].—**Plating Solution.**—I have been trying to make a solution from a recipe given by Watts' electroplating book, and have failed. The directions given are:—Take, say, 10z. nitrate of silver dissolved in one quart of distilled or rain-water. When thoroughly dissolved, throw in a few crystals of hyposulphite of soda, which will at first form a brown precipitate, but which eventually turns red; dissolve if sufficient hyposulphite has been employed. A slight excess of the salt must, however, be added. This seems all very well. What does it mean by a few? I kept on adding these few crystals, but found that, instead of redissolving, turned the solution like black mud, and there it remains. Will some of "ours" kindly help me out of my trouble in recovering the lost or making fresh?—PLATE-CLEANER.

[45109].—**Electric Lighting.**—I want to fit up about 50 incandescent lamps of 16 to 20 candles power. I have a flow of water equal to a 12in. pipe over a fall of 30ft. I purpose to erect a water-wheel, but, as this is one mile distant, (1) how could I control the speed, also, stop and start it when required—electrically or otherwise? (2) What thickness of copper wire or iron rod would be required to bring the current one mile without unreasonable loss? (3) What are the advantages and disadvantages of alternating currents and continuous currents, and which does the Siemens machine produce? (4) What power would a machine take to drive for 50 lights of, say, 10 candles, and what speed would be required per minute for best results?—VULCANITE.

[45110].—**Indigestion or What?**—As Dr. Edmunds is so kind as to give advice, I take the liberty to ask him respecting myself. I am a married man, 32, moderate drinker, and good appetite, and with healthy and not over-hard employment. I have suffered some eight or ten years from indigestion and gradually got thin and weakly, and mind rather dull. I never get pains or biliousness from indigestion, but am much troubled with wind, especially after meals. This last twelve months or so, wind seems more about the heart and left side, but no pain with it. The worst time is the first part of the night in bed, and sometimes there is slight palpitation. The wind then, at times, seems to interfere with the action of the heart, and suddenly wakes me up with a queer sensation, and at times sweats at the bottom of my feet and hands. I then rub my stomach and left side, and thump my chest, which causes the wind to rise, and then I seem to get a stronger pulse and circulation and comfort after. Reading or writing gives me uneasiness, and a feeling of fullness about the heart or nearer to the side. Heart and lungs, are, I think, all right. On a few occasions I have seen medical men who gave me something for indigestion. The last adviser, a doctor, recommended me to drink holly-tea; but I shall leave that until Dr. Edmunds has kindly answered. No doubt it is indigestion, but I don't want to keep taking a lot of physic.—LIGHTER.

[45111].—**Secondary Batteries.**—Will Mr. Lancaster kindly say whether, in his opinion, small compressed slabs of red-lead powder, each slab compressed on a thin sheet of lead for the attachment of the pole, will answer the same purpose as the thin sheets of lead mentioned in the description of the De Meritens secondary battery, which appeared in the "E. M." of Oct. 14th? The idea is that if a steel die of a suitable size for one section of an element have placed on the following a thin sheet of lead, and if the die be then filled with very finely-divided red-lead, and be exposed to blows in a percussion press, a consolidated slab of red-lead with a thin sheet of lead firmly attached, will be formed in a very easy and rapid way. Suppose a pair of such slabs be so placed as to have a thin porous membrane between them—one element of the battery would be formed. The next step will be so to inclose this element in an envelope of ebonite, or some such substance, that when it is placed in the acid bath, the powdered red-

lead can be penetrated with the acid, but not disintegrated by it. The advantage of such a battery would be simplicity of construction, and a larger area of superficies acted upon by the acid than is possible from sheets of lead, because a finely-divided powder has its superficial area in direct proportion to the number of its particles. It is probable if the red-lead powder be damped with British gum previous to being consolidated into slabs, the liability to disintegrate might be overcome, and thus one of the difficulties in the construction be removed, and the porous membrane between the sections of the element be dispensed with.—A. C. P.

[45112].—**Boiler Construction.**—Will any practical boiler-builder please show me why the straight seams in cylinder boilers should be double riveted, when the cross seams are single riveted only? I should prefer a rough sketch, with easily-understood explanations.—VULCAN.

[45113].—**Kindergarten.**—Perhaps some of your correspondents will enable me to become a little more acquainted with the Kindergarten system of educating young children. I have read "How the Plants Grow in the Kindergarten," and should be glad to hear of any other books on the subject. Also, can you tell me where, in Manchester or Liverpool, I can see a Kindergarten?—MAMMA.

[45114].—**Glass Embossing.**—Will any reader supply me with some information I require about the method at present employed for glass embossing and "brushing out" patterns on designs in gold upon glass? I am well acquainted with what I believe to be the ordinary method of glass embossing—that is, of pencilling the whole of the design in Brunswick black or similar substance previous to "biting in" the exposed parts; but have seen a great deal of ground embossed glass, with such profuse designs, with such a large part of the surface covered with ornament, that some more expeditious method than pencilling must be employed, namely, some kind of "stencilling." Then, with regard to "brushing out" (as I believe it is termed) plain gold border—not embossed: I have seen round glass panels, which I cannot think have been pencilled. Gilded glass advertisement tablets often attached to shop windows seem to be done by some such process. I should be thankful if any reader would kindly furnish me with the information I seek, or tell me where I could purchase a handbook treating of the exact subject I speak. I have a Painter's and Decorator's Handbook, but it does not mention anything of stencilling or "brushing out" on glass. As I said before, I understand the ordinary way.—C. J. V.

[45115].—**Estimating Alcohol in Tinctures, &c.**—Would Mr. Allen kindly inform me the best means of estimating alcohol in tinctures, &c.? A rapid and tolerably accurate process required.—R.

[45116].—**Medical.**—Would Dr. Edmunds kindly tell me how I can get cured of the following, which, I am told, is liver and kidney complaint?—I had scarlet fever about two years ago, and since then have been troubled with severe headaches and a feeling as if cold water were being poured down the back—this I have had at intervals. About seven weeks since I had an attack of what I am told is kidney complaint. About four weeks since I had the following symptoms, which still continue:—Headache, ringing in the left ear, furred tongue, disagreeable taste in the mouth, occasional feeling of sickness, pains above and between the shoulders and in the small of the back (the pains in the back are worse on the left side at times); I have also pains in the knee-joints. I have seen local doctors, but have not got any relief. One doctor recommended me to go to the Isle of Man for three or four months, but I could not afford it.—ONIS PAIN.

[45117].—**Enlarged Toe-Joint.**—Will Dr. Edmunds kindly give a few words of advice to a working lad who has suffered from a pain in the large toe-joint for three or four years? I was often told it would get well of itself, but it has failed to do so as yet. It becomes much swollen and very painful on walking any distance. It is only on the right foot.—F. C.

[45118].—**Analytical.**—Would Mr. Allen kindly inform me the best means of detaching the water residue from glass or platinum dishes in the estimation of nitrogen as nitrate and nitrite?—BIRMINGHAM.

[45119].—**Astronomical.**—To "F.R.A.S."—I have a 5ft. achromatic of 31in. aperture, which is furnished with eyepieces from 30 to 500. What power should show the snow-caps of Mars best? Could I see anything else on him? Also, what power should bring out Jupiter's dark spot?—A YOUNG OBSERVER.

[45120].—**Mechanical Model.**—Some time ago I saw at a conversation a working model consisting of a man planing wood at a carpenter's bench, the body moving to and fro as he worked. Could any reader give a description, with diagrams, of the mechanism? If so, I should be obliged.—MECHANIC.

[45121].—**L. and N. W. Engines.**—Will someone give dimensions, weight, &c., of Mr. Webb's eight wheel radial tanks in use on the L. N. W. R. for local passenger traffic; and of the outside cylinder tanks with leading bogie on the same line which work the Mansion House and Broad-street traffic? Also, the date and class of No. 943, "Shah of Persia."—TITTSWORTH.

[45122].—**Contact Breaker.**—An electric bell I have sometimes refuses to ring, in consequence of a deposit forming on the platinum of the contact-breaker. By slightly rubbing the two surfaces together the defect is remedied for a time. The contacts are pieces of sheet platinum (about as thick as an ordinary direction card) soldered to springs of armature, and to, also, post with tinfoil (sweated together). Is the deposit caused by the platinum being soldered instead of being riveted?—NEMO.

[45123].—**Gas-Fires.**—Would Dr. Edmunds kindly say if gas-fires with asbestos or coke are injurious in a bedroom to an elderly invalid who suffers at times from attacks of asthma? The fire would only be lighted an hour or so before going to bed and then put out. There appears to be a diversity of opinion about gas-fires. Two contributors, the "Gas Man" and "Gnablight," recommend asbestos with air-gas flame at bottom of grate; but Mr. Fletcher recommends the reflector pattern,

[45171].—**Nervous Asthma.**—Would Dr. Edmunds kindly advise a sufferer from this complaint? I have been receiving medicine from a local doctor for some time, but to no purpose. When the atmosphere is clear and dry I am tolerably well, but when the atmosphere is damp or the wind is in the E. or N.E., then I am troubled with shortness of breath and coughing. The doctor advised me, if I got no better, to go to a warmer climate, such as New Zealand or Australia. I should like Dr. Edmunds's opinion on this question, for I should not like to leave England if I could help it; but if nothing but a change of climate will be of use, then would he advise New Zealand, Australia, or Canada, as I have read of Manitoba and the N.W. Territory possessing a beautiful dry bracing atmosphere, and though it is very cold yet it is dry. I may just say that I am a man about thirty, not very strong, but have no complaint except this. I am unmarried, and am employed in a manufactory where some of the rooms are heated by steam to 100°, while others are at ordinary temperatures. Will Dr. E. kindly give me his advice as to medicine, diet, &c.?—W. M.

[45172].—**Asphalte Roof.**—In Ward and Lock's "Every Man His Own Mechanic," the Anglo-Danish Patent Asphalte Roofing Pasteboard is strongly recommended, with Krichen's patent India mastic for a dressing. The writer adds that "the roof may be spread over with lime, chalk, or plaster of Paris, or any colour may be given to it to suit the taste." I should be glad to know if anyone has tried it, what he thinks of it, and, more especially, whether the rainwater from such a roof is perfectly pure, so as to be fit for culinary purposes and tea-making. Where I want to use it the springs lie so deep that very few wells are used, their place being supplied by large rain-water tanks.—J. W. D.

USEFUL AND SCIENTIFIC NOTES.

A Strong and Handy Cement.—One of the strongest cements, and very readily made, is obtained when equal quantities of gutta-percha and shellac are melted together and well stirred. This is best done in an iron capsule placed on a sand-bath, and heated either over a gas-furnace or on the top of a stove. It is a combination possessing both hardness and toughness—qualities that make it particularly desirable in mending crockery. When this cement is used the articles to be mended should be warmed to about the melting point of the mixture, and then retained in proper position until cool, when they are ready for use.

New Freezing Microtome.—At the Microscopical section A. A. S. Mr. Thomas Taylor, Microscopist of the Department of Agriculture at Washington, presented a model of a new freezing microtome of his invention. Mr. Taylor described his invention as consisting essentially of a thin brass tube about one inch and a half in length, by one inch in diameter. A tin brass tube is secured within the large cylinder. This tube enters the bottom where it is secured, and proceeds to within a quarter of an inch of the inside surface of the top. To the outside open end of this tube a rubber tube is attached; the other end of the rubber tube is made to communicate with a freezing mixture composed of finely-cut ice and salt in about equal proportions. The pail containing this mixture is placed over, and about fifteen inches higher than, the section cutter. The object of this arrangement is to fill the brass cylinder with a freezing liquid, drained from the pail, and caused by the liquefying salt and ice, the temperature of which is about zero. On filling the cylinder with the liquid any object on top of the cylinder becomes frozen in a short period, and may then be cut to any degree of thickness. In order to preserve the low degree of temperature in the cylinder, a second tube is secured in the cylinder to remove air and keep up a constant current of the freezing liquid. This tube enters the bottom of the cylinder, where it is fastened. It projects upwards to within an eighth of an inch of the top, and has a diameter of about one-half of the supply tube. This microtome or freezing cylinder in other respects is arranged like other microtomes, such as are used for ether or rhigoline; and the same mathematical accuracy attained in cutting sections.

A PRACTICAL experiment can be performed with the chemicals to be found in every photographer's laboratory—hyposulphite and acetate of soda. The former is capable, if heat be applied, of dissolving in its own water of crystallisation: hence it will be easy to prepare a solution with one-tenth of its weight of water. If such a solution be prepared and placed in a test-tube it will, if kept quite still, remain without crystallisation, and will allow another solution—acetate of soda liquefied with one-seventh of its weight of water—to be poured upon it without any admixture taking place. If carefully preserved from concussion the solution will remain liquid; but if a crystal of hypo., held by a thread, be carefully passed through the acetate solution into the hypo. solution the latter will solidify at once, while the acetate remains as liquid as ever. If, however, a crystal of acetate be suddenly passed into the acetate solution the latter will solidify directly. The two kinds of crystals thus formed have very different characteristics, and the whole forms a very pretty experiment.—*British Journal of Photography.*

ANSWERS TO CORRESPONDENTS.

* * All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 51, Tavistock-street, Covent Garden, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

* * Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 26, and unacknowledged elsewhere:—

T. T. SHAW.—T. Taylor.—W. Horton.—Rankin Kennedy.—H. Maxted.—T. S. Basley.—E. Broderip.—Lee and Nightingale.—J. C. Clough.—C. Mostyn.—Phosphor Bronze Co.—H. Warry.—Joe Blain.—Caemist.—E. Lloyd.—M. D.—Onlooker, Bradford.—F. M.—A Student.—J. Brasher.—A Five Weeks' Reader of the E. M.—F. A. M.—Watchman.—Water Thumper.—Bucks.—Vomsvangen.—Ingua.—Beauchamp.—J. F. C.—Orderic Vital.—A Country Parson.—Alfred Booth.—Netherby.—Cousin Jack.—L. C. D.—H. A. S.—Argues.—Joseph Marples.—E. A.—Dunrod.—J. C. L.—Jeff.—W. M.—A Fellow of the Royal Astronomical Society.—Lockitch.—Verax.—R. B.

ASTI-BUTCHER. (We think a book of the kind is published by Dr. Nichols, 429, Oxford-street, W.)—**PUZZLED.** (Take the tube out and tap the closed end on a table, warming it to get out the bubbles. Fill quite full, close with your thumb, and invert it into the mercury in the cistern.)—J. F. (Use pure methylated spirits. You must have got hold of some with resin in it.)—**A. FARMER'S CHAIRMAN.** (Solution of chloride of cobalt, which turns green when heated, and becomes invisible on cooling.)—**G. CALVERT.** (The best way would be to procure the catalogues of the music-sellers, Cocks, Bosc, Chappell, and others.)—**A. YOUNG BURNMAN.** (1. No, merely polished. Soap-and-water, with bloodstone and polished steel burnishers. It requires practice. 2. At any of the shops where jewellers' requisites are sold: Clarks, Sheffield, Birmingham.)—**STYRMAN.** (If it is a polytup you should consult a surgeon. You will find many references to model locomotives. Have you any idea of the pressure of steam in "real locomotives"?)—**INQUIRER, Preston.** (We do not know of a book on the subject, but there are articles on such processes in Watts's "Technological Chemistry," and the dictionaries of Arts and Processes.)—**A. WOULD-BE VENTRILOQUIST.** (Are they anything new? The usual thing is a doll's dress and a head, or else the fingers of the operator.)—**CHOUHART.** (The cup-and-ball microphone was described in No. 846.)—**W. E. W.** (One part gelatine to four parts glycerine. See p. 545, Vol. XXXIX., and the index to Vol. XXX.)—**GLASS BOTTLE.** (If you can use the blowpipe, fuse a piece of glass in. If not, you must try a cement, say, plaster of Paris mixed with alum-water.)—**J. CHORON.** (You do not say whether you have plants or not. If you cannot refer to our back volumes, you should procure one of the cheap handbooks.)—**POLYMETAL.** (You must make them of oil, but see a reply on p. 98, Vol. XXXII., where varnishing with boiled oil is recommended.)—**C. J. E.** (Oil or thin linen coated with rubber varnish. Reckon 50 cubic feet of coal-gas to each pound to be lifted. For cutting gorges, see p. 102, Vol. XIV.)—**IGNORAMUS.** (Keith on the "Use of the Globes" is the book, but we forget the publisher. Try Wyld, Charing-cross.)—**LITTLE BIRKS.** (We believe it will. See p. 140, Vol. XVII., and p. 16, Vol. XXVII.)—**B. STIMMONS.** (An old exploded hypothesis. The premises are erroneous, and the conclusion consequently fallacious.)—**LONDONIAN.** (Nonsense: if it could be filled once it could be refilled.)—**ENFIELD.** (To make a delimeter of the size you mention would be a waste of time; that is, the result would not be worth the labour expended. For instructions, see p. 582, Vol. X.; p. 83, Vol. VII. You should also read a letter on p. 596, No. 231, and p. 46, No. 522.)—**F. F. C.** (We do not know of any book on the subject.)—**JOHN DAVIS.** (If you had made your question clear we should have referred you, as we do now, to the advertiser. We believe it was illustrated some time ago in our columns, but the advertiser will, no doubt, give full particulars.)—**WILLIAM.** (The only way to get such a situation is to apply to the owners of steamboats or to the engineers on board.)—**S. FINEWORK.** (See back volumes, or procure Dr. Browne's "Minor Fireworks" from the Bazaar office.)—**T. MACCALL, M.D.** (Your questions are answered on pp. 119, 140. Crystals of acetate of soda are melted and the liquid poured into the cases until they are nearly full, in returning to the solid state the acetate of soda gives out heat, and it is again made to absorb heat and to become liquid by immersion in hot water. No water is used to melt the soda.)—**E. AMOTL.** (We have not seen one, but should not hesitate to buy if we wanted one. We never recommend queries to buy anything.)—**T. WASTON.** (Your opinion of their value is, no doubt, correct; but having been bitten once, why not consult

a medical man about the kidney complaint? How can readers know that it is a kidney complaint?)—**R. T. B.** (We answered you on p. 148, under signature "Subscriber, West Houghton." The first question was too elementary, and the second too indefinite for insertion, and you are so anxious for a reply that it is too much trouble to look for the answer.)—**VOCALIST.** (Certainly, he could do them easier on a tuning-bellows.)—**GAS METER.** (Supposed to be three, but it varies with pressure, and the kind of burner. 2. To measure the gas; the wet meter was illustrated and described on p. 466, No. 747; the dry on p. 33, No. 768.)—**LOUIS DAVIS.** (Such a recipe as you require would have considerable commercial value, but you will find the usual recipes by searching the indices of back vols.)—**ALFRED.** (See recent replies to 44798.)—**LADOLE.** (Powdered lime and washleather, or jewellers' rouge and a brush.)—**J. C. L.** (It is constitutional weakness; defective circulation. Very common. Take more exercise. You will find many answers in back volumes.)—**LIVER.** (Several recipes in back volumes. See pp. 140, 568, Vol. XXXI., and pp. 100, 124, Vol. XXVI.)—**QUERZO.** (If you can describe the coins fully without the cuts, we will insert your query, but we cannot spare space for engravings. Give full particulars if you want accurate replies—for instance, you omit in every instance to say what metal the coins are. We do not insert queries about foreign stamps.)—**ESAO.** (If you are, as you say, in good health and enjoy your existence, be satisfied; you will probably grow stouter as you grow older, and if you do not, you will have little to complain about.)—**W. G. D.** (Have nothing to do with stimulants: they will rather increase than diminish your nervousness. Some simple tonic would probably do you good—taken under medical advice.)—**H. HARRIS.** (Rendle's or Helliwell's systems would probably suit you; see advertisement pages of the *Building News*.)—**AGRICOLA.** (The genuine ones—about one in every five hundred—are carved out of the solid material; the others are moulded, some out of chips and cuttings of the real article, and the rest out of all kinds of artificial materials; other query next week.)—**J. T.** (We never have any difficulty, when kept in a stone jar; but if kept in very large quantities, you must do as the shopkeepers do—damp it—and spoil the flavour!)—**FLOR ALMONI.** (We fancy you have misapprehended the tone of the letter you criticise, and we fall altogether to see the joke that seems to have amused you.)

WALLACE.—J. F. C.—F. Bedford, and others have replied to queries already similarly or adequately answered.

Sheathing Iron Ships.—A patented process of protecting the bottom of iron vessels is thus described:—An iron or steel vessel having been built in the usual way, it is ready for the sheathing. The method of attaching the zinc is peculiar. On the iron plates of the vessel spots about an inch in diameter, and about a foot apart, are polished so as to present a smooth, clean surface. On these pieces of a special solder or alloy are stuck, and the zinc plate is put on. Heat being applied by a new dynamo-machine from without, the zinc plate is immovably attached to the iron. The bottom being completely sheathed in this way, the salt-water acting chemically on the zinc, and also on the iron (as sufficient moisture will permeate between the iron and zinc plates), a galvanic current is set up between the iron and zinc, the iron being the positive plate and the zinc the negative. By this means the outside face of the zinc is constantly, though slowly, wearing away, and a deposit of chloride of zinc takes place on the iron plate. The wearing away of the zinc prevents barnacles, seaweeds, &c., from growing, and the zinc always presents a smooth, clean surface, enabling the ship to sail or steam faster. The plates dissolve away at the rate of about 2oz. per square foot per annum. This method of fixing on the zinc plates requires no boring of holes in the ship's plates, but at the same time the zinc is firmly attached. The dynamo machine of Siemens is used to economise labour, as by its use one man can do as much work as forty plumbers could do with soldering bolts. The invention has been patented by Messrs. Atkinson and Henwood.

To Remove Ink-Stains.—An article in the *Journal de Pharmacie d'Anvers* recommends to use for this purpose the pyrophosphate of sodium, which does not destroy cellulose, and yields colourless compounds with ferric oxide. Before treating the spot with this salt, it is recommended to let a few drops of tallow, from a candle, fall upon the spot, and then to wash in a solution of the pyrophosphate until tallow and ink-spot have disappeared. If necessary, the operation is to be repeated.

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence at 51, Tavistock-street, Covent-garden, London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the Kingdom.

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The charge for Advertisements for Situations is One Shilling for Twenty Words, and Sixpence for every Eight Words after.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, NOVEMBER 4, 1881.

THE LEYDEN JAR FOR MEDICAL PURPOSES.

A METHOD of utilising frictional electrical machines for the production of current for medical purposes has been discovered by Dr. W. J. Morton, of New York, and as the discovery is one of some importance, a few words descriptive of the method employed may find an appropriate place in these columns. The methods of administering or utilising static electricity in hospitals and private practice have hitherto consisted in insulating the patient, or by giving the current in the shape of sparks or shocks. By very simple arrangements Dr. Morton has contrived to convert the frictional machine into an appliance which will do all the work for which medical coils and other devices are employed, and at the same time it can be used for producing the effects of static electricity. His arrangement, it is stated, is superior in its effects to the ordinary Faradic currents, inasmuch as it produces the required muscle and nerve stimulation with a far less amount of pain. In the medical circles of the United States they speak of Franklinic and Faradic electricity as synonymous with what are generally known as frictional and voltaic electricity, and, so far as the medical world is concerned, the great importance of Dr. Morton's discovery is, that it puts at the disposal of the practitioner both forms of electricity from the one machine. Some time ago—in the spring of this year—Dr. Morton stated that an induction-current could be obtained from a Holtz machine which would produce nerve and muscle reactions similar to those produced by the induction currents in common medical use under the designation Faradism; and he demonstrated that the static-induced current, as he called it, would produce maximum muscular contractions with the minimum amount of pain. Following out the line of study indicated, he has arrived at the simple arrangement to be described further on, which, as we have mentioned above, puts both systems of electrical treatment at the service of the surgeon. Soon after he commenced the study of the medical capabilities of static electricity—using, as we understand, an ordinary form of Holtz machine—Dr. Morton was struck by accidentally receiving from the conductors a thrilling sensation and contraction of the muscles, which exactly recalled the peculiar effects of the Faradic current. After a little reflection he constructed an "electrode" for obtaining muscular contractions at any given point by means of sparks, which, however, were not allowed to reach the skin. The principle of this appliance rests on the fact that if two static and sustained potentials in the act of discharge are interrupted in the circuit by a series of sparks, the effect upon muscular fibres in some remote part of the circuit is to be thrown into contraction. Thus the "electrode" consisted of a couple of balls carried in a holder, and so arranged that the distance between them could be regulated at pleasure. One of the balls had its stem extended so that a sponge or other appliance could be attached and applied to the skin of the patient, who of course was not insulated. This electrode he found useful for avoiding the pain of sparks ad-

ministered to children and timid subjects, but soon discovered that the physiological effects of the sparks and the current thus interrupted were not identical, so that the "electrode" is now used only in cases for which otherwise the Faradic electrode would be employed. After several experiments, the desired effect was obtained—viz., a smooth, agreeable current, producing strong muscular contractions. To the outer coatings of two Leyden jars, the conducting wires are attached by means of small hooks or clasps, the connecting bar or chain being removed, while the inner coatings are connected by the discharging rod or rods. The subject takes hold of the sponge electrodes at the end of the conducting wires, and the machine being set in motion, the discharging rod is drawn out for a fraction of an inch, and at once a current is felt between the sponge electrodes, which, in its general characteristics, is undistinguishable from the Faradic current. The muscles to which this current are applied spring into energetic contraction, the response being quicker than with the induction current in general medical use—a peculiarity which is of especial value from a diagnostic point of view. Being soft and agreeable, the "static-induced" current produces a maximum of effect with the minimum of pain, and compares favourably with the sensations produced by a Ruhmkorf coil, a magneto-induction apparatus, or an ordinary galvano-faradic instrument. The current has a high tension, indicated by a tendency to leave the conducting-wire or chain in the form of fine prickling sparks, and necessitating careful insulation from the sponges upwards. Dr. Morton uses glass handles for the electrodes, and encases the wires in black-rubber tubing. The machine must, however, be kept generating a considerable quantity of electricity, or a "jerkiness" in the current becomes evident. The strength of the latter is regulated to a nicety by means of the discharging-rod, from a slight, almost imperceptible, tingle, to rigid flexion of the arms if the electrodes are held in the hands. The rationale of the term "static-induced" current is thus stated by Dr. Morton:—Static, because the source is static electricity; induced, because the outer coatings of Leyden jars are electrified by induction in the same manner as the secondary coil is electrical. The inside of the jar may be said to correspond to the battery current of an induction coil, the outer coating to the secondary current, while the interruptions at the discharging-rod, in spark form, correspond to the interrupting-hammer of the Faradic apparatus. Each spark causes a rise and fall of potential in the interior of the two Leyden jars, and, as a consequence, a corresponding rise and fall in the induction of the outer coating. There are thus two supplies or potentials of opposite induction electricity on the outer coatings, and with each spark as many waves or induction impulses whose strength is determined by the strength of the spark; that is, by the amount of discharge permitted between the insides of the two Leyden jars. The "static induced" current must not be confounded with the series of discharges taking place between the inner coatings of the jars; in silent current forms they produce no muscular contractions or sensations of any kind, while in repeated discharges, caused by the interruption of the circuit, they are too painful to be borne. One conducting-wire and electrode may be connected to the inside of one jar and the other to the outside of the other jar; but in this case the current is not so smooth as when the conducting-wires are attached to the outer coatings of both jars. As to the value of the current thus produced, from a medical point of view, we are not concerned to inquire: it is sufficient that its discovery was brought about by the desire of a medical

man to provide Franklinic and Faradic electricity in one and the same machine. It is not unlikely, however, to lead to other discoveries in the field of electricity, and will certainly be welcomed as a lecture experiment wherever a frictional machine and a couple of Leyden jars are found.

THE EXPANSION OF STEAM AND THE REGULATION OF THE ENGINE.

IN a short paper, read before the American Society of Mechanical Engineers, Prof. R. H. Thurston returns to a subject which has previously engaged his attention—viz., the ratio of expansion at maximum efficiency, and the proper method of obtaining it, and regulating the engine. Lately he has been studying the results of a series of experiments made with a large engine fitted with variable expansion gear, the valve-motion being so arranged as to permit of the amount of compression being varied without change of either steam, expansion, or exhaust lines. He promises to give the results and the conclusions in a future paper; but the most important is the fact that a decided gain is found to follow the adjustment of the compression to a far higher ratio than is indicated as best by the simple geometrical conditions usually considered to determine the point. Prof. Thurston attributes this beneficial effect of a high ratio of compression to the action of the compressed fluid in heating up the passages, cylinder-heads, and piston-surfaces, thus checking or compensating for the initial condensation which takes place when steam enters a cylinder that is cooler than itself. All engineers who have had any real experience with the working of steam-engines are aware that, when running under fixed conditions, and with a given pressure of steam, there is a certain ratio of expansion or point of cut-off which gives the greatest economy; and when called upon to advise as to the purchase of an engine, they study, not only the conditions which affect the efficiency of the engine itself, but all the elements which enter into the cost of setting up a plant for working by steam-power. These elements include, first cost, with the interest on capital expended, wear and tear, as well as running expenses. Thus, the engineer must put down first the cost of the different styles of engine; then the cost of power in weight of steam used at various pressures and points of cut-off; and, finally, he selects that machine which, at the least ratio of expansion, gives the required power, other points in the comparison being reduced to an equality. It is just here that the difficulty of selection is experienced; for it is practically impossible to determine, without trial, what is the ratio of expansion giving highest efficiency, though from a consideration of data obtained in practice a tolerably close approximation may be made. Rankine's rules when certain conditions are established are almost exact, and his method when applied to examples of the best practice in modern steam-engines shows that commercially profitable expansion is in ordinary circumstances confined to a narrow range, but is nearly always less than the ratio for maximum efficiency. The ratio of expansion which gives the best results from an economical point of view having been found it should remain unchanged while the steam-pressure and the work remain the same; but as most engines are required to work under variations of load, and nearly all with fluctuations in steam-pressure, some means of regulating them is needed. The simplest method of accomplishing this is by the aid of the well-known governor which operates a throttle-valve; but in the best modern engines the governor is attached to

the expansion gear in such a way that it causes a variation in the point of cut-off according to the load upon the engine, or in other words the demand for power. In the now familiar Corliss engines this regulating mechanism is very sensitive, and where the variation is small, is effective even at low speeds. As an instance, Prof. Thurston mentions an engine running at 60 revolutions per minute with 90 lb. steam on gauge, which was kept within a difference of two revolutions when the whole power was thrown on or off—the variation in the power exerted being a minimum of 35 h.p., and a maximum of 150 h.p. So far the appliances for regulating the engine may be said to be all that could be desired; but as the proper ratio of expansion is determined mainly by the steam-pressure, any variation of the point of cut-off will be found as a rule to reduce the efficiency, and it therefore follows that to secure the greatest economy the ratio should be fixed at the best proportion for the steam-pressure employed and be never changed. If that is done, however, by what means is regulation to be effected? The adjustment, by means of a throttle-valve, is clearly inadmissible, as it involves variation of the steam-pressure, and the object is to keep the steam and expansion lines permanent for all loads. Hence it follows that any allowable system of regulation must affect the back-pressure or the cushion line, and as the former is out of the question, as too costly, it becomes evident, says Prof. Thurston, that the only admissible plan is the variation of the power of the engine by alteration of the compression line, which is done in such gears as that known as Stephenson's link-motion. When the link is down the ratio of expansion is determined by the lap and lead, and is usually not more than one-third; when the link is raised this ratio is increased; but with the change in the steam-line there is a simultaneous alteration of the point of release and of closure of the exhaust which gives a change in the compression line on the side of increase. The result is great smoothness of working when running with high-pressure steam, and considerable economy, which Prof. Thurston traces, as explained above, to the higher ratio of compression. With the link-motion, however, the steam and expansion lines vary; and Prof. Thurston's experiments were necessarily made upon an engine fitted with a valve-motion which permitted the ratio of compression to be varied without altering either steam or expansion lines. The idea of regulating by compression occurred to him some years ago, and has been suggested to him by other engineers to whom the thought was original; but, so far as he knows, no attempt has been made to determine its advantages by any actual trial. The publication of the results obtained in his experiments will be awaited with some interest by engineers, as there should be no mechanical difficulty in making the cut-off operate on the exhaust side instead of attaching the motion to the steam-valves. Maximum efficiency is obtained, says Prof. Thurston, with higher ratios of compression, and what would be considered by many excessive cushioning results in less loss than is found with equal variation from the point of cut-off giving maximum efficiency. As compression is increased the area of the indicator diagram is decreased, and the work developed in the engine becomes less; but the secret of the economy in regulating by compression is, no doubt, found in the fact that the excess of work in cushioning results simply in a transfer of heat to the exhaust side instead of rejecting it at the exhaust end of the piston. Amongst existing forms of valve-gear, the best are those which give a variable expansion with a constant compression, are also capable of giving an exact adjustment by means of a governor; but, if Prof. Thur-

ston's conclusions are correct, the best method of working a steam-engine would be to have a fixed cut-off with the governor so attached as to determine the point of closing of the exhaust. Properly-constructed relief-valves will, he says, prevent all danger from the influx of water with the steam, as would using nothing but dry steam; and where exhaust-ports are beneath the cylinder drainage is rarely imperfect. In cases where engines have a nearly invariable load, and are properly adjusted to their work, the advantage of the proposed plan is at a minimum, and, in practice, would be found inappreciable; but where engines are subjected to great variations of load or are too large for their work, the increased efficiency, Prof. Thurston thinks, will be considerable, especially where cylinder condensation now occurs to any great extent.

IMPROVEMENTS IN THE MANUFACTURE OF CELLULOSE.

SOME improvements in the manufacture or treatment of cellulose by which the resulting product is rendered unflammable, have been recently patented by Mr. Alex. Parkes, of Gravelly Hill, Birmingham, the original discoverer of the substances which have been known as Parkesine, xylonite, and celluloid. The present invention also relates to the manufacture of articles from cellulose direct, instead of employing the process formerly adopted with paper, thread, and other substances composed of vegetable fibre—viz., passing them through a bath of chloride of zinc, which partially dissolves the surface, and produces a glaze or varnish over the articles. In the present invention, the patentee first obtains a complete solution of cellulose or such like substance from cotton or linen fibre, or from paper or fabric made from such fibre, or from other woody cellulose, and combines with it colouring matters or pigments, and moulds or shapes the mixture into various forms by pressure or otherwise, or employs it for coating paper or other surfaces. For dissolving the cellulose he employs iodide of zinc or nitrate of zinc. These substances should be employed as neutral as possible, and concentrated to a syrupy condition of about 1:600 to 1:750 sp. gr., heated to about 200° Fahrenheit or a higher temperature, but not so high as to cause carbonisation of the cellulose or woody fibre. Although he prefers iodide of zinc or nitrate of zinc, chloride of zinc alone or mixed with the above may be used to effect the solution of the cellulose; nitrate of lime, or chloride of calcium, may also be used; but whether nitrate of zinc, or iodide of zinc, or chloride of zinc, or any of the above solvents of cellulose is employed they must be concentrated to from 1:600 to 1:800 sp. gr. and by preference heated to 180° to 250° Fahrenheit. The cotton or paper (whether pulped or otherwise) or fibre is immersed in the nitrate of zinc or other solvent and quickly dissolves, and fibre or paper is added until the solution arrives at a stiff, pasty condition, suitable kneading or mixing machinery heated to the required temperature being employed to break or blend up the compound as the dissolving of the cellulose goes on. The pasty mass can also be put aside for future use and masticated afterwards. If the cellulose solution is to be used for coating paper, textile fabrics, leather, wood, metals, and such-like, it may be used thinner than when articles are to be shaped and moulded from it. For coating paper, textile fabrics, and other surfaces, the patentee prefers to use the cellulose solution in a pasty and well-blended state, and heated so that it shall remain plastic; spreading it upon the paper by the use of a gauge, knife, and rollers, or other machinery, with the solvent still remaining in it, as by doing it is firmly attached to the paper or other surface, and two or more coats may be applied if it is desired to increase the thickness. When the coating has been effected the nitrate of zinc or other solvent can be removed by washing in water or alcoholic solutions. The articles so coated may be calendered or embossed or otherwise finished, and will produce upon the paper or other substance a fine hard flexible surface.

Sheets and other forms and hollow ware may also be moulded from the cellulose solution whilst the solvent remains in it, and the solvent

can afterwards similarly be removed by water or alcoholic or vegetable naphtha solutions, and the articles so formed may be further finished by rolling, pressing, or otherwise to consolidate them and give to their surface a finer and more ornamental character. The solvent of the cellulose may be first removed by washing the solution in an agitating or pulping machine, and the washed cellulose may then be pressed or rolled into sheets or other forms whether combined with pigments or not. It has also been found that the washed dissolved cellulose can be coloured by dyes or pigments, and in the pulped condition it does not lose the property of strongly adhering together when subjected to pressure and slightly heated in moulds or in rolling or spreading machinery; it can also be floated as in paper-making upon fabrics, or can be made into a substantial sheet alone, and on being calendered in the usual way it forms a fine vellum-like sheet or substance, as hard as ivory, tortoiseshell, or horn, and which being free from smell and also unflammable may be used for an endless variety of purpose. The hard substance formed as above can be turned in a lathe, cut with a saw, and shaped or finished into figures, animals, tubes, combs, buttons, knife handles, and other articles, plain or ornamental, and may be white or black, or coloured with a variety of delicate pigments, or dyes, as desired. In order to prevent the rapid combustion of nitro-cellulose, which has been an objection to the use of nitro-cellulose or xyloidine articles, the patentee admixes with dissolved nitro-cellulose, oxalates of lime or zinc, or phosphates of lime, zinc, or alumina, oxalates of magnesia, baryta and strontia, phosphate of soda and ammonia, ammonia phosphate of magnesia, tungstate of zinc, borate of zinc, and phosphate of zinc or boracic acid; of these substances phosphate of zinc is probably the best for the purpose; from 10 to 100 or 150 per cent. of the substances will be found sufficient to prevent the rapid combustion of articles made of the cellulose or nitro-cellulose substances.

THE PARIS ELECTRICAL EXHIBITION.—X.

OUR readers are aware that for transatlantic communications ordinary telegraph instruments are not up to the mark. Sir William Thomson's reflecting galvanometer is the only apparatus delicate enough for such work. It consists of a coil of wire in the middle of which is a small magnet bearing a little mirror. A beam of light is thrown upon this mirror and its reflection is received upon a white screen. When a current passes through the coil, the magnet is deflected to the right or to the left, according to the direction of the current, and the mirror greatly amplifies this movement. The spot of light goes either to the right or to the left, and the alphabet is spelt out just as in the single needle telegraph. Now, although this instrument is very delicate, it will easily be seen that it has several great defects. (1) It gives no permanent record of dispatches; (2) It requires a most experienced clerk to read by this apparatus; (3) It is a most fatiguing and dangerous task for the eyes of the telegraph clerks, who are obliged to remain for hours together in a dark room, watching the rapid oscillations of the spot of light. Sir William Thomson himself has been the first to outdo his own invention. His siphon recorder, which is one of the latest additions to the British section, is an important step in transatlantic telegraphy. The siphon recorder gives a permanent record just as the Morse instrument. Sir W. Thomson has made use of a very well-known property of electricity, which has hitherto been left aside altogether in telegraphy. It is a well-known fact that a vessel containing water or other fluid will not let the water escape if the only issues are capillary, if, however, we electrify the water, the repulsive force of the electricity will immediately cause it to stream out. We will now refer to Fig. 1 and 2, which represent the principal parts of the siphon recorder. E E are two powerful electromagnets permanently excited by a strong and constant local battery. C is a rectangular coil of wire in connection with the line-wire. It is maintained vertically by two small weights, W W. When the current passes through the coil C, it will be deflected to the right or to the left according to the direction of

11. This cistern is supplied with water through the ball-valve 12.

Housemaid's Sink.

Fig. 13 is a housemaid's sink, lined with lead and soldered 16in. up the angles, as shown at AAA. W is the waste-pipe from the cisterns: H a ground-in gunmetal cock, with a spanner to turn it; C the cold-water cock coming off the O pipe.

Fig. 14 is a round hopper-closet basin fixed into the dip of a U-trap 15. A 5in. strainer with lin. hole is dropped into the bottom of this basin, which is kept in its place by a piece of lead 3in. deep, tapered to the shape of the basin, and fitted as shown. The top of the basin stands 2ft. 2in. from the floor line, and the front of the sink 5in. higher, in all 2ft. 7in. The lead from the bottom of the sink is worked down into the basin, as shown at 16, and the basin is flushed with a 1½in. pipe and spindle valve, 17in. cistern 1. In the side of the U-trap is fixed a 4in. cap and screw, 18, and the waste or out-go pipe, H—S W (housemaid's sink) is 4in., branched into the soil-pipe S, which is continued to the top of the roof, and has a Stevens' exhaust cowl, 27, fixed on the top; 19 is a white washing basin, 14in. over, 2ft. 6in. high, having hot and cold water, as shown at 20 and 21; 22 is a 1½in. trap and waste-pipe, L W (lavatory waste); 23 is the overflow from basin to heel of trap, fixed 5in. above the water line. By tracing the pipe L W, it will be seen that it does not discharge itself into the soil-pipe, but into another and separate waste-pipe, W. On the top of the trap, 22, is branched a 1½in. ventilating pipe, 24, continued up above the roof, and having a "Weaver's" cowl, 25, fixed on the top. The 2in. waste-pipe, W, is continued to the top of the house, and has a Buchan's ventilator, 26, fixed on the top. The hot-water tank has a piece cut away from the side, in order that you can see the method of fixing the end of the flow-pipe, F, above the end of the return, R. The flow is the hot water from the boiler-pipe. The return is the cooler water passing from the hot-water tank to the boiler, where it mixes with the hot water, and again ascends in regular order. (This will be explained in detail in a future article.) This is known as the close tank system, and no draw-off pipe be at any other place than off the top, at 28.

Fig. 29 is the vent pipe, which must be well protected from frost, and taken above the water-line in cistern 7.

Fig. 30 is the manhole in the tank, to clean out or screw up the fittings. N.B. The air vent-pipe, 29, must never be taken the least below the top of the hot-water tank, but be fixed to the top with a proper flange.

The pipes, F R and H F are fixed with back nuts and grommets on the side of the stationary back nuts, because then the turning round of the nut does not cut the grommet away.

(To be continued)

EFFECTIVELY FINISHED AND CHEAP ENLARGEMENTS.*

WE will suppose that the enlargement has been mounted upon stout card, well rolled, and pinned upon a drawing-board. The picture should be moderately dark, with all the gradations fully brought out, the object being to let the photograph do all the work of drawing and shading, as by that means there is less danger of losing the likeness. With pumice-powder rub evenly all over the print, and when every part has been gone over, dust off every trace of the pumice-powder either with a tuft of cotton or a soft linen rag. Now take of your soft pastel, to be obtained at any artists' colourman's, the flesh tint which will nearest match the complexion of the sitter, and, taking a large piece of cardboard as a palette, crumble a little of the pastel between the fingers and thumb upon it; rub the tip of the forefinger into the powdered crayon or pastel until it feels smooth, and then transfer it to the portrait, rubbing the flesh tint evenly all over the face. Do not mind if it goes over hair, eyes, or whiskers, as it can easily be removed with a little bread. When this is done, there should be an even tint of flesh-colour all over the face, with the photograph showing through it, the shadows showing grey in contrast to the warm tint put upon it. One thing to be remembered in putting on this first tint is, that if the complexion is dark, it should incline to yellow; if fair, to pink.

* By G. SAUNDERS in the *Photographic News*.

Having got on your local tint, take the pink pastel for the carnations, and crumbling it upon the palette as before, transfer it with the finger to the cheek, commencing at the line which begins at the wing of the nostril, working downwards towards the corner of the mouth, then upwards towards the ear, getting less of the carnations as you reach it. Repeat this with a deeper tint of the same colour upon the shaded side of the face, and soften and blend this into the local tint with the tip of the finger, using it as a stump. It will be found necessary, perhaps, to use the crayon itself in some touches near the nose—for instance, where the photograph is apt to be deeply marked. This must be done with the sharp edge of a fracture, since it is impossible to point these chalks, as they are too soft. As a rule, you will find the carnations, as sold, too pink for male complexions, and, in fact, most female complexions. This must be corrected with a little yellow ochre, or any other yellow not too bright.

It is now time to do something to the shadows, which now look colder by contrast to the warm colours laid on. Take the Venetian red from the Swiss or half-hard crayons, and, after making a rough point upon a piece of coarse glass paper, carefully go over the deepest shadows, to warm them up in parts where they are very black; it may be necessary to use a brighter red to kill the black—even a bright red as vermilion may be used for that purpose; of course a little of it will go a long way: remember that you must only use just enough to kill the black without making the red too prominent. This must also be graduated with the finger towards the lights, the grey of the photograph and the thin layer of colour blending together to make the warm grey tints seen in the demi-tints of the face.

It is now time to attend to the other parts of the picture. With the soft pastel, cobalt blue and light red, mix a bluish grey upon the palette, and transfer with the finger to the background, making it deeper and warmer near the head, and lighter and colder as it is graduated into the white of the vignette. This can be done in the form of clouds, and very pretty effects may be obtained by mixing various tints of grey, and graduating them one into the other with patches of blue to represent sky showing between. The local tint of the dress can now be put in; if a black coat or dress, a bluish grey can be rubbed all over, not forgetting to graduate it at the bottom into the white. The local tint of the hair can also be put in, and your picture will begin to look finished. Now comes the most important part of the work. First, clear off any flesh tint which may have gone over the eyes with a crumb of stale bread, moulding it to a point with the finger; deepen the pupils with academy chalk for light eyes, or Conté crayon for dark ones; if they are blue or grey, mark round the outside of the iris with the academy chalk; next put in the local tint with the fractured edge of the proper coloured crayon. Then, in the same manner, touch in the high lights and reflected lights; the line of the lash must be defined with the colour of the eyebrows, and the brows themselves put in broadly without attempting to mark out each separate hair. The hair must be marked out with a darker tint of the colour, whatever it may be, and with dark hair a little light grey may be touched upon the high lights. All these touches must be done as much as possible without after-touching with the finger, the object being to leave them firm and spirited. Mark the division between the lip with Indian red; touch the upper lip with light red and vermilion; the lower lip must be touched in with the carnation used for the cheek, shaded with light red; then the high lights upon the forehead, nose, cheek-bone, chin, &c., can be put in with a light-yellow, graduating where it may be wanted, but as little as possible; the deepest shades in black draperies can be put in with the soft Conté crayon; and if high lights are wanted (upon a silk dress, for instance), a light-bluish grey pastel can be used, touched with firmness and decision; white lace or linen can either be put in with white chalk or Chinese white water-colour; jewellery is also best touched in with water-colour. When there are cast shadows from the hair, &c., upon the flesh, they must be touched in with a light-bluish grey for fair complexions, while for dark the grey may incline to greenish.

COLOUR-BLINDNESS.—IV.*

By R. BRUDENELL CARTER, F.R.C.S.

(Continued from page 180).

THE method for testing for colour-blindness must be adapted, it is evident, to avoid the sources of error which Messrs. Pole and Holmgren have pointed out as likely to arise from nomenclature, to avoid those also which might arise from the different luminosity of the various

* The substance of a series of Cantor Lectures delivered before the Society of Arts.

tests, and to be rapidly applicable in practice to large numbers of people. All these conditions are fulfilled by Professor Holmgren's coloured worsteds, and by these only; although there are many other methods of examination which are applicable for different purposes, and especially for analysing the precise nature and degree of colour-blindness in cases in which it has been already discovered to exist.

The worst conceivable test, that which on the one hand would allow a large proportion of the colour-blind to escape detection, and which, on the other, would cause persons to be set down as colour-blind who were not so in reality, is one which has been adopted, in pure ignorance, by certain railway companies, who profess to test the colour-vision of those seeking employment on their lines. This test, the worst feature of which is perhaps its superficial appearance of being satisfactory and complete, consists in the exhibition of red and green lights, alternately or in irregular succession, while the candidate is called upon to name them as they appear. In order to estimate this process at its true value, it must be remembered, that a red and a green light, under similar conditions of illumination, would not look alike to a colour-blind observer, who, if he were red-blind, would see the green light as the more luminous of the two; and, if he were green-blind, would see the red light as the more luminous of the two. Between the two lights, therefore, there would in either case be a distinctive difference of their apparent luminosity; and the person examined would manifestly have more than an even chance of being right in his guess as to which of the two was red and which was green; and would be able, if he were right the first time, to keep right all through the questioning process. An examiner who knew or suspected that the candidate was colour-blind, might be able to lead him into error if he had command of a contrivance by means of which the brightness of each lamp flame, behind the coloured glass, could be increased or diminished; but nothing of this kind has been ordinarily employed for the purpose, and it would at best be a troublesome contrivance. A man who was not colour-blind at all, but only dull, or careless, or imperfectly acquainted with the names of colours, although quite able to distinguish them, might easily call red green, or vice versa; and then the question would arise as to how many mistakes in the name of the exposed colour might be accepted as evidence of colour-blindness, or how many correct answers as evidence of colour vision. When thus regarded, it is manifest that the test is worthless; inasmuch as no colour-blind person would be likely to be wrong every time, and many colour-seeing people, of the class from which railway servants are chiefly taken, would be very likely to be wrong occasionally. Besides these objections, there is the further one that no test is satisfactory which rests in the least degree upon nomenclature. The object of the examination is to discover whether some given person sees colour in the same way as the majority of mankind, or in the same way as the colour-blind minority; and what the colours are called, either by the majority or by the minority, has nothing whatever to do with the real question at issue.

New the principle of Holmgren's method of examination is to compel the colour-blind to reveal themselves by their acts, altogether without reference to their language; and for this purpose they are not asked the names of colours, but are directed, from among a large number of coloured objects, to select the tints which match or resemble certain selected patterns which are placed before them. If the persons examined are colour-sighted, they will select only the correct matches for this purpose, while, if they are colour-blind, they will make certain definite mistakes which will disclose the precise nature as well as the existence of their defect, and which could be predicted by any who were previously aware of it. A person who was only careless, or a person who, if such a thing could be conceived, was simulating colour-blindness from mischief or from some other motive, but without adequate knowledge, would, so to speak, make the wrong mistakes, and would thus betray himself at once to a competent examiner.

For the purposes of such an examination, almost any coloured substances might be employed; but skeins of Berlin wool are found to present many practical advantages. They are cheap, easily handled, easily obtainable in every variety of tint, and therefore easily replaced when soiled or injured. Holmgren's full collection consists of about one hundred and fifty skeins, including red, orange, yellow, yellow green, pure green, blue green, blue, violet, purple, pink, brown, and grey; several shades of each colour, and at least five gradations of tint, from the deepest to the lightest. Green and grey, several kinds each of pink, blue, and violet, and the pale grey shades of brown, yellow, red, and pink, must be especially well represented. The normal-eyed readily selects the right ones from the mass; whilst the colour-blind,

miles of air, demolishes trees, rocks, and flocks of sheep, steeples, and massive bells. Here is an historical fact. A lady and gentleman were struck by a flash of lightning immediately after putting up an umbrella. They were taking a drive. Mr. Boddington's clothes were set on fire, the electric stream shattered his left hand, melted his gold studs, tore his raiment into shreds, burnt off his eyebrows and eyelashes, killed one horse, and nearly suffocated his wife, yet, strange to say, he recovered. These are vivid examples of electric tension. Clouds themselves appear at times to exchange their thunderbolts. I have seen myself an electric discharge dart from one cloud to another, covering a space of, at least, seven miles, in zig-zag majesty. This tension has many, I may say, almost infinite varieties. In frosty weather the air, commonly dry, is a bad conductor. The electricity of hair and silk is easily excited and strongly retained. Friction then causes such substances to crackle and sparkle. The lightning thunderbolt is an example, then, of intensity. A century ago Europe was ringing with the startling surprises of artificial electricity. Humboldt, in South America, witnessed the effects of this agent upon the wild horses of South America driven by Indians into the marshes, where the big yellow electric eels were swarming (some have been seen 20 ft. long). They rose from their native slimes, stunned the horses with their shocks, which then sank drowning, to be food for these prodigious worms. He describes the affright and terror of these helpless quadrupeds in language too vivid to be repeated without exciting the horror of my audience at this cruel Indian method of fishing for the eels by sacrificing the horses maddened with the cries and darts of the hunters, and the intense pangs shot through the water by these electric monsters. From such creatures as these, however, all the evidences of a generated electricity have been obtained: sparks, shocks, magnetic action, and chemical decomposition. This kind of agent is strictly voltaic—fuller in quantity, but lower in intensity, than lightning. But electricity, and nothing else.

Researches in both kinds went on hand-in-hand. Franklin electrified the world by drawing down the first lightning flash. His electric kite rose 550 ft.; a storm was approaching; black clouds blackened the zenith. At a distance of 5 ft. from the insulated string Franklin felt the strong sensation of a spider's web covering his face (I have often felt precisely the same thing from an electric apparatus fully charged). The wind rose, and with it the kite, to 700 ft. Three straws were dancing up and down the string—the largest a foot long, jumped up. At that moment a loud crashing report, heard in the centre of the town, proclaimed the fact that Franklin had drawn the first flash from the skies. It appeared in a spindle form, eight inches long and several in diameter. The long straw now ascended the string; long plates of fire and constant explosions attested its flight. Its movements were seen at a hundred yards distance. A phosphorescent odour warned the numerous bystanders of their danger, whilst a luminous cylinder of light everywhere irradiated the whole length of the string. Such a wild sight of electricity had the world never seen before. But Rickman, the Professor at St. Petersburg, was less fortunate. Emulating this daring feat, he erected a thunder-rod aloft. Distant thunder was heard. He approached the electrometer, incautiously inclined his head, when a vivid blue ball of fire shot from the instrument, which struck him in the forehead, leaving a small blue mark, but killing him on the spot. The force and heat of such discharges are irresistible. Haystacks have been found pierced with a perfectly-formed cylindrical hole, the whole of the silex or flint composing the vanished hay, being deposited below by the electric spark, vitrified, and of about the size of an infant's hand.

I cannot refrain from one more recital, communicated to the French Academy. At a village in the Lower Alps three masses of fire were seen by some persons to strike the spire of the church, which was thrown some distance. Within a priest in a silk gown escaped. Service was progressing; all the women in a moment were hideously dishevelled, many in flames; 80 persons were struck, 1 killed. A child was driven some distance out of its mother's arms. The misal of the priest was carried off and dashed to pieces: the lightning struck the gold lace of the robe, carried one shoe to the other end of the church—broke his buckle and the chair on which he was sitting, yet the weather was fine, and only a few large clouds were visible. Three great crashes instantaneously succeeded the thunderbolts. Edifices of enormous size are pierced occasionally by thunder-storms. Matthew relates that at T. at six a.m., after a brilliant sun, which clouds dimmed suddenly, and shortly covered the country with a thick darkness, accompanied by a north-east wind and incessant flashes. A lightning bolt struck the roof of the house, which was set on fire. The trees were destroyed, and walls overthrown, or rent by the hailstones. Strange electrical action!

The weakest form is seen in the Aurora. This beautiful appearance—a real transformation scene of nature's hand—is, perhaps, the loveliest of all celestial phenomena. It rays sometimes strike the earth. Ross and Parry were admiring the extreme beauty of the polar light, when they uttered an exclamation of surprise—both saw a bright ray shoot suddenly downwards between them and the land, three thousand yards distant. It has also been perceived to produce, not only a phosphorescent odour, but a crackling or a hissing sound.

The electrical action of the Aurora is most surprising in its effect upon the mariner's compass, especially when the centre of the Aurora arches coincide with the magnetic pole. From the days of Plutarch those celestial glories have been celebrated in history:—

Fierce fiery warriors fight upon the clouds,
In ranks and squadrons and right form of war.

Sir Francis Ronalds, in 1816, showed that electricity could be used to convey messages over long distances, yet so little notice was taken by the public of his discovery, that Sir Francis wrote he was taking leave of a science which once afforded him a favourite source of amusement, and of bidding a cordial adieu to electricity. At this time Sir Humphry Davy produced the electric light, but little, however, was known of the new form called voltaic. A few short years and another accidental discovery was made, which was pregnant with the grandest scientific effects the world has ever seen. Oersted observed, in 1820, that a magnetic needle was either attracted or repelled by an electric wire, i.e., a wire conducting a current of voltaic electricity. This crowned the science. Next, Ampère found electric currents in wires actually repelled and attracted each other. This led to the construction of galvanometers. Next, it was discovered that every bar magnet is surrounded with circulating currents, and every circulating current, especially in spirals, develops magnetic force. Further, parallel currents affect each other. They act and re-act, and this property is named *induction*.

It is just fifty years ago that the great Faraday communicated his immortal discoveries to the Royal Society—1831. Little did he then recognise the mighty results about to flow from these profound researches. He shows the extraordinary increase of electricity by introducing iron cores into spirals of electric wire, and the wonderful magnetising powers of these spirals. The papers are headed:—(1) The Induction of Electric Currents. (2) The Evolution of Electricity from Magnetism. (3) A New Electrical Condition of Matter. (4) An Arago's Magnetic Phenomena.

It was Faraday, above all others, who made possible the wondrous development of the present hour. Faraday wrote, "An agent which is conducted by wires, and possesses the magnetic actions of electricity, and can convulse and agitate the limbs of a frog, and, finally, produce a spark, can only be electricity." All machines for the conversion of work into electricity are founded on Faraday's discovery of the induced current; derived from the relative motions of a magnet and a coil of wire.

To the labours of Mr. Crookes we are indebted for the invention of the most perfect method of exhausting the air from "lamps of incandescence." Swan and Lane Fox have finally perfected the domestic lamp.

So far, electricity of high, low, and moderate tension has been alluded to. The last century was signalised by these researches. In the present time enormous advances have brought this subtle power under human control, not only when present in huge quantity, but in a state of very high tension. We have reached a new era in electrical science. This mysterious agent permeates all nature in various forms, degrees, and intensities. Everywhere the twin sisters, electricity and magnetism, are indissolubly united with each other. Every ray of solar light is enriched with the inscrutable combination. You cannot develop one without associating with it the other. The great discovery of the present era is the conversion, by mechanical power, of magnetic into electric force.

At the Paris Exhibition, Swan, of Newcastle, appears justly to carry the palm. Hundreds of little lamps, the size of a large egg, arranged in chandeliers, most pleasantly light up an admiring crowd. The lights are soft, mellow, yet effective. A touch on the wall instantly lowers, brightens, or extinguishes the light. A single lamp, they say, will burn its tiny wick 900 hours.

There are also big globes fit to illumine a sea fog, which draw their brilliance from steam power. Further: a single-copper wire, a lin. thick, conveys many a horse-power of force in electric energy again to be developed by proper manipulation into tremendous mechanical power. It is thus that Sir William Thomson has estimated that a copper wire over 3 in. in thickness, could convey under the Atlantic Ocean the mechanical force of the Niagara Falls in an electric form, again to be distributed in the towns of England, for lighting, driving locomotives, and a hundred other purposes. Equal in wonder is the newly discovered system of

electric storage. Power either for light or force can be sent by a train securely. It will, doubtless, be delivered in time to houses, to be consumed at will for domestic lighting or driving household machines. Still more marvellous are its works.

Dr. Siemens, F.R.S., applies it to grow fruit and flowers at night. The electric light, however, unless shaded by a sheet of clear glass, withers instead of producing vegetable growth. The electric energy is supplied by a small steam-engine driving an electric generator. The electricity thus obtained during the night is engaged in horticulture. By day the same energy is carried by a small copper wire to a great distance, and there works pumps and other machinery. It also lights up Dr. Siemens' house with many lamps of a delightfully mild effulgence. Sir William Armstrong illuminates his library, dining-room, and picture-gallery with 74 of these lamps of Swan, by a power conveyed a mile or more from a turbine. I hope myself shortly to light my own house with water-power furnished by our local waterworks.

DR. WERNER SIEMENS ON ELECTRICAL RAILWAYS.

THE following is the substance of the lecture delivered by Dr. Werner Siemens, of Berlin, at the Congress of Telegraph Engineers and Electricians held in Paris. It will be seen that it dealt mainly with the relative merits of magneto-electric and dynamo machines. Dynamo-electric machines are essentially distinguished from magneto-electric machines by the absence of any permanent magnet. In machines based upon the employment of permanent magnets, the strength of the electric current supplied by the machine depends upon the constant intensity of the magnetic fields across which the conductors, or the indirect electro-magnets, are passed. In the dynamo-electric machines, on the contrary, the permanent magnets of the old magneto-electric machines are replaced by one or several electro-magnets, in which the helix forms a portion of the general current. The intensity of the efficient magnetic field in the dynamo-electric machine is not, therefore, continuous, but only a function of the intensity of the current of which it is itself the first cause. If in such a combination the masses, together with the resistant forces, are suitably established, a minimum quantity of the magnetism retained by the electro-magnet will suffice to produce in the united conductors in this weak magnetic field a current susceptible of increasing the magnetism of the electro-magnet. The magnetism thus strengthened, increases, in its turn, the induced current, the one succeeding the other until an equilibrium dependent upon the construction of the machine and of the speed of the rotatory movement is established. Magnetism and the magnetic field defined by Faraday, the great investigator of induction, form therefore in the dynamo-electric machine only a transitory effect, or, if you like, an intermediate product of the transformation of the mechanical work in the electric current. It is on this account that, in describing at the sitting of the Academy of Science at Berlin in January, 1867, the dynamo-electric principle, I proposed to call the machines based upon this principle magneto-electric-machines, which produce electric current by means of existing magnetism. It is evident that the dynamo-electric machines also play the part of electro-magnetic machines, if they receive a current from another source, as, for instance, from another dynamo-electric machine. That is the direct result produced by the dynamo-electric principle, which requires that an electro-magnetic machine, however it may be turned contrary to its rotation, strengthens the electric current by which it is traversed, that is to say, it constitutes a dynamo-electric machine. Although a magneto-electric machine, combined with an electro-magnetic machine, may agree perfectly in theory, so far as regards the transmission of energy, and more particularly electric locomotion, yet in practice it does not attain that end. In the first place, the magnetism of the steel is exceedingly feeble compared with that of the electro-magnetism, and that involves magneto-electric machines of very large size if the object is to produce strong currents, such as would be necessary for locomotion. The placing together also of a large number of steel magnets involves for a brief period the loss of a great portion of their magnetism. Apart from this inconvenience of the magneto-electric machines, however, the fact remains that magnetism as an operation of the intensity of the current forms a condition of extreme importance in the application of the electric current to locomotion. If two machines of this description are placed together in the same circuit, and one of the two is made to revolve by exterior force with a determinate speed, while the other will have a variable work to perform, the work produced by this secondary machine will, to a great extent, remain almost independent of the speed of its revolution. It follows, therefore, from this that

SCIENTIFIC NEWS.

ACCORDING to M. L. Schulhof, of Paris, Dun Eclat Circular No. 36, Denning's comet, γ , 1881, has a period of $7\frac{1}{2}$ years. The elements he gives are T 1881, Sept. 13-07, Berlin mean time: $\alpha = 312^{\circ} 4' 17.5''$; $\delta = 51^{\circ} 34' 4''$; $\log q = 9.539675$.

Dr. Oppenheim, of Berlin, Dun Eclat Circular No. 37, gives the following elements of Barnard's comet, γ , 1881. T = 1881, Sept. 13-2553; Berlin mean time: $\alpha = 9^{\circ} 8' 26''$; $\delta = 25^{\circ} 25' 35''$; $\log q = 9.69454$.

The two juvenile lectures at the Society of Arts during the Christmas holidays will be delivered by Mr. Preece, the subject being "Recent Wonders of Electricity." A course of Cantor lectures on "Some of the Industrial Uses of the Calcium Compounds" by Mr. Thomas Bolas, will be delivered before Christmas, and there will be three other courses during the session.

The meeting to discuss the Society of Arts' Patent Bill will be held on Nov. 30th, and on such subsequent evenings as may be found convenient. The secretary will be pleased to supply tickets to any persons who, interested in the subject, are not members of the Society.

The Linacre professorship at Oxford, vacant by the death of Dr. Rolleston, will henceforth be known as the Linacre professorship of human and comparative anatomy. There are four candidates for the chair—viz., Mr. H. N. Moseley, M.A., F.R.S.; Mr. J. D. Cunningham, F.R.S.E.; Mr. V. Hatchett Jackson, M.A., F.L.S., demonstrator of anatomy in Oxford University Museum; and Dr. R. L. Anderson, demonstrator of anatomy, Queen's College, Belfast. The professor will receive from Merton College a stipend of £700, in addition to the emolument of his fellowship, to which will be attached a fixed annual stipend of £200 clear of Income-tax. Probably some other names will be sent in, but at time of writing only those mentioned were known.

At the opening meeting for the session of the Birmingham Philosophical Society, a report was read from Dr. Gore, in which he stated that since he had been intrusted with grants from the Birmingham Endowment of Research Fund, he had made, partly with the aid of those grants, the following researches in physics and chemistry, which had been communicated to the Royal Society, and published, as follows:—Thermo-electric behaviour of aqueous solutions with platinum electrodes; influence of Voltaic currents on the diffusion of liquids; experiments on electric osmose; phenomena of the capillary electroscope; electric currents caused by liquid diffusion of osmose; influence of voltaic currents on diffusion of liquids; and phenomena of the capillary electroscope. He hoped before long to submit to the Philosophical Society an original communication.

The first lecture of the session at the Midland Institute, Birmingham, was delivered last week by Dr. R. S. Ball, Astronomer Royal for Ireland, on a "Glimpse Through the Corridors of Time." The subject is one that has recently engaged some attention in our columns. In the course of his remarks the lecturer said: While the day was gradually lengthening through the moon's action on the tides, the earth reacted on the moon, and drove it farther and farther away. The circle described by the moon was, therefore, gradually increasing, and thus the day was getting longer and longer as the moon was receding farther and farther. If they looked back to earlier periods, the moon must, therefore, have been closer and closer to the earth. The farther they went back, and at one epoch, which he put at about 50,000,000 of years, the moon must have been very close to the earth, and then the day, instead of being 24 hours, would only be three hours long. The closer the moon was to the earth the more quickly it revolved; and, looking back to that remote period, they had the extraordinary state of things in which the earth was spinning round once in every three hours, and the moon rotating once in three hours also. At that time the earth was really a mass of semi-molten matter, and if the oceans were there at all, they were suspended in vapour round it. He showed that the nearer the moon to the earth the greater was the rise

of the tide; and he calculated that, when the moon was so near to the earth, the tides must have been 216 times as great as at the present time. Rising 240 feet high, the tides would have washed over the whole of England.

The Gresham Lectures on Astronomy will be delivered by the Rev. E. Ledger next week on the evenings of the 7th, 8th, 10th, and 11th inst.

The recent stormy weather has put a stop to Mr. Wragge's meteorological observations on Ben Nevis, the hut at the summit having been rendered quite untenable. It is suggested that the meteorological stations, especially those so elevated as the Ben, should be connected with the head office in London by subterranean cables.

The American electric light companies, with the exception of Edison's, have agreed to form an association, the holders of the Gramme patents having succeeded in convincing them that it would be mutually advantageous, as the majority of the machines were merely modifications of Gramme's. The Siemens machine is, however, open to all, as through some error the patent has been lost in the United States.

The Beaumont compressed-air motor is at last about to be put upon the North Metropolitan Tramways for an extended trial in actual work.

According to "A Brazilian" writing in the *Times*, permanganate of potash, hypodermically injected, is an antidote to snake-poison. It may be remembered that in Sir J. Fyfe's experiments in India, permanganate of potash, like the other suggested and tried antidotes, was found useless.

An expedition is being organised in the United States, to start next May, for Beacon Hill, Gibson Cove, in order to make further investigations respecting Franklin's expedition. Peter Bayne, who formed one of Hall's party, will accompany the expedition, and undertake a long sledge journey in the north west of King William's Land.

Native strontianite, which contains about 90 per cent. of pure carbonate of strontian, is now largely used in sugar refineries, the mines in Westphalia yielding many thousands of tons per annum. The strontian is used to extract the saccharates, with which it combines in the proportion of 1 to 3.

The limiting depth to which light penetrates in water was some time ago stated to be 40 metres for Lake Lemán, by Prof. Forel, who used albuminised paper in his experiments. M. Asper has recently made similar experiments on the Lake of Zurich by a slightly different method. He used the photographic plates called *emulsion plates* (more sensitive than albuminised paper), and immersed them during the night of Aug. 3, to depths of 40, 50, 60, 70, 80, and 90 metres. They were brought up after remaining twenty-four hours in the water, and treated with oxalate of iron. All the plates, without exception, were distinctly affected by the light. Thus the chemical rays penetrate in clear water to at least 90 metres depth.

Animal life in the Sahara has various interesting features, among which, the adaptation of colours is specially notable. The general colour of the ground is, of course, that of sand, and the scanty, greyish-leaved vegetation, away from oases, is hardly noticed, being covered with sand. Now (according to M. Vogt), one is struck, on coming from the coast, with the absence of all bright colours, red, green, and blue, in the animals of the desert. With few exceptions, their hue approaches that of the ground; the adaptation is most remarkable in birds, reptiles, grasshoppers, &c. Black and white exist in some animals—e.g., the male ostrich, which do not fear enemies; the female and young have some protection in their dappled, brownish coat. There is a single exception among insects—the Coleoptera are nearly all black. How is this to be explained? M. Vogt says that these insects have a disagreeable smell, and that all of them, when in presence of danger, feign death. In that contracted state, they are exactly like the excrements of gazelles, goats, and sheep. This, with their odour, is thought to afford them sufficient protection. Again, a number of animals, chiefly fish, but also crabs, larvae of insects, &c., are brought to the surface by the water of Artesian wells. M. Vogt looked

in vain for any of the usual characters of subterranean creatures in these (blindness, &c.), or, indeed, any difference from species in surface waters. This is explained by the fact that these animals have only a temporary sojourn underground; they pass down with the streams that partly disappear for a time, in tunnels in the ground, called "bahrs" by the Arabs. The artesian wells are artificial "bahrs," which allow of their return to the surface.

Asparagin is known to be an optically active substance, and it was found by M. Pasteur that in alkaline solutions it rotated the plane of polarisation to the left, in acids to the right. Herr Becker has lately described to the Berlin Chemical Society experiments made in order to determine the influence of different quantities of alkalies and acids. He used solutions of soda, and of hydrochloric, sulphuric, and acetic acid. The last acts much more weakly on the rotating power than mineral acids, and it is interesting to note that, with gradual increase of the acid from zero, a reversal occurs. The specific rotation, which in pure aqueous solution (1:300 molecules), is about 5° to the left, gradually diminishes, and with 10 molecules of acid, the activity wholly disappears. Proceeding further, there is increasing rotation to the right.

M. Jovis, an aeronaut well known in France for his perilous ascents over the Mediterranean, made a night ascent lately (Oct. 8th), from Saint Quentin, starting about 8 p.m. The balloon rose rapidly, and soon encountered very intense frost. It became covered with hoar frost, and the provisions were frozen. Several times M. Jovis observed the curious effect of the luminous shadow of the balloon on the clouds. A double, silvery-pale aureole surrounded the shadow, and, in descending to the earth through mist, he remarked that the shadow was bordered by a remarkable triple aureole. The descent was effected at Gaurin, near Tournay, at 10.30 p.m.

In the French Department du Nord, there is a nearly circular piece of water, called *The Mer de Fines*. In ancient times it seems to have been a place of pilgrimage, as is witnessed by numerous Roman and Gallo-Roman coins found in the mud, with statuettes and debris of pottery. M. Daubrée has observed, that though the water is cold, i.e., of ordinary temperature, many of the bronze coins have been profoundly altered. They are partly or wholly converted into sulphide belonging to that variety of chalkosine which Breithaupt named *cuprim*. They resemble in aspect, the Roman medals got at Bourbonne-les-Bains, but there is no thermal spring, as in that case, and one may affirm that there has been none since submersion of the coins, for the sulphide enveloping the coins has also incrustated numerous fresh-water shells, quite similar to those now met with in the pond.

It is known that the workmen in the St. Gothard tunnel have been largely subject to a painful disease, arising from presence of a small parasitic worm in the intestines. In a recently published memoir, Dr. Bugnion gives full information about this disorder. The nematoid worm (*Ancylostoma duodenale*) was first discovered in Milan in 1838; it has been met with in various parts of Italy; is extremely abundant in Egypt, and has also been found in Abyssinia, India, the Sunda Isles, Rio de Janeiro, Cayenne, and the Antilles. In the intestines of the first tunnel-workman who died of the disease (at this Hospital), more than 1,500 individual worms were counted. Many workmen have been severely afflicted, but the extent to which the fact, stated by M. Bozzolo, that the eggs of *Ancylostoma* in the stools of he examined, without exception, has prodigious fecundity. Happily not developed in the person who has the development begins in the excrement moist earth, and gains admission to it with unwholesome water. Dr. Bugnion minutely the symptoms of the the results of various treatment of it.

A recent chemical examination of cal organ of the torpedo, by Herr Naples Zoological Station, yields during life, the organ is for the most part alkaline, seldom neutral, contains, on an average, 89 per cent. ash, and 9.5 per cent. of tauts, of which latter Herr Weyl different substances. It is not

work, done more by scraping than by cutting, as in the successful execution of simpler designs in the softer woods. The specimens submitted by Mr. Coulson furnish us with almost perfect examples of this, the highest branch of wood-turning. I say "almost" perfect, because one scarcely likes to fix a limit to human skill; but it may be safely said that anyone who sets himself to produce better work, will have a very hard nut to crack. Mr. Coulson is a joiner, cabinet-maker, and wood-turner by trade. His workshop is situated up a narrow passage, in one of the leading streets of Thirsk, and is so choked up with wood, and a miscellaneous collection of things in general, that it is with difficulty one can move about in it. Mr. Coulson is at all times willing to show his lathes and specimens of work to those who are interested in such matters; but if anyone expects to see a hundred-guinea lathe by Holtzapffel, with appliances costing as much again, he will be disappointed. There are two lathes in the workshop, at one of which an apprentice is always working, and over the other of which Mr. Coulson himself presides; and these lathes are employed from morning till night in the production of cart-wheel-hubs, table-legs, pump-suckers, and a thousand other similar articles. Mr. Coulson's lathe formerly belonged to his grandfather, and was at length discarded by him as worn out. His son, however, rescued it from oblivion, and continued to use it as long as he lived. The lathe has 10 in. centres, rests on a long wooden bed, and has a heavy fly-wheel which runs on friction-wheels, and is fitted with a flat leather belt running on its circumference. There is consequently only one speed. The mandril is a straight one, and rattles in its collar with age and much usage. The poppet-head centre-point is so worn, that it has almost ceased to be a point at all. On this lathe then, and with the occasional help of an oval chuck, Mr. Coulson produces not only cart-wheel hubs, but also all his



ornamental work. I have often had the privilege of seeing him at work, and it may interest my brother readers to know that I have been unable to learn from him any special secret in connection with wood-turning, or to detect any royal road to the attainment of this fascinating art, for the simple reason that neither exists. What I have noticed is soon told. Mr. Coulson always works with sharp tools. The moment a tool has lost its fine edge down it goes to the oilstone. Also he is never in a hurry, but works with the utmost deliberation, and seems to prefer, especially when engaged on a delicate part of the work, to drive the lathe at a slow speed.

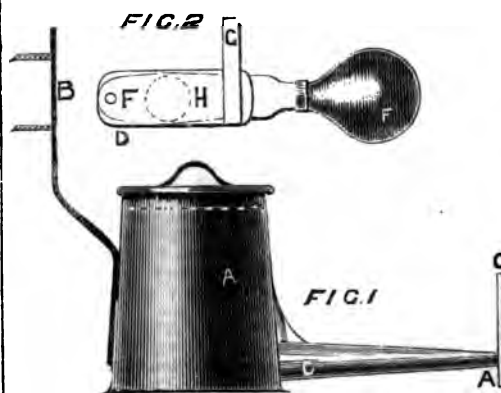
If anyone possessing an expensive and a complicated lathe will pay Mr. Coulson a visit, he will, it is to be hoped, return home a wiser man, and will have learned that an expensive lathe is not essential to the production of the highest class of work, but that the chief requisites are an artistic eye, a steady hand, a sharp tool, deliberation of purpose, and constant practice.

A Country Parson.

BRASHEAR'S SILVERING PROCESS.

[19370.]—I CERTAINLY owe a contribution to the literature on the telescope that is from time to time appearing in "our" valuable journal. This I had promised to several of your readers who are, I am pleased to say, personal correspondents through an introduction made by the letters I have

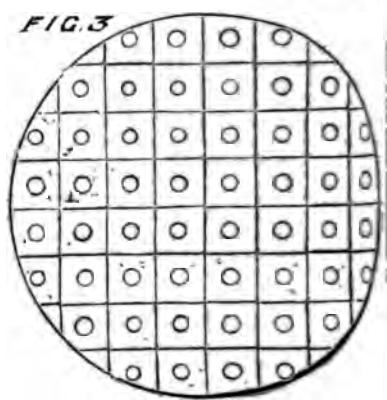
already written for your columns. That I may not waste time or valuable space, permit me to say that I am pleased to know that so many of your readers have had uniform success with the method I gave of silvering glass some time since. I note, however, that Mr. Holmes (letter 19260) has failed. I think I can possibly set him right. First, as to the potassa. I have found by practical working, and Mr. Geo. Clark, of Alvan Clark and Sons, finds the same, viz., that the amount of potash is not an essential element of success, for a less quantity can be used, as can also as much as double the quantity. I find equal quantities works nicely. When adding the ammonia, after mixing the silver and potassa, sometimes there will remain some floating particles of oxide; but never mind them if the solution is fairly clear. Now add the silver solution, which has been held in reserve until a decided yellowish-brown colour is obtained; and here I would add the italics, as I did before, *never undertake to silver without this colour*, for then you are sure that you have an excess of silver oxide, and no excess of ammonia, two of the most essential elements in getting a bright, hard, and thick film of silver. The solution may now be filtered, especially if there is any sediment. When the reducing agent is poured in, the solution changes to a reddish-brown, and then black, in less than a minute; and if the solutions are too warm, it is a difficult matter to get the glass in quick enough. So, to sum up, I should think Mr. Holmes' error lies in not having an excess of silver, as one is apt to drop in too much ammonia when he sees floating oxide undissolved. To give an idea



of how I have succeeded with this process, I would say that Prof. S. P. Langley recently asked me to silver three Heliostat mirrors for him, one a 12 in., the other two 7 in. diameter. He wanted these so bright from the bath as to need no polishing with the pad, as he intended them for a delicate experiment, in which it was necessary that there should be no microscopic scratches such as may be seen after polishing with the pad. The films came out beautiful and bright, though not so black as they can be made by retouching. I have only this to add, that the unexperienced had better take rather more, even double the quantities given in my formula. "J. C. L." and Mr. Bell (letters 19262 and 19263) have cleared up Mr. Baldwin's sky, and he should have no difficulty in following their directions. Mr. Bell's method of truing up the edge of a glass is nearly the same as I use, only I use a copper strip instead of tin. When the speculum is out of true much, I chuck it and turn it off with a "carbon diamond" tool, as I also do the face of glass, to approximate curvature. This can only be done well in a slide-rest, and, even then, care must be used to keep from splitting off the edge; but it is a very expeditious way of doing the work. Permit me here to offer, for the free use of "all whom it may concern," my method of making polishing tools for polishing lenses and specula. Of all things in the manipulation of an optical surface, making the polishing-tool according to the "stereotyped" methods, was to me the *nastiest* and most undesirable. Lassell's method is elegant, cleanly, and effective, but tedious. The method of smearing the tool over with pitch and then cutting or sawing out the grooves, at best, dirty and uncertain. As for the merits of my method, I shall leave the decision in the hands of those who, I hope, will try it. First of all, as to the material for polishing. I use only the black coal-tar pitch so much used in this country for roofing purposes, and I have no doubt it is plentiful in England. About .05 of its weight of beeswax is melted with it. Without any pulling or any other manipulation than melting, it is ready for use. Its chief advantages are toughness and good polishing qualities. There is no splitting off to annoy you, and it cuts like soft rubber when you desire to change the size of any of the polishing spots. Alvan Clark and Sons use it exclusively. To make the polisher I first have a copper vessel made like A, Fig. 1. This may

hold a pint or more. The pitch is better melted and mixed with the beeswax in another vessel, and then strained into this vessel, when it can be melted any time it is wanted by setting a spirit-lamp under the bottom. A flat curved handle B, made of lin. by jin. iron, is securely fastened to A, and has at its upper end two holes for securing it fast to any convenient place, preferably over a table, so that in making the polisher the left arm may rest on the table. The valve at the end of the spout C I have drawn half size at Fig. 2. It is really an old-fashioned treacle spicket in miniature. A copper-plate D is brazed on to the end of the spout C, in one end of which the hole F is made, and on the other the guide G is fastened. This guide is for the purpose of holding the plate H, which acts as the valve, close up to the plate D. The plate H is riveted loosely to C at F. The handle is of wood to keep the heat from the fingers. It is well to let the end of the spout project in front of the plate D, say 1-32nd of an inch. Then the valve-plate H will lie close and prevent leaking. The spout C can be made any length desirable. In practice it is well to have it made so that the spirit-lamp can remain under while making a polisher.

While I am laying off the polisher, I place an alcohol-lamp under the vessel, and get the pitch quite hot. The iron tool on which the pitch is to be placed is laid off into squares with a lead-pencil, and gently warmed. If the grinding-tool is used for the polisher, the pitch can be dropped on the squares without the trouble of laying it off. When I am ready, I run the flame of the lamp along the



spout, holding it for some time at the end, so that the pitch will cut off quickly. Now, holding the warmed iron tool in my left hand, I raise the gate-valve and let a drop of pitch fall on a square, and then move to another, and so on, until the tool is finished, which will be in less than five minutes for a 12 in. mirror. Objection may here be raised that it will be difficult to make the spots the same size. Slight differences in the size are not detrimental to first-class surfaces if they are well distributed over the polisher; but a little practice soon enables one to make nearly every drop the same size, and any differences may be corrected with a pocket-knife after the tool has been gently pressed on the speculum (previously well wetted) to give the proper form to the tool. It should then be cooled in water before using, as when the base is warm the spots are apt to spread too much. The pitch itself may then be gently warmed when the work is commenced. The shape of the polisher is like Fig. 1. I find the following advantages of this polisher:—First, the pitch being tough, will not splinter. Second, its keeping qualities are splendid; if kept clean, they can be laid aside and used a year afterwards. Third, the spots being circular there are no sharp corners to break off. Fourth, with proper polishing rouge, it gives a fine black polish. Fifth, from the nature of the material, the size of the spots can readily be altered by cutting without the danger of breaking, as in the resin polishers. And finally, the ease, quickness, and cleanliness with which it can be made. The whole apparatus can be made by any tin or copper-smith for, say, two shillings, and once made, will last indefinitely. The joints should be brazed, not soldered.

The pitch can be remelted at any time by the alcohol lamp; always remembering to keep the pitch in the spout quite hot by running the flame along it occasionally. Now, dear Editor, I am ashamed of this lengthy letter, but I hope it is of practical use to my fellow-workers, else I should not have spent so much of my own valuable time to write it. I have just returned from a pleasant visit to Harvard Observatory, and Alvan Clark's great optical works, and I will, with your consent in my next tell your readers some items of interest I saw there.

Jno. A. Brashear.

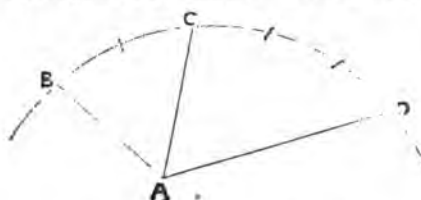
Pittsburg, Penna., U.S.A.

[Consent most willingly accorded. All English readers will be glad to hear something about the workshop of the great American optician.—Ed.]

INDIAN RAILWAY PROBLEM.

[19371.]—THE centre line of the East Indian Railway, in Bengal, was usually set out before any land plans could be made; on one occasion a long curve had been set out, a stake being driven at every 100ft., and a tall post erected every 1,000ft. The assistant who set out this curve having gone on leave, and no record having been left showing the radius, I went out with a theodolite, chainmen, &c., to ascertain what the radius was. I found, however, that owing to floods, I could not get within about half a mile of the curve, and nothing was visible but the tops of the long poles at every 1,000ft., and they were only visible from one point, A, owing to trees, &c., intervening. The curve, we knew, was of one radius throughout, but nothing more was known.

At the point A I placed the theodolite, and as I



could see the posts at B C and D, I read the angles BAC and CAD. The length of the line AB was also found by trigonometry.

The distance from B to C (measuring round the curve) was known, as it contained two intervals between the posts, each interval being 1,000ft., and in the same way the distance CD was known, as it was seen to contain three intervals, or 3,000ft. I require to find the radius of the circle from these data.

This problem can be solved by a tentative process by plotting the angles, then cutting trial curves out of paper, marking the distances on these to any scale, and finding where the points B, C, and D will coincide with the lines containing the angles. The radius of the curve which satisfies this condition will be the correct radius, but I would like to see if this can be done mathematically.

M.I.C.E.

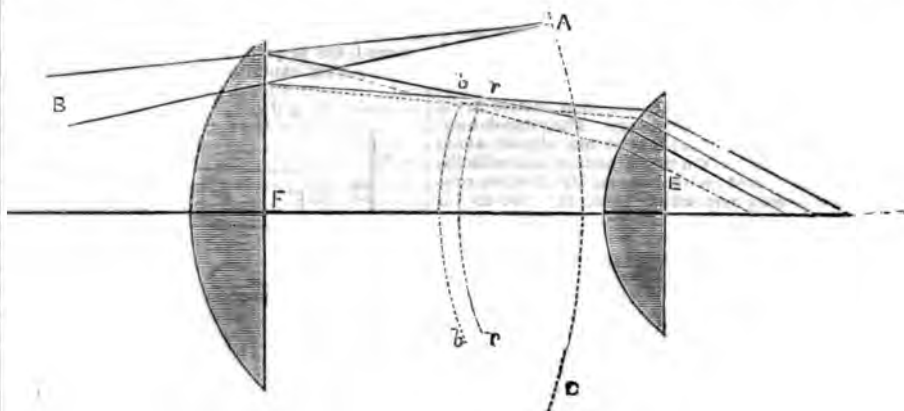
DOUBLE OBJECT-GLASSES.

[19372.]—THE question asked by "Query" in (45082), admits of a very short answer; but as the subject is rather interesting to many readers, I trust you will be able to grant me space for a few remarks in extension of my reply.

The partial achromatism of the Huyghenian eyepiece is an effect arising from the circumstance that the refracted image produced by the object-glass falls between the combined lenses. If this were not so, the combination of convex glasses could have no power in combining chromatised light. In general cases of refraction, it is necessary that one of the lenses shall be concave, in order that the dispersions may be in opposite directions. Achromatism is best attained when the correction is produced by two lenses in contact, for it must be remembered that the effect of the concave lens is to make the directions of all the coloured rays parallel, not to combine them in one point; so that the less separated the rays are allowed to become the more perfect is the achromatism. In the dialyte, in which dispersion is balanced by a combination considerably distant from the object-glass, I imagine achromatism is only obtained with central pencils. In a simple telescope with a concave eyelens, achromatism is more or less obtained, which accounts for the clear but contracted field of such an instrument. The foci of a convex and of a concave lens may be proportioned so as to destroy chromatic aberration, and this is the only case in which two such lenses can be employed alone. Thus let F be the focal length of a crown lens used as the object-glass, and f the focus of a flint concave lens used as an eyeglass. When this lens produces distinct vision to an eye placed behind it, its position must be a distance in front of the crown focus equal to its own focal length; that is $(F - f)$. Now, if δ be the dispersive ratio, in order that two separated lenses may achromatise, it is necessary that $\delta = \frac{(F - \delta^2)}{F \cdot f}$. Substitute for δ its value in this case—viz., $(F - f)$, and there results $\frac{f}{F} = \delta$. Therefore, when the crown

focus is F , the concave flint focus must be $\frac{F}{\delta}$, and the instrument will be achromatic. It will be seen that very little magnification can be produced by such a telescope; for as the power is $\frac{F}{f} = \frac{1}{\delta}$, and δ is not often less than 0.5, the magnification cannot exceed two linear or four times superficial.

Let us now transfer our attention to the Huyghenian eyepiece. The annexed diagram will show its action. Let B A, a pencil transmitted by an achromatic object-glass, converge to the point A. By the convergencies of successive pencils, a curved image, A C, is formed convex towards the eyelens. But by the refraction of the field-lens the curvature of this image is reversed—that is, it is made concave towards the eyelens, and is thus in a proper form for being transmitted distinctly to the eye. But there are other effects produced by the field-lens. The various pencils are brought to foci nearer to the lens and nearer to the axis also! but dispersion is also produced, the blue rays converge on the front curve bb , and the red on rr . This chromatic effect is not altered by the second lens, neither can it be destroyed by separating the lenses. If the points b and r were in the same line, it is obvious that some dispersion would be caused by the second lens; for in order that all coloured rays may be parallel on emergence, the positions of r and b should be reversed. But a partial compensation is effected in this way. The blue rays of the pencil B A, being more refracted than the red, come to a focus in bb nearer to the axis than the corresponding red focus in rr . In passing to the second lens, the slightly greater incidence of the blue rays than the red compen-



sates for the extra refraction of the former, and both rays emerge parallel. This is the effect which is produced by properly adjusting the separation of the lenses, and constitutes the whole action of such a combination, in producing partial achromatism. The dispersion produced by the field-lens is not neutralised, so that when used with an achromatic object-glass the image is under-corrected for colour, that is, at the focal point. There will be superfluous red rays outstanding. This under-correction may be neutralised in two ways: first, by over-correcting the object-glass. If the pencil B A, instead of being achromatic, had its red focus at A and its blue focus slightly beyond it—that is, over-corrected—then the refraction of the field-lens would cause the curves bb and rr to coincide, and achromatism would be attained. Or the same result might be obtained by achromatising the eye-lens. For the pencil falling on this lens, is over-corrected, since b is beyond r ; and if a slightly under-correcting concave be combined with the convex eye-lens, the eyepiece will be achromatic.

I hope my querist will now understand that for general cases of refraction of parallel rays, the Huyghenian combination has no effect in correcting dispersion, but rather the reverse. Dr. Wollaston advocated the use of this combination as an efficient simple microscope, being under the impression that its self-contained capacity for correcting chromatic error held good in all cases. But Dr. Pritchard found that under the altered conditions, the ordinary rule for separation—half the sum of the foci—was not applicable, and that the best correction was obtained when the lenses were a distance apart equal to the difference of their foci, their thickness also being taken into consideration. If the foci are in the ordinary proportion of three to one, this is the same as the common rule, but with short foci lenses, it is difficult, if not impossible, to define the relation between foci and separation.

Orderic Vital.

TRICYCLE.

[19373.]—NOTHING could be farther from my wish or intent to "tread on the corns" of Mr. Dicksee, and I certainly regret that he should have felt it as such. If there is one thing that I dislike, as showing narrow-mindedness, it is the use of personal attacks. What I stated was simply my opinion, and by no means intended for one moment as directed against him, nor with the idea of the

slightest personal feeling, and I therefore trust he will take this statement as I meant.

Now here, for instance, are a series of points on which I differ from our good friend Mr. Dicksee. I well know that the great majority of us are apt to think that the particular make of machine we ride is the best. But although I do not claim that I have a better-balanced mind than the other gentlemen who contribute to your columns, I endeavour to weigh as carefully as possible the points of each case, and to do equal justice to each. Therefore, even on this ground alone, and quoting the oldest historical authority in the world, I would remind our friends that "a wise man altereth his mind often—a fool never." I think this should be borne in mind always, and should show us that if circumstances occur that prove to us that we are wrong in theories we hold, there is no disgrace in altering opinions, rather than uphold them in words although we are secretly convinced that we are maintaining theories *not* based on fact. But this more particularly refers to what I have to say later on. And desiring to clear the ground as I go, I would say to Mr. Dicksee that I much regret that I am too far from town to avail myself of the acceptance of his proposal; but allow me to say I think it a very good and practical one, and likely to produce real practical results. Nothing so much

convinces a man, even against his will, as actual experience.

I would add a few words on the opinions of Mr. Dicksee, however, on a point or two on which I considerably differ, and I will state them thus: (1) That in my opinion it is the reverse of advantageous to place the rider exactly over the wheels, and hence my statement that I consider the best position to be so that the rider is just behind a vertical line which should pass upwards through the centres of the treadle-shaft and the wheel-axes, and I would illustrate it by stating that supposing the rider was placed on the vertical line, in going down hill, the centre line of gravity would be actually leaning forwards. This would not, until it obtained a very considerable excess, cause any danger of tipping up, but would make it feel uncomfortable, and too far forward. Possibly both Mr. Dicksee and myself really mean practically the same thing, but state it differently; and I would, therefore, say that when I say place the rider "behind the vertical line," I would explain that, from experiments made to obtain the greatest possible power from the human frame, it was shown that the centre of gravity of the man should be represented by an inclined line backwards from the line of vertical pressure. Otherwise, on a rotatory action, the foot travelled so far to the rear of the producer that it passed his centre line, and that power was lost thereby. Let me add that if Mr. Dicksee was placed on a machine to correspond with a vertical line passing through the treadle-shaft, the wheel-axes and his own theoretical centre, although it would appear perhaps that he could apply pressure by simply straightening his leg and standing vertically on treadle-shaft, yet he would quite fail to give off a uniform pressure of the same amount, owing to the action of the feet in passing to the rear of his centre line as if he was placed slightly to the rear. The best result has been produced when the rider is so placed that when the leg is extended to reach the crank on the bottom centre, the knee of the rider would be, say, 1 in. behind the centre vertical line of treadles and wheel-shafts. Now this is as close to being over the treadles as is well to get, and the greatest power is exerted when the rider straightens himself and forms almost a straight line, falling just to the rear of treadle and wheel-axes. Now many of the best open-fronted machines are so arranged, and I note that the "Nationals" are all arranged that the treadles and wheel-axes are both on the same vertical line. But when our friend instances the case of the

being pushed or being drawn over on an obstruction, he argues most strongly in favour of the hand-steered machines. Nearly all the championship races having been won on hand-steered machines, it certainly looks as though, in practice, this class must run easiest, in spite of the fact that the rider cannot be directly over the treadles; although, no doubt, it would be found that they were placed just as I state, immediately behind the vertical line.

(2) The argument and fact adduced are favourable to double-drivers, provided he was back pedalling. But otherwise it was simply a question of the brakes being equally applied. And I really fail to see how the question of the double-driver much applies, and the fact of one wheel being caught by a stone would not necessarily cause a back-steered machine to swerve. On the question of single v. double-drivers, I would mention that the Scottish Championship race was run with the roads in a dreadful condition, and up and down hills as well; yet the winner rode a single-driver. On my single-driver I can travel just as you state with my hands off the steerage as he states, therefore, on the level, the advantage (if any) does not appear.

In mentioning the Arrow tricycle, the inventor is wrongly named. It should be "Grout," not "Grant." If I have transgressed in mentioning am sure I sincerely apologise. But as I do not even know who the proprietors are, the machine itself only having come under my notice, I erred in ignorance that I was transgressing. I can assure Mr. Steel I never had the least idea of advertising them, or any one else.

I think that the double chain-driven machine does run a *very* trifle harder; but so little that the extra power on a hill more than counterbalances it. And the difference really is very slight. The double driving of the Salvo with the one chain is done by means of what is sometimes termed "differential gear." It consists of three bevel wheels at right angles, the centre wheel being the primary driver of all. It has long since been used in loom and even traction engines. But these last have a pin to lock the gear at any difficult point. When first applied to machines it was termed "balance" gear, and this it surely is. Now, as a *practical* test, if we take such a machine and block both drivers off the ground; now turn the crank as if the machine was at work on the road, and round go our wheels. But if we place our hand against one wheel we can easily stop it, although the crank-shaft is still revolving, and the other wheel still going round. So that really only one wheel drives, and that, unfortunately, is the one that in rounding a corner would describe the smallest curve; therefore I submit that I am right. When the resistance is equal, then both wheels would drive; not otherwise. So that with every change of resistance the driving power is alternately shifted from wheel to wheel. On turning a corner, not to upset the balance of the steering, the outside wheel ought to drive, whilst the inside one should do as little as possible. By this means the driving-wheel does not tend to drive the machine one way and the steerage the other, but both work harmoniously together—and this is one of the strongest points possible in favour of the National machines, so that they steer round a curve most perfectly. The original patent as applied to tricycles was, I believe, the property of the makers of the "Salvo," although with very slight alteration it is now used on several machines. The weight on the front wheel in front-steered machines is such that no one, except they actually saw it proved, would credit the force it takes to drive it over obstacles, such as stones, &c., and hence Mr. Dicksee's argument comes in with great force in favour of a steering wheel that is drawn, not driven. But on the question raised by Mr. Steel at the end of his second paragraph, I certainly consider that the wheel which travels farthest requires the most force applied to it, and hence the outer wheel should, in my opinion, drive, not the inner one, which would be the case with differential gear.

Time will not allow me this week to discuss Mr. Steel's proposed machine, but in a later issue I may have something to say on the idea.

Mr. Westropp exactly states my idea of the position of the seat. A short time before he was kind enough to write me on the matter. I tried an inclined and springing seat, which rose as the weight was taken off. A day or two ago I took it off again and replaced it with a flat seat. I need only remark that the loss of power was something marvellous. When at rest or on a level I sit on an inclined plane really, and in riding up hill on a still "teeper" one, so that, as he states, one only leans, as it were, against, not the edge of the seat, which would be painful, but against the full surface of the seat, but more steeply inclined. I, therefore, am happy to say that the plan of a rising inclined seat certainly is a great help. At first it felt unsafe going down hill, but that feeling has quite worn off, and in its place I feel a command over the pedals that I never did before. I am further

modifying the seat, and will shortly send sketch and description.

I will let him know further on the "National" double driving-gear shortly. To his eighth paragraph, that the machines he quotes necessarily do not require a safety-stay, as the rider's weight falls well on, if not in front of, the wheel axles, but at the same time the pedal shaft is in front of both rider and wheel axles. As to size of wheel I have not altered my opinion as to that at all. I simply stated that as far as appearance goes that a large wheel, though it may have to be speeded down, looks well, but I do not say it runs better than the smaller wheel, either gearing up or level. By "easy to ride" I do not mean to propel, but easy as far as jolting motion is concerned, so that I hardly see the application of "What next!"

Sunlight.

[19374].—I HAVE taken much interest in the discussion on the subject. I have tried all sorts of machines, both rotary and lever, back-steering and front-steering. Except for its great weight, which I hear is now reduced, I think the "Salvo" far and away the best and most scientifically-planned machine in the market. A lighter machine is doubtless faster, and may be better for hill-climbing, but then they are so lively that on a rough road both machine and rider get more jolting than is conducive to the well-being of either. The seat is so exactly over the axle that I have frequently run for many yards with the steerer off the ground, the perfection of the double-driving gear keeping the machine as straight as it could be steered. It is in curves that the double-driving gear comes into action; in surmounting obstacles I always found both wheels act together perfectly. My experiences of a back-steerer were tolerably extensive, and by no means felicitous. When one got well over the pedals going up hill, the back-wheel generally kicked up and declined to steer to any useful purpose; in fact, on one occasion it kicked me out on my nose, while the machine ran backwards down the hill, finally turning one or two somersaults, seriously deranging its internal economy, and rendering it necessary to drag it by hand to the top. I christened that machine "the stone of Sisyphus." I never found the tail-wheel of my "Salvo" of the slightest use, and finally as it persisted in rattling and was extra weight, I took it and its supporting rods, &c., off altogether. People said I should fall backwards and crack my head, but I did not. I consider the strap-brake, when applied so as to act on both wheels, far better than any spoon. The objection about grease is more in idea than in reality. But if the brake-wheel is not protected it will occasionally get clogged with grit and dust, but a moment's attention when oiling up will prevent any undue accumulation. I rode a "Coventry" for some time, with a ground-brake. It was a mistake. It took part of the weight off the steering-wheels; it jarred the hand that applied it most unpleasantly; it caught in every obstruction, and made the machine steer wild, and even swing round; on really steep hills it was quite powerless, unless applied with such vigour that it lifted the machine bodily off the ground; in fact it had all the faults a brake can have, without any countervailing advantage, except that of making an awful row, to let folk know that something was coming along presently. My *beau idéal* of a tricycle is: a front steerer with double driver, 50in. wheels geared level, 6in. throw of cranks, seat as near as can be over the main axle—and a seat, not a saddle, in spite of its assumed advantage; comfortable feet-rests, pedals always remaining in gear: as a reserve of brake-power, an effective hand-brake, acting on both drivers at once; all bearings either balls or rollers; the whole machine made of best materials, and as light as consistent with strength. Luggage to sling under main axle. With such a machine, though it may weigh a trifle more than a light "open-front," more real work can be done with greater ease and comfort; and, though on perfect roads the light machine might possibly attain greater speed (though even this I much doubt), on an average of high roads and turnpike roads, the front steerer, with its big drivers, would simply "lose" the "light racer." Hill-climbing—that is, real hills, not mere inclines—is waste of power and time, and, on a long journey, means fatigue and 20 miles less a day. I may add that I have ridden such a machine from London to Weymouth, via Andover and Salisbury, in two consecutive days, and back, via Wimborne, the New Forest, Romsey, and Guildford, in two more, also consecutive. Anyone who knows these lines of road will know that both these journeys will try a machine pretty high. I came out of Ringwood with a bicyclist, also bound to Romsey. At "Pickled Port" he left me, saying he wanted to get on. I was in Romsey 20 minutes ahead—so much for getting on. The rough descents were too much for him.

Treadle.

[19375].—I HAVE taken considerable interest in the discussion on this subject, and quite agree with

"J. H." (letter 19331, p. 162), that the speed of the rim of a 40in. wheel is the same as that of a 50in. wheel or any other size, so long as they are running at the same number of miles per hour, although the revolutions per minute differ. It is absurd to think that any one would say that the number of revolutions are the same as "Sunlight" (letter 19353, p. 184) seems to infer.

Let me give an illustration which I think will convince anyone. Take an ordinary foot-lathe, the fly-wheel of which has a gut driving a smaller pulley on the mandril, which must run exactly the same speed as the fly-wheel, and suppose the circumference of the former is 1ft. and the latter 5ft., then the small pulley would make 8 revolutions to one of the fly-wheel. Now imagine that the gut between the points where it touches the two wheels is the ground, and the illustration is complete. According to "Sunlight's" theory the rim of small wheel in this case ought to be running at a considerably higher speed than that of the large one. If so, how does it contrive to slip under the gut?

29th Oct.

E. L. P.

[19376].—I READ the ENGLISH MECHANIC every week with great pleasure, because I am very desirous of having a good tricycle, and await the show in February impatiently. I do not approve of the three-track machine, with hind steering-wheel in the medial line of travel.

The National Tricycle Company have a two-track machine with antifrictional roller gearing, but unfortunately it is not *double driving*.

"Sunlight" does not mention this No. 2 machine in the last No. of ENGLISH MECHANIC (19335). I should like to know if there is more danger of a capsize when the steering-wheel is placed behind the off-driving-wheel. If "Sunlight" has ridden this No. 2 two-track (National), I should like to have his opinion. If any other correspondent will give his experience of it I shall feel grateful.

I am decidedly against single driving and three-track machines. I do not think a brake acting on the steering-wheel can be efficient or safe. I expect the best brake will be a ground-brake, acting upon the hubs and frame simultaneously, instead of the circumference of wheels, and a part of the mechanism of "the tricycle of the future."

Mr. Stapoole Westropp's last letter (19328) is very interesting, as suggesting that every person has his proper (medium) wheel, which also has its proper length of crank, the adjusting of seat accomplishing the rest that may be required. Is it so? I am not a mechanist, or experienced tricycle rider.

I fancy the tricycle which requires fewer turns of the crank to carry the machine a certain distance, say, a mile, must be the most agreeable to travel on. Does the large wheel speeded down do this?

Verax.

[19377].—I AM a traction-engine and thrashing-machine proprietor, and consequently have a deal of getting about, and have long felt that availing myself of this means of locomotion would be a great boon to me. My first essay was with a "Coventry," lent me by a friend. Well, this machine suited me fairly, but still not well enough to induce me to invest; and there is certainly a decided tendency towards the defect mentioned by "Sunlight" in his letter of this week. I next did a little riding on a No. 1 "Salvo," and although I consider this machine far better than the other in principle, it was a heavy goer. Since which time I have done a good bit with an "Excelsior" 50in., and my first experience with this machine was to get a nasty spill coming down my first hill, which led to dislocation of my elbow—one of the most painful accidents I ever had.

Still, after a year's interval, I have ridden this machine much more successfully, but I don't like it, the seat being especially defective. And here I would add that I have always been of the same opinion as "Delta" with regard to front-steering, particularly when combined with good brake power such as is found on the "Devon" for instance. And before the tricycle is to occupy a thoroughly useful position before the public, I consider that the general run of prices must be lowered and the efforts of the National Company, Coventry, I consider most commendable in this direction. Their No. 5 machine seems to come far nearer to my idea of practical utility than anything I have seen yet. The only think I don't like is the hind steerage and brake, and as soon as I can hear the character of this machine I shall feel tempted to invest. I have particulars of a machine on this identical principle designed by a Mr. W. Service, in an old No. of "our" journal, 1868 or 1869 I think, and there it is spoken very highly of.

I am sorry to say that I don't predict a great deal from any of the elaborate systems of hill-climbing gear, discussed by your correspondents; my opinion being that to a practical man, direct action, a medium-sized double-driver, and walking

what this won't effect, will be the simplest way of meeting the difficulty. Thomas J. Scott.

TRICYCLES—ADJUSTMENT OF FLAT.

[19378].—"SUNLIGHT" has, in the discussion on tricycles, occupied three times as much space in the present volume as any other writer, and the value of the theoretical portions, at any rate, has been tolerably apparent from time to time, especially in his remarks on "centrifugal force," which have culminated in the first par. of letter 19353, p. 184. I am astonished to find him defending his statement at all; he might as well have called it "gravitation," or a "forward tendency," or anything else, as "centrifugal force," with which it has nothing whatever to do. Let me assure "Sunlight" that "J. II.'s" titles are all right, so far, and that even a superficial knowledge of elementary mechanics would enable him to see this. Before he replies to this letter, let him calculate, if he can, the precise speeds of the peripheries of 40in. and 50in. wheels travelling at 10 miles per hour. Comment is unnecessary to those who know anything of arithmetic.

As regards "Guido's" second disadvantage (letter 19357, p. 186), I would say that the smaller wheel would be stronger than the large one for same weight—four times as strong as it seems. There would, of course, be an increased strain on the bearings of the pedal-shaft with the smaller wheel, but there would, on the other hand, be less friction probably; indeed, there might be almost more on the driver-shaft. "Guido" having conceded some of his claims, we almost agree in the matter now.

The reasons Mr. A. H. Dicksee (letter 19354, p. 185) gives for preferring front-steering machines are curious. In the first he gives us to understand that it is easier to get over the pedals in a front-steering machine, than one that steers behind, which is incorrect. The remainder of No. 1 is also wrong, and the analogy with the hand is entirely imaginary. It does not matter, as far as holes are concerned, whether the rider is a foot before or a foot behind the driver. His No. 2 I substantially agree with.

I see I did underrate the eccentricity, but I do not see it from Mr. Westlake's diagram, as he says I may (letter 19340, p. 154). However, if I underrate it, Mr. W. appears to overrate it quite as much; instead of it being, as he says, more than 1-16in. at 12in. from focus, it really is 0-03665in. in my hypothetical 12in. 9ft. mirror; that is to say, the central ray is 0-0525in. from the centre of the mirror. Paugul.

QUADRICYCLES.

[19379].—MAY I be allowed to inform Mr. Charles F. Steel that his idea (of a quadricycle, combining all the advantages he mentions), is not a new one, I having thought the same thing myself a few months ago, and that I am having one constructed on that principle, and hope, in the course of a week or so, to let him know the result, which, I believe, will be satisfactory in every way? The two large wheels on my machine drive and yet revolve independent of each other when turning, no clutch, ratchet, or any other gearing being employed; the steering is effected in a novel manner, is not so sensitive as in the majority of the tricycles now constructed, and cannot possibly throw the rider or machine over. The crank arrangement can be adjusted to suit any length of leg or state of roads, the saddle or seat being so placed that the rider is nearly in a line with the centre of crank-shaft; the steering-handles are also in line of crank, and are adjustable to suit any length of arm, enabling the rider to exert the force of his arms and shoulders in propelling the machine. Respecting weight, it will be a trifle heavier than a tricycle, but the great advantages obtained will make up for that, and besides, it will run over rough ground easier and steadier, which is not the case with a three-wheeler; will drive backwards as well as forwards, no catch of any kind being used. The only drawback will be, I am afraid, whether the machine will be a good hill-climber by the small wheels going first, if not, I can alter seat so that rider can sit with his back to steering and drive large wheels up first. The brake will be a tire-brake, but with very large spoons, inside which will be covered with leather, and will be applied with the foot, acting as a rest as well.

Oct. 29.

H. Howell.

[19380].—MR. C. F. STEEL has thrown out a suggestion (19355) that is worthy of serious consideration. Such a plan for a quadricycle as he indicates has been in my head for a considerable time past. Mr. Steel states well the advantages such an arrangement would possess.

The practical difficulty I apprehend is to determine the proper width of the machine. In the springtime, before the road-crust is worn down to a general smooth surface, the advantage of having only two tracks must be enormous. But to be a

success, when one track coincides with a cart-wheel track the other should run in the horse-track, or both tracks should coincide with average cart-wheel tracks. The former arrangement would necessitate a very narrow machine, like the "Coventry," the latter a rather wide one.

STEADY STEERING.—I have been using for a couple of years a little dodge of my own invention that I have never seen suggested by any other rider. The arm that directs the rudder is attached to the ends of two bellhanger's spiral springs. Indiarubber cords would probably act just as well. The other ends of the springs are fastened to fixed points in such a way that the tension of the springs when at rest is exactly equal, and in opposite directions. By this means they tend to keep the rudder in the position for going straight ahead, and to restore it to this position if it has been moved from it by the action of the steering-handles. The rider can take his hand off the handle to fill and light his pipe, put on his gloves, &c., without any danger of being suddenly run into a ditch. He can push his machine straight up a hill without having to keep hold of the steering-handle; and when rushing down-hill at full speed the steering is delightfully steady. At first the steering feels a little stiff, but this sensation wears off in a day or two. I could not ride comfortably now without this simple arrangement. When, for experiment, I have sometimes removed it, I found the steering required far more attention without than with it. The whole thing costs only a few pence. Will someone who uses and understands the "Salvo" say if "Sunlight's" views upon its double-driving mechanism are correct?

Oct. 29.

W. H. Stacpoole Westropp.

MEDICAL REPLIES.

[19381].—ON palpitation (45076) "E. M." states his case pretty clearly, but he should have stated his weight. If heavier than when in best condition at 30 years of age, by starving down to that weight he will probably get vastly relieved. Many cases of palpitation in middle-aged people are simply the palpitation of the fat ox. They carry half a hundredweight of fat about, and get their hearts encumbered with fat; but this accumulates so gradually, and they have so accommodated themselves to it, that it never occurs to them to ascribe it to their redundancy in carcase. Getting fat is a graver disaster than is generally realised. Fat people may safely starve down at the rate of a pound a week, and sometimes more. Weigh every week and note weight carefully. Attempting to work fat down is a dangerous error. Do what work the body can safely bear, but with a heavy carcase extreme fatigue is very dangerous. Stop fat from going in, instead of using yourself up to work it out. Fat people who suffer with palpitation find their attacks aggravated by flatulency. The reason is that the heart lies upon the stomach with only the diaphragm between, and the stomach, when distended with wind, pushes the heart up out of its place and doubles up the great vessels which suspend the heart in the chest. Thus the heart loses its footing, and cannot bring its muscular power to bear properly, while at the same time a mechanical obstruction is set up to the discharge of its blood. Extreme distension of the stomach often kills patients who suffer from this condition of heart. Therefore, such people should avoid flatulency. This may be done by selecting food carefully, masticating it very carefully, and making a business of each meal. Flatulency may be relieved by a tumblerful of hot ginger tea. If this does not suffice, take a teaspoonful of sal volatile in a wineglassful of tepid water. Carefully avoid quack medicines and vulgar receipts. They do harm ten times for once that they happen to do good. If "E. M." be spare in person, he probably has some defect in the valves of the heart left by old rheumatism. In that case rest, and the habit of taking things quietly, and the avoidance of worry and nervous excitement are the means of easing his heart. Avoid tobacco.

ENLARGED TOE-JOINT (45117).—Wear a well-made boot with a sole nearly straight along the inner side, so as not to force outwards the great toe; the sole under the tread of the foot as broad as the foot; the heel square and low (4in. higher than the sole). Let the boot grip your foot across where a Blucher boot laces, so as to keep the foot from shifting about, and yet leave room for the toes. Pare away your toe-nails carefully, and keep them cut as neatly as your finger-nails; keep the toe-nails as short as possible. For the present pain, bathe the foot carefully at bedtime in hot water with a little washing-soda dissolved in it. Take a seidlitz powder in half-a-pint of hot water with a pinch of ginger directly on waking of a morning as often as is necessary to keep the bowels acting, or as the urine is thick on standing.

GAS-FIRES (45123).—I always find that gas-fires and also coke-fires are injurious in the bedrooms of asthmatic patients and in the studies of literary men. The gas-fire rarely is so arranged as to in-

sure all the products of combustion being carried up the chimney. Coke-fires give off carbonic oxide and dry the atmosphere of the room so as to be very unhealthy and irritating to the lungs of asthmatic patients. A gas-coal fire is the best fire by far for bedrooms and studies and sitting-rooms. Asthmatic patients should see that their rooms have a proper inlet for fresh clean air, on which read former papers in the "E.M."

HEADACHES (45168).—"A Sufferer" is probably the subject of anæmia; and, if pale, should try my reply 19368, No. 861.

VARICOSE VEINS (45168).—An elastic or lace-up stocking is the remedy. Sometimes a 6-yard bandage, 2½in. wide, of unbleached calico, with the selvage torn off, can, after a little practice, be wound round the leg so as to be more comfortable and yet quite efficient. The bandage should have no joint, and have raw edges. Two such bandages should be kept for alternate use—one on and one off. If the leg be very large the width may be 2½in., torn a ½in. less for the first yard, which is used for the foot and to turn the ankle. The bandage, when taken off, should be washed, ironed, and rolled up hard. Then begin just above the joint of the great toe and roll the bandage on—reversing when necessary to make a turn—until it reaches well above the belly of the calf, and let a few turns run back down the leg. Then stitch or pin carefully, and draw on a stocking. Each fold should overlap the last about one-third of its width. The process cannot be further described to good purpose. It must be seen: a good surgeon or skilful nurse must show you the trick of bandaging the leg. After that, practice will make the thing quite easy. The calico roller is cheaper and better than anything else when skilfully applied. It should be taken off on getting into bed, and replaced before getting out of bed each morning. Varicose veins, especially if in the left leg, are aggravated by constipation, by corpulence, by alcohol, and by the use of tobacco. Standing upon the feet for long periods also makes them worse. Their cause is weakness of the walls of the veins, and various obstructions to the return of their blood. Thereupon the veins—especially those of the legs, and of the left leg in particular—stretch and bulge into pouches, in which the blood accumulates. The remedy is mechanical support, so as to counteract the weight of the column of blood and the avoidance of the erect posture. Varicose limbs are very liable to chronic ulceration, which cripples poor women and hard-working men in large numbers, and which is incurable unless under special management. That consists in supplementing the local applications with various contrivances, giving mechanical support to the vessels, and so enabling the healing process to go on in the varicose leg just as it would in the patient's arm. Any slight injury causing a break in the skin of a varicose leg will degenerate into a chronic ulcer unless carefully managed from the first. Sometimes a sheet of thick lead-foil is put over the dressing, and retained by the bandage. Sometimes the limb is carefully encased in a special kind of adhesive plaster, unirritating and spread upon unglazed calico, the plaster being cut into strips an inch or more wide, and twelve to fifteen inches long, and so applied that each strip overlaps the other all the way up, and, without biting the skin or girding the leg, becomes a perfectly comfortable, adhesive casing, fitting to the limb like an unyielding skin, and yet, giving no such compression as is given by the elastic bandage. This is the only way of curing varicose ulcers of the legs, unless by confining the patient to bed for eight or ten weeks. The plaster, however, is very difficult to apply properly, and few surgeons have quite the knack of doing it. The performance must be seen at a hospital, where they do the thing well, in order to be more perfectly understood.

45116, 45114, 45162, 45171, are queries of such a character that I cannot usefully reply to them. Purely speculative replies I cannot undertake. All these cases need the analytic eye of a practical physician, and I must refer them to what I said some weeks ago upon *diagnosis*. 45110 should note what I have said on *fat* and on *flatulency*. A dry, clear climate, such as that of Australia, Tasmania, or Manitoba, would doubtless benefit "W. M." (45171).

Considerations of time and space also preclude my replying to any mere personal queries which do not involve points that will be of interest to a considerable number of readers. Cases vaguely stated, or needing diffuse replies, also cannot be met. As I have already said, I will see any such patients at the Temperance Hospital on Mondays or Thursdays at 2.30, and there, on seeing them, will make everything clear. As to working men who cannot leave their work, and yet have some ailments which have not been relieved by ordinary medical treatment, I shall be very pleased to see them, gratuitously, if they will knock at my door at 10 a.m., on Sunday mornings.

James Edmunds, M.D.

8, Grafton-street, Bond-street.

NORTH BRITISH ENGINES.

[19382].—In my letter 19336, I find the following slips:—Near the top of the page, instead of reading "is running between Edinburgh and Roslin via Glencorse," read "running from Edinburgh to Roslin and Glencorse." Anyone may see that the former reading is quite absurd. Instead of reading "420, 264, and 219 classes are fitted with the Westinghouse, &c.," read "421, 264, 419 classes, &c." No. 219 is a six coupled goods. Although I have given 425 as a bogie engine, now that I remember, I believe it has only one pair of leading wheels, and is like 421. Carstairs.

THE ACCIDENT NEAR EDINBURGH—AUTOMATIC AND NON-AUTOMATIC CONTINUOUS BRAKES.

[19383].—GENERAL HUTCHINSON'S report upon the accident and collision which occurred on the 11th of August, near the Abbey Hill Junction, Edinburgh, on the North British Railway, has just been published. The circumstances of this accident elicited much attention in the railway world, from the fact that an inefficient non-self-acting continuous brake was rendered useless at the very moment when it was most required, a summary of the details will therefore be read with interest.

The 8.30 p.m. down East Coast express from King's Cross to Glasgow and the North, consisted, when it left Berwick, of two engines and tenders and seventeen vehicles, one of which was a Pullman sleeping-car. The train was fitted with Smith's vacuum brake, under the control of the driver of the second engine, with the exception of a mail van and saloon carriage, which had only the Smith's connecting-pipes, and an unfitted fish-wagon, which also caused the vacuum-brake upon the rear guard's van to be out of use.

The express train was stopped by signal from the West-end of the Calton tunnel, Edinburgh, and was just starting, when the couplings between the tenth and eleventh vehicles gave way.

If the train had been fitted with an automatic continuous brake, fulfilling the conditions of the Board of Trade, it would have instantly applied itself to both portions of the train, and no accident would have occurred. Most unfortunately for the injured passengers the train was only provided with a non-automatic brake, which does not fulfil the necessary conditions: the result, therefore, was that at the very moment when the brake was required, the hose-pipes were pulled apart, and Smith's vacuum brake rendered useless.

When the coupling broke, the rear part of the train was standing in the Calton Tunnel, and the portion which had broken loose, consisting of seven vehicles, one of which was the Pullman Car, ran back down an incline of 1 in 78 for about 1,000 yards, when it came into collision, at a speed of about ten miles an hour, with the 6.5 a.m. special passenger train from Musselburgh to Edinburgh and Glasgow. Five passengers in each train were injured, and much damage was done to the rolling stock.

The rear-guard of the express, and also the Pullman Car-conductor, applied their hand-brakes, but as the seven vehicles weighed about 110 tons and the gradient was 1 in 78, they were powerless to prevent the collision.

The driver of the Musselburgh train, we are told, acted promptly, and "with a continuous brake he would no doubt have been able not only to have stopped, but also to have got into backward motion before the collision, and thus have mitigated its violence."

The coupling which broke was of the strongest form made by the Great Northern Railway, who maintain the East Coast joint stock, but there was a flaw in it which could not be seen after it was painted.

In my letter, p. 599 of last volume, I called attention the subject of the breaking of couplings in passenger trains: such failures are very much more common than is generally supposed.

Even with the most careful examination, concealed flaws will exist in the strongest and best made couplings; and the only way to avoid danger from their breaking is to fit the trains with efficient automatic brakes, which will bring both portions of a divided train to rest in the least possible time and distance.

There has been considerable discussion upon the question of automatic and non-automatic brakes, but all disinterested readers of the ENGLISH MECHANIC will agree with me that a non-automatic brake, which is rendered useless just when most required, is a very dangerous appliance.

General Hutchinson, in his concluding remarks upon this accident, states:—

"An automatic brake would in this case have been of great service, as the brakes on five of the rear seven vehicles (two not being connected) would have been at once brought into play upon the severance of the couplings taking place, and these vehicles would have been immediately stopped."

This quotation shows the public at once that the so-called accident near Edinburgh is simply another of the very long list of preventable accidents, which will continue to occur until the railway companies adopt continuous brakes, fulfilling the Board of Trade conditions, and other well-known safety appliances.

Some newspapers, I understand, have censured the North British Railway Company, because the East Coast joint stock is fitted with an inefficient brake; but I must point out that both the North British and North Eastern Companies are fitting all their own passenger-trains with automatic brakes, fulfilling all the requirements.

Smith's vacuum brake was fitted to the East Coast joint stock, because that is the brake in use on the Great Northern Railway; but the recent accidents, and the fact that during the first half of the present year the "return" states that on the Great Northern alone the vacuum brake "failed to act when required" no fewer than 33 times, should certainly call the attention of the directors to the subject of efficient continuous brakes.

Clement E. Stretton.

Saxe-Coburg-street, Leicester, October 29th.

A WRINKLE OR TWO WORTH RUBBING IN.

[19384].—To clean a copper, or as they are called in some parts, set-pots. These are mostly cast iron, and when not well galvanised or tinned, are a nuisance—spoiling all the clothes put into them; so, out of sympathy with the fair sex, I send you a perfect cure. Fill the copper with water, make a good fire under it, then take 1lb. of sulphuric acid (oil of vitriol), and when the water boils put the acid (not direct into the hot water, or it will fly), but put it into a quart of cold water, which must be added carefully to the boiling water. Have plenty of fresh air in the place, and mind and don't get the acid on your flesh. Should such an accident occur, immerse the part in cold water, or wash in water directly afterwards: and here let me say, in view of vitriol-throwing, which is now very common in some places, if by any chance whatever vitriol comes upon the skin, do not rub it, or the skin and flesh will come away under the operation; but if water is at hand, wash immediately, and this is the only chance of averting disfigurement; water kills vitriol directly. But to return to the subject; having put the vitriol into the copper, draw the fire or damp it with slack and empty the whole contents of the copper down the drain; now, with a piece of carpet or cloth and sand, scour well the inside all over, and rinse it well with water; fill with water again, add 1lb. of soda, and boil for half an hour, and you will never have to complain of iron-moulds any more.

Caution.—Always empty while hot, and keep the inside dry. This should be of great service to readers of ours, judging from the many inquiries I have heard of how to clean coppers efficiently. I should like to send directions how to make a fan, seeing the many inquiries we have had; also how to flute taps in the lathe, and how to make cutters for same. It is 12 years since I became a subscriber to ours, and I have never seen these subjects properly explained: therefore, if our kind editor has room and is willing to take the matter in hand, I will do my best.

Lookatitoh.

[Please send. With so much to say, why have you waited twelve years before helping us?—Ed.]

THE BLUE OF THE SKY.

[19385].—SIR J. LUNBOCK, in his address to the British Association, refers to Tyndall's idea that the blue of the sky is produced by the reflection of the blue rays by the minute particles floating in the atmosphere; also saying that Brücke showed that very minute particles suspended in water are blue by reflected light.

I do not doubt this; but I should like to draw attention to one thing which I noticed long ago, and which has often struck me. If you are in a large building at night, well lighted by gas, and you can see through plain glass windows, the sky, if clear, appears perfectly blue. This has so often struck me that I have often wondered whether it has anything to do with the blue of the sky; that by day the mass of brilliant light, yellow or white, by contrast produces the blue of the sky, while at night, when this light is removed, the sky becomes dark, no blue being visible.

If this has nothing to do with it, how can the fact be accounted for of the sky looking blue when seen from a well-lighted building?

M. A.

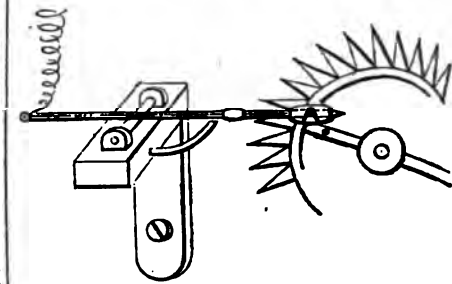
M. PINSOR, the forester of the Bois de Boulogne, finds that dynamite can be used with advantage for uprooting and dividing stumps of trees, but it is not applicable to felling trees which are to be used as timber.

REPLIES TO QUERIES.

*** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[44518].—Tangent Galvanometer (U.Q.).—It is difficult to advise without knowing what kind of work the instrument is for; but I should think No. 35 rather fine for ordinary use. My own instrument is made (with a few modifications) from the directions given in Sprague's "Electricity." Its needle is $\frac{1}{4}$ in. long, with a filament of glass $\frac{1}{4}$ in. long, fixed on it at right angles as a pointer—the whole suspended by a silk fibre. The coil is 8 in. diam., and has first 10 turns of thick wire, giving deflection of 29.5° for 1 chemic, or about 72.5° for 1 veber; then 90 turns of No. 20, which, when in series with the 10 turns, gives deflection of 10 times that of the thick coil, within an error of 1 per cent.—J. BROWN, Belfast.

[44531].—Electric Contact.—Having received some good wrinkles from "ours," I deem it only right to impart a wrinkle in return. I have had an electric time indicator about five years, but until a year ago was much bothered with the contact, which closely resembled F. B. McClennan's in our last number; it occasionally going two, and sometimes three, minutes instead of one; but since adopting the above it has never failed me once. The sketch



requires very little explanation, except that A is a short length of platinum wire, with a piece of glass melted on the end, which is then ground away at right angles to expose the point to come in contact with platinum-pin in cross of wheel, adjusted so that contact is made as the wheel is moving forward, occupying less time than the 20th of a second; the spiral is of fine wire, answering for a spring as well as connection. Shall be happy to show it working to anyone interested living near.—E. LYON, 214, Regent-road, Salford.

[44640].—Size for Orange Lead.—"L. E. J." is mistaken. It does not interest me in the slightest what he meant by his query; but if he is really desirous of an answer, it would be well for him to say what he wants to do. Even now he does not say whether the mark should wash off. If it may be permanent, he should mix his orange lead with the pale varnish used by letterpress printers, which is nothing more than linseed oil, boiled until it will fire by a light applied to the surface. If the mark must be removable easily, he can try mixing with pale glue size, to which a little glycerine has been added.—T. J. M.

[44646].—Collapse of Flues.—I note "S. E. D.'s" addendum to his query, but regret that I have not time just now to answer it fully. The 2-19th power of a number is found by multiplying its logarithm by 2.19: the product is the number required. Tables of logarithms are necessary for such calculations. I append the values required for some of the most ordinary thicknesses of boiler-plate. They are taken from Wilson's book on boilers.

$$\left(\frac{3}{16}\right)^{2.19} = 0.02558$$

$$\left(\frac{7}{32}\right)^{2.19} = 0.03585$$

$$\left(\frac{1}{4}\right)^{2.19} = 0.04803$$

$$\left(\frac{9}{32}\right)^{2.19} = 0.06216$$

$$\left(\frac{5}{16}\right)^{2.19} = 0.07829$$

$$\left(\frac{11}{32}\right)^{2.19} = 0.09646$$

$$\left(\frac{3}{8}\right)^{2.19} = 0.11671$$

$$\left(\frac{13}{32}\right)^{2.19} = 0.13235$$

$$\left(\frac{7}{16}\right)^{2.19} = 0.16538$$

$$\left(\frac{15}{32}\right)^{2.19} = 0.19027$$

$$\left(\frac{1}{2}\right)^{2.19} = 0.21915$$

$$\left(\frac{17}{32}\right)^{2.19} = 0.25027$$

$$\left(\frac{9}{16}\right)^{2.19} = 0.28361$$

$$\left(\frac{5}{8}\right)^{2.19} = 0.35725$$

—GLATTON.

[44654].—Air-Vessel.—On reading this query I hoped that some one would explain the dis-

ance of the air from the air-vessels of pumps, but no such explanation has been offered, and night" seems to be unaware of this disappearance.

I have seen many pumps and pump-ings, and have found that very little is generally known of the value and action of the air and vacuum chambers; and I do not know of any book which gives any valuable information on the subject. Tomlinson's "Pneumatics" certainly does.

The effect of pumps having long suction and delivery-pipes (and especially when those pumps are vacuum-acting), is vastly improved by the air and vacuum chambers; and that is not all: the wear and tear of the machinery is reduced, and the noise, consequent upon their absence, ceases. But the absence of these chambers is little good unless they are properly understood and managed. A consideration of the action of a pump will explain all. Suppose the pump to be taking its up-stroke, the water in the suction pipe is set in motion, and the water flows into the pump until the stroke is finished, when the supply is suddenly checked, and a more or less violent blow is given. Perhaps the stroke of the pump has been quick to set the water in the suction-pipe in motion, and the down-stroke has been commenced before the pump has been filled, and the pump has not done its proper duty. Now, suppose a chamber (the "vacuum chamber") full of water to be in connection with the suction-pipe, as near to the foot-valve of the pump as convenient. The pump in taking its up-stroke immediately takes water from this chamber, forming a vacuum in the upper part, which is filled by water from the suction-pipe, so that when the pump has finished its stroke the water in the suction-pipe, instead of being suddenly checked, flows quietly into the vacuum chamber, and forms a reservoir for the next stroke of the pump. The contents of the vacuum chamber, therefore, should be twice that of the pump, and should be fitted with a glass gauge, and a small pipe communicating with the top of the chamber and the bottom of the pump, by which the air from the top might (from time to time) be drawn off. In considering the action of the air-chamber, suppose the pump to be starting on its down-stroke: if there is no air-chamber, the water in the delivery-pipe is put in motion suddenly, and a blow is given; but if an air-vessel well charged with air is in connection with the delivery-pipe, and as near the pump as convenient, the air is forced into the air-vessel, compressing the air, and the water in the delivery-pipe is put in motion gradually, by the pressure of the air in the air-chamber, and indeed, should flow there in a quiet, continuous stream. The contents of the air-chamber should, therefore, be about twice the contents of the pump, and should be fitted with a gauge-glass, and the pump should be fitted with a small valve opening inwards (called a "lifting-valve"); this valve should be fitted to the bottom of the pump, and its use is to allow the pump upon its up-stroke to draw a little air, in order that the air-vessel may be kept constantly full of air. This snifting-valve should be made to regulate by a screw, so that any small quantities of air may be admitted as necessary. Without this valve, or an equivalent, the air in the vessel will disappear, and the action of the air-vessel will be entirely destroyed. The study of air-vessels of an hydraulic ram is well calculated to teach the true uses of both the air and vacuum chambers of a pump.—ARQUES.

4671.]—Punching Machine.—I have endeavored to make a sketch of the parts required, but fear it is very rough, being taken from memory. Details are omitted for the sake of

and S the shaft. The shaft S is supposed to be continually revolving, and with it the cam G. The lever C, as shown in sketch, is keeping the slide stationary, and the cam G is outside the groove H, as shown in No. 2 in dotted lines. If the lever C is moved downwards ("on") it draws the cam G into the groove H. The cam touches the groove at top and bottom, but clears it at the sides; thus the up-and-down motion. This kind of punch is generally used in conjunction with the shears.—L. C. D.

[44675.]—New Pivot to Verge Watch.—Take the balance, and with a hollow drill—chisel pointed—cut away the brass round the root of top pivot; the drill must be made with a hole just the size of the root; drill half-way through, break off the root. Now drill a hole in a piece of brass; put on a small arbor, and turn and fit in hole; it should go about $\frac{1}{2}$ in the hole. Now fit piece of pivot drill, previously filed up, in brass plug; cut it off nearly close to the plug—not quite—and make bottom flat with oilstone; leave a piece on the other side long enough for a pivot. Now, with a hollow punch or spring-punch (see Fig. 1) drive



the plug into the hole you have made, and turn up pivot.—A FELLOW WORKMAN.

[44686.]—Even Temperature.—Thanks to "Nun. Dor." for his reply to my query. I have tried iron coil in a narrow vessel about 12 in. wide, 24 in. long, 18 in. deep, and although it is being constantly stirred, is not hot enough. Would super-heated steam be of any advantage, and how is it obtained? Would copper-coil and copper-vessel be an advantage?—COUSIN JACK.

[44783.]—Gas-Lighting by Electricity.—The most "economical way" (!) would be to have a bichromate battery, so that the elements could be lifted out of the liquid when not in use; but really the query betrays so much want of knowledge of the simplest rudiments that replying seems to be of no use. Let the querist take good advice as it is meant—read up back numbers, or procure one of the elementary manuals on the subject. All he wants is to get a spark to pass between two points of platinum, or he may render a small platinum coil incandescent, and then his gas will light; but to do that will cost a great deal more than the wages of a boy who will light the jets when he is told, and be otherwise useful.—NUN. DOR.

[44791.]—Tempering Circular Saws.—The tempering is as usual; the flattening is the difficulty. Let the querist refer to p. 4, Vol. XXIII., where he will see a patented apparatus, used for the purpose. There were also some replies on the subject in recent back numbers.—NUN. DOR.

[44795.]—Composition Stops on Harmoniums.—It is impossible, without examining the instrument, to do more than guess; but most likely each stop pulls on two sets of reeds, which

purpose. To such an extent they may be useful, as when a long forte passage has to be played it is handy to have the stop to keep the swell open; but in a properly-built harmonium, "forte" is produced by means of the feet on the treadles and the swell. I presume the querist does not mean grand jeu; that is different, being equivalent to Full organ; so that all I can say is, "Forte general" must be something wonderful. No doubt it opens "all the forte stops at once;" but in the name of common sense, how many are there?—SAUL RYMEA.

[44802.]—Mine-Pump.—This querist had better put down a gearing that will give speed enough, as he has plenty of power. He seems to have some vague idea that the electric motor is a prime mover which works without being driven; and surely he does not imagine that one of $\frac{1}{2}$ to 1 horsepower would do much work on a 4 in. pump. The rods would not do; and he would have to lay down copper rods. If he said what "power" is available, he might obtain satisfactory reply.—NUN. DOR.

[44804.]—Portable Black-Board.—Mix very finely-pounded coke with Brunswick black if a glazed surface is required, or with black paint (with excess of turps) if dull surface. A very little coke goes a long way.—NUN. DOR.

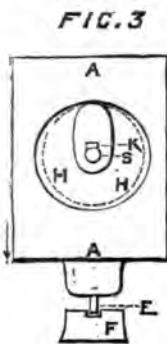
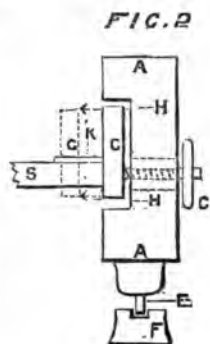
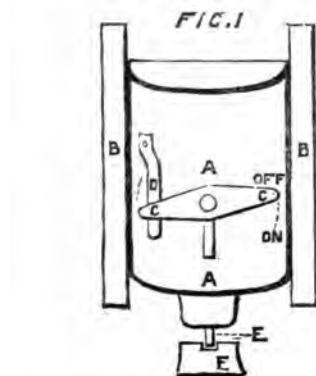
[44828.]—Separating Gluten.—Gluten is obtained from wheat flour by washing the latter in several waters, the starch being dissolved out. Gluten bread or diabetic bread is made from flour which has been robbed of two-thirds of its starch, or from gluten flour, which is prepared from the waste gluten of the starch factories. There is little of the latter nowadays.—NUN. DOR.

[44830.]—L. N. W. Engines.—"Diomed" makes a slight mistake in respect to Cyclops, 805: it is a Ramsbottom, but not a completed engine; it is a 7 ft. 6 in. "Lady of the Lake" class.—FORTUNA.

[44873.]—Steel Drops.—Try a strong solution of salts of sorrel in hot water. Rub the solution well into the fabric.—J. C. L.

[44880.]—Dew Point.—To Mr. W. J. LANCASTER, &c.—I am sorry I have been unable to answer you before; the fact is, I have not had time to even read the MECHANIC, much less write. Now, your query does not present any difficulties to me. The atmosphere, as you know, always contains moisture; the amount is always varying, and, when the two tubes on a hygrometer read alike, you know the air is saturated, and condensation must speedily take place in the form of rain. The two thermometers, however, rarely read alike; there is always a difference, and this difference enables you to obtain the percentage of humidity at the moment of reading. Now, when the dry bulb reads 50°, wet bulb 46°, then the humidity (taking 100 as saturation) would be 74; but if you could keep wet bulb at 46°, and lower dry bulb to 48°, then percentage would be 80. Lower it another degree to 47°, then percentage would be 93; and, when dry and wet bulbs read alike, then the air is saturated, and rain will fall. The rise of temperature preventing dew is erroneous. Dew is deposited, but is instantly absorbed again, so that there is no perceptible dew. We know that evaporation is always taking place; so is condensation. There never has been, nor ever will be, a period of rest between them. You will, however, find that a S.E., S., or S.W. wind will give a nearer reading between wet and dry bulbs than a N.W., N., or N.E. wind; consequently, although the change from, say N.W. to S.W., may give a rise of 10°, the wet bulb will rise quicker than the dry, showing that the air coming from S.W. contains a greater percentage of moisture than that which formerly came from N.W. Aqueous vapour prevents free radiation from the earth's surface, consequently, prevents dew remaining on bodies touching the earth.—W. J. LANCASTER.

[44916.]—Coil.—To Mr. LANCASTER.—Purchase, if you have not any by you, $\frac{1}{2}$ lb. of cotton-covered wire, and 2 oz. each of 26 and 30 cotton-covered wire; now get a pennyworth of iron wire (soft) 24 gauge, cut the wire up into pieces 4 in. long, and tie them into a bundle, say $\frac{1}{2}$ in. to $\frac{3}{4}$ in. thick, tie them tightly at each end, then get a large spool that has had cotton wound on it, cut off the two ends, leaving them $\frac{1}{2}$ in. thick and about 1 $\frac{1}{2}$ in. diameter; make the holes in them just large enough to fit tightly over the ends of the wires, glue the ends into wooden reels, and when cold begin to wind the wire, first glueing a piece of brown paper round the iron wires, wrap the paper round three times, glueing every layer; when cold make a hole at one end just above the paper, for the wire to go through, put, say, 2 in. of the No. 20 wire through the hole, and then wind the wire round and round as close as possible to the brown paper, and each ring touching the next; go on winding until the first layer is nice and smooth, then begin a second layer, going back, and so on until all the wire is wound. Put the end through another hole in the reel, and just where the



urness. No. 1 shows the front of the slide or as; No. 2, the side view; and No. 3, the back. is the slide, BB the bearings, CC lever for rting and stopping punch, D spring to keep er in position, E the punch, F the punch-block, the cam, HH the groove, K the key on shaft,

have separate knobs of their own. As to "Forte general," it must be one of those that go to swell up the 21; for most certainly "forte" stops on the harmonium or the American organ are only of use when they save the performer the trouble of keeping the swell open with the lever provided for that

is bent to go through hole, remove the cotton and solder one end of the 26 wire, then wind this round and round, bringing at last about 2in. of it through another hole in bobbin, soldering end of 30 to this, and winding on until all is finished; now put it in the oven and get a penny paraffin candle, and when the coil is warmed, melt the candle and hold the coil by the fire, letting the paraffin melt down into the coils of wire. The whole when cool may be put on a board and have a contact-breaker, or you can mount the contact-breaker on to one end of coil. You will then have a capital little coil, costing you less than half a crown.—W. J. LANCASTER.

[44930].—Cosmorama.—Pictures that are rendered transparent by the use of a mixture of Canada balsam and turpentine, and afterwards well rolled-down on a glass plate, will never curl from the heat of a lamp at a reasonable distance and with proper ventilation. The simplest and least "messy" way is to use paraffin-wax; but the best plan to allow the pictures being handled would be the Canada balsam one. To use the first, the best way is to heat the paraffin-wax in a tin or metal dish, then soak the picture to be used in it. When soaked through, which will be in a minute or so, transfer the picture to the plate of glass, which must be well cleaned and previously warmed. But, let me add, this process is only suitable for views or pictures which have no printing or other matter on the back. The second method is best done as follows: well soak the picture in turpentine alone for, say, ten minutes; then warm the glass plate and pour on it a mixture of Canada balsam 2 parts, turpentine 1 part, just as you would collodion, pour off the surplus, and then slide on the pictures soaked in turpentine, taking care to avoid air-bubbles. Keep in a warm place for a few hours, and, when cold, if there is any printing on the back, it can be easily removed by soaking in water and gently rubbing it with your finger. When the back film of paper is removed, give it either a coat of varnish or of balsam to remove the ground-glass appearance that would be produced by the rubbing. If no necessity for this, simply float over with balsam and dry. It will then be found that the picture is firmly fixed to the glass plate and will not curl or contract except unfairly used. With regard to lenses—they greatly add to the reality of the scene, and if arranged stereoscopically, would produce the real stereoscopic effect. This effect you cannot produce properly without the aid of lenses even if stereos were used. The extra effect produced by the lenses are well worth the extra cost, as you would see on trying.—SUNLIGHT.

[44930].—To "Sunlight."—See reply to Mr. J. Stubbs, which will give all the information you ask so far. The process will work all right with the first three classes, but the last two I have not tried myself, and so can't speak of. But any pictures that are capable of the Canada balsam treatment would be pretty sure to be fairly good; but if a linen back be existent, I hardly think that it would be of much use. To make the picture perfectly smooth, a roller may be passed over the picture and well pressed down. But very little difficulty will be found, as the pictures will lie flat of themselves. Colour effects are produced by interposing sheets of coloured gelatine between the lamps and the views. For instance, supposing behind a picture of Venice we have a groove to slide in these colours. By slipping in a sheet of blue gelatine, with a round hole cut for the moon, and sundry radial-shaped slots for stars, we have not only a moonlight effect, but also the appearance of the moon and stars, to make the illusion more complete still. Sunrise is imitated by using a sheet of rose or pink gelatine; and a little artistic skill would enable the designer to show the sun rising behind clouds, by partly cutting away the gelatine and working on the face of it with water-colours even, to make a natural cloud appearance. Storms also can be shown by a sheet of very dark green gelatine, or two sheets together, with lightning shown darting down, and, if wished, by cutting away the gelatine and gumming on some yellow over the apertures, lights in the windows, or a conflagration caused by the lightning is easily simulated. In fact, it only requires a little ingenuity to devise many beautiful effects, including lighting up of windows, &c. And finally, with a sheet of white gelatine running over two rollers, and which has a lot of open holes punched through it, a snowstorm is producible. Any one who has any artistic skill may produce a lot of easily-made yet beautiful effects, which must depend on the views. If I have not sufficiently described this little matter, I will be pleased to further describe it.—SUNLIGHT.

[44930].—Cosmorama.—As I have been requested by "P. D." on page 189 of our present volume to send instructions for making a zoetrope or wheel of life, I have now done so, hoping that which I have forwarded will be found of some interest to the inquirer. Procure two pieces of mahogany or beech, well seasoned, and perfectly dry, $\frac{1}{16}$ in. thick and 12 in. square. Then unite these two pieces together with good hot glue in such a posi-

tion that the grain of each piece crosses each other. This, when dry, will prevent its warping. When the glue is thoroughly set and dry, plane each surface of the wood perfectly smooth with a good sharp plane. Afterwards mark with a compass a circle of 11 in. diameter. Be very particular about this, as it is required of a particular size. When marked, saw round with a fine, sharp saw, taking great care not to jag or split it. When this is done, smooth the sawn edge with fine glass-paper or emery-cloth. When this is accomplished, you will then have a circular disc of wood, which will form the bottom of the cylinder into which the slides will have to be placed. In exactly the centre of this disc insert a piece of brass pipe 3 in. long of $\frac{1}{4}$ in. bore, one end of which must be flush with one of the planed surfaces of the wooden disc. Over this end of the pipe screw a piece of hard metal or steel 2 in. square and $\frac{1}{4}$ in. thick. Four screws will suffice for this, say, one at each corner. On the remaining portion of the brass pipe fix a small grooved wheel or reel. When this is done the disc will be complete. Afterwards procure a piece of tin $\frac{7}{16}$ in. wide, and in length $\frac{1}{4}$ in. over that of the circumference of the disc. Divide the length into 13 equal parts by the aid of a compass and small bradawl. Don't scratch the tin any more than is necessary when marking it. Within $\frac{1}{4}$ in. from one of the long edges of the tin (of course, there are only two long edges) cut 13 slits 3 in. long and $\frac{1}{4}$ in. wide. These should come exactly on the marks you have made with your awl. These slits should be exactly at right angles with the edge of the tin. You will require sharp tools to cut the slits out. After this bend over $\frac{1}{4}$ in. of the edge of tin neatly. This will form the top of the cylinder. The 13 slits will then be $\frac{1}{4}$ in. from top of cylinder, and, of course, vertical with it. Then solder the two free ends of the tin neatly together, allowing the extra $\frac{1}{4}$ in. to lap over. If this is properly done it will allow the insertion of the wooden disc to form the bottom of the cylinder with the reel or grooved wheel outwards, the sharp edge being flush with the under planed surface of the disc. When the disc is properly fixed in the right position, the tin may be secured to it with some fine iron or brass rivets round the edge of the disc. After this is done, the inside of the cylinder should receive a coating of white enamel or good white paint. The outside should have a coating of black japan. When applying care should be taken not to clog the slits with it. The same care will be required when applying the enamel or paint on the inside. When thoroughly dry, your cylinder will be complete. You have now to make the stand, which should be of mahogany, beech, or birch, 1 in. thick, 18 in. long, and 12 in. wide. The edges may be mortised if desired, and also polished in order to give it a respectable appearance. When polished and dry, insert a steel pin furnished with a point. The pin should be thick enough as to fit nicely into the brass pipe, so that the cylinder may revolve on it without shaking about from side to side. The pin may be of sufficient length as to project, point upwards, about 3 in. above the level of the stand. The pin must also be inserted perfectly upright, so that the cylinder may revolve steadily over it. It should be placed about $\frac{1}{4}$ in. from one of the narrower sides of the stand, and at equal distance from each of the other sides. At the other end of the stand fix a grooved wheel, of four or five inches diameter, furnished with a small knob, so that it may be turned by the hand. Then place your cylinder on the pin, pass a cord or small indiarubber band round each of the grooved wheels, and then your zoetrope will be ready for the slides, which should be placed round the bottom portion of the inside of cylinder against the tin. When the cylinder is revolving, look through the slits, and the figures on the slides will appear as if endowed with life. The cylinder may be made to revolve on a stand without the grooved wheels, the motion being given to it by the right hand; but the method I have described imparts to the cylinder a much steadier and regular revolution, and is unquestionably the best plan. In my previous reply to this query, I have stated where the books can be obtained. I wish our readers to understand that the wheel of life is not a new invention, and though a clever scientific discovery, is unfortunately almost forgotten and gone out of date.—G. FRYER, Richardson-street, Swansea.

[44930].—To Mr. Lancaster.—Deschanel is quite correct, although he does not explain it sufficiently for a student to understand the reason of the difference. I think we can soon clear away the mist. Now, then, to begin with: beats can only occur when two waves are travelling together, one having more vibrations than the other, the quicker one gaining on the slower one until the phase of elevation or crest of one wave is precisely over the phase of depression or the sinus of the other wave; or, in other words, when the condensation of one wave and the rarefaction of another wave occupy the same space at the same time: then we shall have silence, the waves go on, and we have sound again, and at last the crest of one is precisely with the crest of the other; here we

get an augmentation of the sound. Now if you will make 320 waves on a piece of cardboard, then alter your compasses and make 300 on the same cardboard, and in the same distance, you will find that 20 times the crest of one wave is just over the sinus of the other, consequently, we have 20 beats. Then just make below these waves 60 in same length, and 40 over the 60; in the latter case it is impossible for you to get crest exactly over sinus, consequently there is no beat. If I have not made it sufficiently clear, write again, and I will do my best to help you.—W. J. LANCASTER.

[44953].—To Mr. Lancaster.—There is not at present any form of machine suitable for amateur to produce the electric light, and it will be a long time before anything of the kind is made, although machines are much better than they were a few years ago, and it is probable that as in the past immense improvements have been made, so in the future still greater things will be done. With reference to the micrometer, do you wish me to give you instructions for making a parallel wire micrometer? If not, let me know which kind you wish to make?—W. J. LANCASTER.

[44961].—L. and N. W. Engines.—Druid 44, should be 1144.—DIOMEDE.

[44961].—L. and N. W. Engines.—I see "Diomed" in his list of L. and N. W. By Engines of "Precursor" class, gives Cosack as 1145 and Druid as 444. I think he will find that Druid, not Cosack, is 1145, and Cosack is 1144. These two and Colossus (1154) are stationed at Carlisle. Jason, 718, is a 5 ft. 6 in. coupled.—CARSTAIRS.

[44961].—L. and N. W. Engines.—Thanks to "Diomed" and "W. B. P." for replies. As "Diomed" is rather doubtful as to the class of several engines he gave in answer to my query (44916), I am pleased to say I can give him information as to those he is doubtful upon. Jason, 718, is a "Precursor." Lawrence, 514; Marathon, 517; Pegasus, 482, are "Precedents." Medea, 925; Mastodon, 479; Pheasant, 233; Petrel, 209, Odin, 1,164, and Wyre, 1,163, are 6 ft. coupled.—FOTUNA.

[44961].—L. and N. W. Engines.—Perhaps "Diomed" will allow me to make a few corrections in the list of "Precursors" he has kindly given. Nos. 514, Lawrence, 517, Marathon, and 482, Pegasus, are "Precedents"; whilst Pheasant, Medea, Saddleback, Odin, and Wyre (their numbers are right), are neither "Precedents" or "Precursors," but 6 ft. coupled engines of Mr. Webb's, very similar in appearance to the above classes. I believe all the five are at Northampton.—W. B. P.

[44971].—Electric Tricycle.—Do not dream of ever having a motor to drive a tricycle. This you will never get. You might work out an idea I had some 10 years ago, to apply a drum containing a series of springs, say 8 or 10, which upon going down hill would wind up, and going up hill would help to drive the machine. If you go, say, 50 miles in one day on a tricycle, the chances are that you are within 100 ft. of the same elevation above sea-level, at the end of your journey as you were at starting, and there ought to be no loss in such a journey. There would be the same length of up hills as down hills, and if a series of springs could be so arranged as to wind up one at a time and to be used at the discretion of the rider, either one at a time or three or four as the case may be, this would save a lot of useless labour in driving a machine up hill.—W. J. LANCASTER.

[44973].—Electric Light.—There is no form of electric light that would enable you to light your room under a heavy outlay at first, and a continuous outlay after, besides being an endless source of annoyance and ill-temper. Better leave it alone altogether than waste time and money. At present there is no apparatus for lighting an ordinary room, but there will be by-and-by.—W. J. LANCASTER.

[44979].—Brass Springs.—You can readily make spiral wire springs. Turn a chuck a little smaller than you require the spring to be, then take some hard brass wire, make a small hole in large end of chuck, and bend the end of wire into a hook; put it in hole of chuck, and commence winding, taking care to keep each of the layers quite close to last one. When all is wound, let it gradually uncoil itself, pull out the little hook or nip it off with the cutting nippers, and stretch the spring to a little longer than you wish it to be. If it is not so strong as you would wish it to be, then put it onto a gun-barrel or a piece of iron rod, and hammer it all round; this will make it as tough as you want it. To make flat springs, cut them to the size you want them to be, out of hard brass, then bend them into form, and with the back of a hammer, make one side of the spring hollow: this will make it strong, and you will find such a spring very durable.—W. J. LANCASTER.

[44986].—Pebble Spectacles.—If the spectacle lenses are cut at right angles to the optic axis they

will show rings; but it requires far deeper curves than any ordinary spectacles to show them in parallel light: by employing convergent light in the polariscope, they will be obtained, if cut as described, which is the proper direction. Should they happen to be cut parallel to the axis, it is quite possible no colour might be seen by ordinary means, and such lenses may therefore be really pebble, but are not out as they should be, which is the reason of the announcement referred to.—L. W.

[44986].—Pebble Spectacles.—Quartz polarises differently to almost every other substance. I say almost, because there are a few other crystals that are the same in their optical department; but quartz is the most beautiful in the series. We call it rotary polarisation, and different varieties of quartz have this property in a different manner. This one variety will cause a ray to rotate to the right, hence called right-handed, while another will produce a left-handed rotation. Now when the pebble is of long focus, there will not be any rings, but only change of colour; but when the pebble is either a deep convex or concave, then the iris coloured rings are instantly seen. Now pebbles may be cut parallel to the axis, or at right angles to the axis; the latter will produce the colours and rings, the former will not. But the latter are worth considerably more money than the former. You may be able to cut out of a crystal only half a dozen good pebbles; while if you don't care what your customer gets for his money, then cut them so as to give greatest number out of the crystal, and never mind their optical purity; and to be beneficial to the wearer, pebbles must be cut so that they will polarise. I have seen pebbles sold by reputed houses that have produced more harm to the wearers than a dozen pair of ordinary spectacle-glasses would do.—W. J. LANCASTER.

[44997].—Chamfering Oxford Frames.—In reply to "Strathay," the greater portion of rebates in Oxford frames can be cut by a circular saw. A small saw mounted on spindle, and running between lathe-centres with adjustable bench to regulate the depth to which the saw is required to cut, and movable fence to slide work against, is what is required. Having cut the two cuts in piece so as to meet in the form of a V, the ends of rebate must be finished with a chisel.—S. C. W.

[44997].—Chamfering Oxford Frames.—I am surprised that among the many answers given to the original query none have dealt with the difficulty experienced by most amateurs who possess few tools of rabbeting. This was a great trouble to me till a friend suggested doing away with it altogether, and fixing a beading instead. This is of easy accomplishment, and by using wood of a different colour a pleasing effect is produced, which enhances the beauty of the work.—DANDIE DINMONT.

[44997].—Chamfering Oxford Frames.—I have read Mr. C. Taylor's letter on this subject, but cannot quite understand his apparatus. Would he kindly explain one or two points:—1. How is Mr. Taylor's fence fastened with two screws so that it may at the same time be easily moved? 2. Is the chamfer to be cut by the 3in. circular-saw, or by the steel roller described subsequently? 3. In what way do the two pieces of wood screwed to the saw-table, at an angle of 45°, assist in the chamfering? 4. Are these pieces of wood to be set at an angle to the top of the saw-table, or to its side, or to the circular-saw, or to the steel collar with the teeth? If Mr. Taylor could give a drawing it might assist us in understanding his plan.—C. E. L.

[45000].—Toning Bath.—You cannot do anything with your present toning solution. Put it away and make up a new one; the better way is to make it up when you want to use it, always keeping two stock-bottles, one containing, say, 10oz. of distilled water with 7½ grains of gold, and the other containing 16oz. of water, 1oz. acetate of soda, and 1 scruple of bicarbonate of soda. To use, mix one part of each together, an hour before it is wanted, and you will be able to produce any tone you wish.—W. J. LANCASTER.

[45001].—Lantern Polariscope.—In reply to "L. U.," whose query I missed a fortnight, owing to absence from home: (1) It does not require more than a minute or so to "evaporate" a salicine solution, but it sometimes requires as much as ten before the crystals form properly, the substance being meanwhile kept melted in its own water of crystallisation. Probably, enough is not put on the glass; I generally use nearly half as much as will lie on the glass without running over the edge—quite a thick layer of fluid. I had many failures at first, but "L. U." will find that by degrees he finds the right heat and its proper management. Do not forget the solution is to be used saturated when pretty hot. (2) The obtuse angles of calcite are ground away at right angles to the crystallographic axis. The plate should only be from 1-12th to ½ in. thick, and will only

show rings in convergent light; for instance, the spar may be covered by a tourmaline, and the two looked through towards any polariser. (3) I have never meddled with cutting hard stones, and have no means of knowing what amateurs "can" do; should say it depended on the amateur. (4) The size named will give good projections; but it is a pity not to fit up for standard sizes if possible, if only for borrowing purposes. (5) I can only answer for square, unannealed glasses. The glass must be made full red-hot, standing on some plate of slate or iron which can be withdrawn and from which it can be slid off. Slide it off, standing on edge, to any massive-faced cold metal surface; stand or balance on its upper edge another, and if you can, bring two more in contact with the side edges—all as cold as possible. Unless it is full red-hot, the glass will fly into pieces on touching the cold metal, but if nearly soft it will not do so. I know this will make good squares; for other shapes I believe Mr. W. Leach can answer the query better than—L. W.

[45013].—Electric Light for Workshop.—What you wish cannot be done under a heavy outlay. There is not yet any simple method of supplying lights for workshops. The dynamo machines are expensive and require a lot of attention, and even then are very troublesome. Wait a little longer, another year or two, and you will be able to do all you wish.—W. J. LANCASTER.

[45117].—Enlarged Toe-Joint.—If "A Working Lad" will send his address to Prof. Kennedy, of 11, Great Brunswick-street, Dublin, he will send him, free of charge, a pamphlet, explaining the different diseases of the feet, together with a lotion which will cure his enlarged toe-joint.—DUBLIN.

[45021].—Dynamo-Electric Machine.—It all depends upon the construction of the machine as to what will be its power. For the armature, use 10 or 12 B.W.G., silk-covered, and it will be better to have it double-covered. Let me know how the machine is built, and of what; then I will help you as far as possible.—W. J. LANCASTER.

[45025].—Astro. Telescope.—Get a tallow candle and a pennyworth of beeswax, put the beeswax into a cup and place it in the oven until the wax is melted; then melt some tallow into it, about 1 part tallow to 2 parts wax. Well mix it, then allow it to cool. Take out the plug, clean all the bearings, and having well rubbed every part of the joint with this home-made grease, screw together, and you will find it all smooth and nice again. Keep the grease in a box ready for use at another time.—W. J. LANCASTER.

[45027].—Photographing the Moon.—The first essential is an equatorial telescope, driven by clockwork. If you have this, and will say so, and also add that the moon is not in the telescope, then I will tell you how to get a photo. It would be most difficult to get anything but a blur from your former arrangement, for you say in query: "If on a clear moonlight night I have a long telescope focus, the moon in it!" I have nearly had the moon in a large telescope before now; but I wish I could only make a telescope with the moon in it. I would not care to photograph it then.—W. J. LANCASTER.

[45033].—Astronomical Computations.—Other books on astronomy containing the necessary tables may be got beside those of Le Verrier's, which, I agree with "F.R.A.S.," would be of little use to a beginner in astronomical calculations. The works I would recommend to "J. L." are Vince's "System of Astronomy," 4 vols., or Whiting's "Comprehensive System of Astronomy," 1 vol., published in 1828. By either of these works the longitude, latitude, R.A., and Dec. of the Sun, Moon, and planets can easily be computed to within one or two minutes of arc for 10,000 years either before or after the year 1800. If "J. L." possesses a fair elementary knowledge of astronomy and plane trigonometry he can soon learn to compute the places of the Sun, Moon, and planets. If he will advertise his address in your columns I shall be most glad to assist him to the best of my ability in a private letter, as the calculation even for one example would occupy too much space in these columns.—W. M.

[45036].—Telephone.—I have noticed the same kind of effect in the telephone many times, and can produce it at will with either a frictional machine or a Ruhmkorff's coil. I take it to be entirely due to induction; and that any line, even on tall telegraph post, insulated and joined up to telephone, will produce the same result. The higher and longer the wire the greater the effect on the telephone plate. I have found something in connection with the telephone that has not yet been reported. I will send it to "ours" in a week or two; and I have no doubt it will interest others as much as it has done myself.—W. J. LANCASTER.

[45038].—Perpendicular Reeds.—The reason that the reeds are placed perpendicular is because the channels in connection with these reeds are

placed vertical in order to save space. There is not the least necessity to remove the entire row in order to replace a broken reed, nor yet to liberate one which may cease to speak, as each channel and reed should be entirely independent of each other.—G. FRYER, Swansea.

[45039].—Gas-Stoves.—"Sunlight" describes a stove with a very fine name, and asserts that a small vessel of water can be made to absorb the products of combustion from an Argand gas-burner. Perhaps it may an infinitely small portion; a very large quantity will escape over the water and into the room, to the inconvenience, and probable detriment to the health, of the inmates. It cannot be too much insisted on that a gas-stove should have a flue-pipe to carry away the products of combustion.—J. M.

[45040].—Dissolving Paper.—By adding liquor ammoniac to a strong solution of sulphate of copper till a deep blue liquid is obtained, we get a solution which dissolves all the fibrous portion of the paper, and thoroughly disintegrates the remainder.—DUNZON.

[45040].—Dissolving Paper.—I made a note of the following from No. 699 "E.M.," but never tried the process: Take ammoniac hydrate (22° Baumé) and add 15 per cent. of hydrated copper carbonate; after the reaction, ordinary cotton (not greasy) added in small quantities, and agitated, will dissolve in this liquid, forming a highly caustic solution. Decant, or filter it through asbestos. A pure paper, I should think, would also dissolve in it, unless the binding material prevented the action.—DAGHERT.

[45043].—Photography.—A screw and its fitting will be difficult for you to make. You can, however, make a rack and pinion easily. The camera should have a sliding tail-board, then two racks, the length you wish camera to adjust, should be screwed on to the sliding part of tail-board, as far apart as you can place them; then a pinion, having each end turned down, to work in a brass bearing; and, on one end, a pinion nut will finish the work. In screwing on to tail-board the two brass bearings carrying pinion, see that they are quite true, and that pinion works smoothly in the racks.—W. J. LANCASTER.

[45044].—Oxy-Hydrogen Microscope.—You cannot use your micro-objectives for an O.H. microscope; in fact, there is not any part of the table microscope applicable for O.H. microscope. If you would like to make one of the latter I shall be pleased to give you all the instructions necessary to enable you to make a good microscope.—W. J. LANCASTER.

[45047].—Steam-pipes.—"Doubtful" must not connect his return-pipe to the boiler, unless he fills boiler quite full of water and pipes too; in which case he will require a supply-tank in connection with his boiler, and then it will be a hot-water apparatus. If he must use steam, let him have a drain-pipe to his return-pipe; or, still better, a steam-trap, and a pump or injector to force the water into the boiler; but I prefer the former plan.—LOCKSTITCH.

[45059].—Medical.—"B. C. F." can overcome obstinate constipation by drinking a tumblerful of hot water, comfortably hot, every night when going to bed. As soon as the malady has been subdued the remedy can be gradually left off.—H. O'B.

[45059].—Medical.—Whole wheat-meal porridge; whole-meal biscuits ("Digestive"); wheaten groats (i.e., the wheat merely flattened, not ground) made into light puddings; and plenty of fruit, will generally cure the most obstinate constipation.—DAGHERT.

[45061].—Three-throw Pumps.—Your figures are quite correct for single-acting pumps. The size of the pipe I would recommend is 6in.; the dimensions of the engine would be 17in. cylinder, 24in. stroke; initial pressure of steam 80lb. per square inch, with a cut-off at 30 per cent. of stroke. The power of the above engine is rather more than is actually required, but it is necessary to allow for contingencies.—J. F. C.

[45062].—Oil-Stains.—Like "C. O.," I had occasion to change my residence some time ago, and my workroom-floor was in a sad state, so much so that the female experts in such matters declared it never would come clean; nor would they be induced to try it, so I had to do it myself. The stains were oil, black and red paint, varnish, and blood—the latter the result of an accident to my hand. I took two pennyworth of oxalic acid (poison!) and added half-pint of hot water; a piece of cotton rag tied to a stick served for a mop. With this I moistened the stains well, then I went over the floor with hot water, soda and soap, with scrubbing-brush, and I had the cleanest floor in the house. This recipe is worth taking care of.—LOCKSTITCH.

[45069].—Heating Railway Carriages with Acetate of Soda.—The acetate of soda is to be

melted without the addition of water preferably, although, of course, you may add a little if you like; it is then poured into the cases, nearly filling them. The cases are then soldered up air-tight. The acetate, in returning to the solid state, yields heat: and it is again liquefied by immersing the cases in a copper of hot water.—S. A.

[45072].—**Percussion-Action.**—The hammers are so arranged as to strike the free ends of the vibrators immediately before they are set in motion by the wind. I should advise "Apollo" to endeavour to find an opportunity to examine an instrument to which the percussion-action is applied, as by so doing he will learn more and will have a far better idea of the arrangement than a volume of words could convey to him. To attach the percussion-action to the harmonium is of far greater difficulty than the querist imagines, as it is one requiring great skill and nicety of workmanship.—G. FRYER, Swansea.

[45074].—**Pressure of Screw.**—This is the second time that I have to apologise for answering a query wrongly. My excuse, as before, is simply that I am overworked just now. The fractions in my reply should stand— $\frac{301 \cdot 6P}{P}$ and 15080.—GLATTON.

[45074].—**Pressure of Screw.**—Many thanks to "Glatton," "Ploni Almoni," and "Sunlight," for their kind replies, though I confess I do not quite understand them. Will one of these gentlemen further inform me as I did not state the pitch of the screw when asking the question. The pitch of the screw is half an inch. How many times does it require to be turned round in order to produce a pressure of one ton? Further information on the subject will greatly oblige, and will be found of real practical use to—G. FRYER, Swansea.

[45083].—**Gas Regulator.**—There are many useless things put in and advertised by agents as affording a great saving of gas that are not the slightest use, as they require to be watched to see how many lights are in use, and are then regulated by hand accordingly. But there is a gas governor in the market, made by Messrs. Bruce, Peebles, and Co., of Edinburgh, that is really what it is called, that is, a gas governor, and its price for 20 lights is 29s. Now this governor really does what is said of it in their catalogue, and it does not matter whether there are 5 or 20 lights on at once; you will never, with its use, have any singing burners; it is so simple and so effective that any ordinary person can manage it; all it requires is to keep the diaphragm properly adjusted with its brass weights which regulate the pressure of the gas, also to keep it soft by the application of a little neatfoot oil, and not to place it where it can be hard frozen. They also make a burner that is a gas regulator of itself, which can be fitted to any ordinary gas bracket. I have put their gas governors in, and now have their burners in use, and can vouch for their being what the makers say they are.—JOE BLAIN, Carlisle.

[45088].—**Leo Major.**—"Carlissimo" will find the most favourable time of the year for viewing this constellation is in February, when its lucida, Regulus, souths at midnight on the 18th; should this, however, be too late an hour for his observations, he will find that it is well placed for viewing at about 9 o'clock in the evening on the 15th of March, 8 o'clock at the end of March, and in the early part of the evening during April. After then it becomes rather too near the horizon, as Regulus sets at midnight at the end of May.—R. B. R.

[45089].—**Pulley Dimensions.**—Rule: Multiply the speed of the first shaft by the diameter of the pulley on the same, then divide that product by the speed you want to run your last shaft, and the quotient will be the diameter of the pulley required. Example:—

$$\frac{60 \times 15}{180} = 5$$

(2) Multiply the speed of the first shaft by the diameter of the pulley on the same, then divide that product by the diameter of the pulley on the last shaft, and the quotient will be the speed required. Example:—

$$\frac{60 \times 15}{8} = 112\frac{1}{2}$$

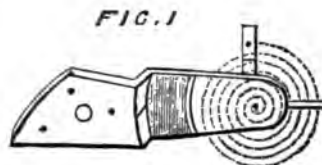
—OVERLOOKER, Bradford.

[45094].—**Stereotyping.**—It is most likely plaster of Paris, or some preparation of papier-mâché. The system adopted now for casting newspapers takes twenty minutes from the receipt of the formes to the delivery of the finished plate.—NUN. DOR.

[45096].—**Fitting Balance Springs.**—A spring being selected as to size and strength, the centre of it should be broken away until the collet is just free. The collet having been placed some-

what firmly on an ordinary cutting-broach, the spring placed in the hole of the collet, a brass pin fitted so as to secure it—having been filed flat on one side—when the length of such pin may be marked by means of a knife-edge being passed over it; when withdrawn, and placed in a shallow groove of a pin-filing block, a knife-edge placed upon the mark formed by the knife, by twisting the pin-vice and holding the knife firmly, the pin would be easily separated from the wire, when replaced in hole of the collet; but, prior to putting it in its place, the edge of a small burnisher should be placed upon the aforesaid mark for length, and the pin-vice being twisted round, the rough knife-mark would be chamfered off. The smaller end of such pin should have its extreme end broken off and "rounded up" before the spring is finally secured. To make it circular and flat, place the collet and spring upon an ordinary arbor, put such in "the turns"; then, by means of a firm-pointed tool—such as the point of a "round broach," by which a fusee upper-hole should be smoothed—the flat and circular character of the spring may easily be adjusted.—SECOND'S PRACTICAL WATCHMAKER.

[45096].—**Fitting Hair-Springs.**—Get some hair-springs (good) assorted for Geneva, lever, and verge. Now we will put a hair-spring in a Geneva:—1st. Take three or four about the strength you require, take the bar and measure circumference, as shown in Fig. 1 (which is about



twice the real size); the dotted line is the spring. Now take your balance with collet fixed, but the pin and old spring removed; press the spring over the collet with your tweezers, so that it will hold. Now take hold of the outer coil with your tweezers, and raise the balance, so that the bottom pivot just touches your white pad, or paper; set it swinging with your right hand, and time it. The way to time a balance spring—have a pendulum hung on the wall directly in front and near you. This should beat a true second. Set it swinging, so that you can see it when it arrives at the right turn. You only count from one side—viz., the right hand. The same rule applies to your balance. You only count that on the right side. You cannot count both ways, it would be too quick, and you cannot follow the pendulum; therefore, instead of counting 5 1-5ths to the second, you count 5 2-5ths to the 2 seconds, 10 2-5ths to the 4 seconds, 15 2-5ths to the 6 seconds, &c., until your balance stops. You will soon see if your spring is too weak or too strong; if either, you have only to slip on another spring and repeat the counting. If you follow these instructions carefully, any amateur, with a little patience and practice, will be able to fit any hair-spring with ease. Lever-springs you count 4 2-5 to the 2 seconds, or rather 9 2-5ths to the 4 seconds. If there is any part of this you do not understand, if you write again I will explain anything.—A FELLOW WORKMAN.

[45097].—**Dissolving Gold and Silver.**—I may mention to S. Gold that unless he has some considerable knowledge of practical chemistry, and a proper place in which to work, he will only succeed in making a mess, and poisoning himself with nitrous fumes. If economy, too, is any consideration, he had better intrust the job to someone possessed of proper appliances. However, here is the process: For an ounce of silver take 2oz. strong nitric acid, diluted with 4oz. of water. Add the metal, and warm till it effervesces briskly, taking care to conduct the operation out of doors, or underneath a chimney to carry off the fumes. After all is dissolved (except possibly a little black powder, which is gold), evaporate gently to dryness to drive off the excess of acid, redissolve in water, and place in the solution a plate of metallic copper scoured bright, leaving it there till a few drops of the liquid added to some salt water does not turn it milky. The copper plate is now washed (not scraped) from any adhering precipitate, and the dark-grey powder washed with plenty of water and dried. It is pure metallic silver, and may be obtained in the form of an ingot or button by fusion in a porcelain or fireclay crucible with some carbonate of soda and salt to act as a flux. Another way, if the querist has proper crucibles and means of heating them, is to add an ounce or two of salt to the solution in nitric acid after largely diluting with water, which separates the silver as chloride in the form of a white curdy precipitate. This is washed thoroughly by decantation, mixed with twice its weight of dry carbonate of soda (not

soda crystals), and heated in a strong coke after which, the pure metallic silver will be at the bottom of the crucible. Gold is dissolved in a warm mixture of two parts muriatic, and part nitric acid. When it has all disappeared evaporate to dryness over a water-bath, redissolve in 4oz. muriatic acid, and 8 or 10oz. of water. Add clean copperas (sulphate of iron) dissolve in hot water—equal to eight times the quantity of gold used—and allow to stand for six hours. Gold will separate out as a brown powder, wash, becomes yellow and lustrous when rubbed with any hard body, and should be washed and dried. It may be fused in the same way as silver, but the heat required is so great that it must be done in a specially-adapted furnace. All copper and other impurities originally present in gold remain in solution after adding the copper. So that the weight of the gold obtained at finish, compared with its weight at the start, is sure test of the quality of the metal.—DIXON.

[45098].—**Resistance Coils.**—The following are the resistances of the German silver wires used in making my own coils:—

No. 24	1 yard resistance equal to	808ohm.
26	1 "	1-4 "
28	1 "	3-1 "

In small resistances, greater accuracy may be obtained by using the thicker wire. In my 10th bobbin there is, approximately, 4ft. of No. 24, the 20hm. 4ft. 6in. of No. 26, 3ohm. 6ft. 9in. of No. 26, 5ohm 3yds. 22in. of No. 26, 10ohm. 10ft. of No. 30, 50ohm. 16yds. of No. 30. So long as the resistance of a wire is known, it is a matter of simple calculation how much of it will be required to make a bobbin of any given resistance. It is desirable to make them rather longer than is actually necessary, so as to allow of adjusting, and this will require a Wheatstone bridge and a static galvanometer, neither of which are difficult to make. As "East Anglia" is no doubt aware, a thermo-galvanometer is made of much thicker wire than one used for detecting feeble voltaic currents. In making mine, I used No. 16 insulated copper wire, with about three layers in all; and care should be taken to have the convolutions of the wire as near the needles as possible. In place of bismuth and antimony, I have employed for my thermopile the formula published by Lord Rosse in "Proc. Roy. Soc."—namely, bismuth for one element and for the other an alloy of bismuth with 1-12th part of tin. The result has been eminently satisfactory, and far surpasses in sensitivity any with bismuth and antimony. With a single couple, 3in. in length and 1-10in. square, the approach of the hand within an inch of the couple causes a prompt and energetic deflection of the needle. A table of tangents is given, I think in Culley's "Handbook of Practical Telegraphy," but I am not quite sure, as I have not the book before me to refer to. Any further information "East Anglia" may require, I shall be pleased to afford.—JOSEPH MARPLES.

[45103].—**Steam-gauge.**—You will have great difficulty in getting the parts. What I should do would be to get a piece of drawn tube the right size and thickness, and then run it through a home-made oval draw-plate, to give it the right section. The case, &c., could be made from sheet-metal, or a section of tube. To the one end you would want to braze on an inlet, for the pressure to pass in, and at the other end a plug with a very light connecting-rod to a piece of pinion wire to form the pivot for the dial pointer. The hole must be bent so as to be slightly eccentric with the case, to allow of its springing outwards under pressure. Size of tube might be 3in. by 5-16in. The case, say, 3in. diameter. To graduate it you would want either a test pump and reliable gauges on it; and mark off the pressures directly on the dial; or else get it marked off from steam-pressure by connecting it with a boiler having a good gauge. If you want to avoid the use of the oval tube, there is a way with a rubber diaphragm and a spring. If this would help you better, would describe same.—SUNLIGHT.

[45107].—**Screw-cutting.**—If you want to cut inside or female threads, and the hole in the work is not less than, say, 2in. diameter, then the way I like best is to use a steel bar with a hole bored through the end crossways, to carry a piece of steel to form the tool—this being, in turn, held by a set-screw, either through the end of the bar or across it. The small steel cutter should be of round steel, so that it can be adjusted to conform to the inclination of the screw-threads, and this allows you to have the cutting edge of the tool better supported. But, in small holes you would have to tie up a tool to do the work. It would be like one for outside threads, but with the end bent to an angle, so as to cut the inside thread. By this plan a much smaller hole can be operated on; but it, on the other hand, means a tool for every size of thread, whilst, with the bar, the small steel cutter only requires to be changed. As to screw-cutting, there is no easy rule, that I am aware of, that deals with the question more than in the most elementary

[45143.]—**Chemical.**—Iodide of methyldiethyl-amiyl-ammonium corresponds chemically to chloride of ammonium, in which the constituent atoms are replaced by organic radicals. Thus, chloride of ammonium is $\text{Cl N}^{\text{H}}_{\text{H}}_{\text{H}}$.

The compound is $\text{I N}^{\text{methyl}}_{\text{ethyl}}_{\text{ethyl}}_{\text{amiyl}}$

Ammonium, NH_4 , can have each of its atoms of hydrogen replaced by a variety of radicals, and yet retain its generic chemical properties.—SIGMA.

[45147.]—**Launch.**—I should use two screw, 20in. diameter, with blades 8in. long from the boss. I should also use 3-blades of the Griffiths patterns with a 4in. boss, and this would take a 1½in. shaft well enough if the blades were fitted with the nut to adjust them on the exterior, instead of inside the boss. The pitch I should recommend you to try would be about 18in. pitch for the blades, and looking at the dimensions as you state them, I should make the blades 4in. across the widest part, which would be about the middle. The exact pitch to get the utmost speed I could not tell you unless I had additional data, and went through a careful series of calculations. But a practical way which you can use yourself is to run the boat a given mile in still water, and gradually increase the pitch, of the fans until you found that the maximum speed was attained. Do not forget that a fine pitch, with the engine running well up to speed, gives the minimum of slip, and yields therefore the greatest real efficiency; therefore, do not reduce the revolutions of the engines by a coarse pitch, especially as I have not the least idea as to the after-lines of the hull. Very possibly a finer pitch than I have indicated even might be found to give the best result. As long as the boiler will make the steam, I should not keep down the speed of the engine, especially as the stroke is short; but let them run well away. The best thing to do is to try on the lines I have indicated, and then let me know the result, when it is quite possible that I can indicate alterations that would be improvements.—SUNLIGHT.

[45154.]—**Abyssinian Tube Wells.**—These are extremely useful wherever there are water-bearing strata, generally sand or gravel, within 20ft. or 22ft. of the surface. They are driven by a small monkey, and of course cannot be used where there are rocks or masses of stone. When water is reached, the pump for some time brings up sand, &c., until a cavity is formed round the end of the suction pipe, into which the water percolates from all sides.—A BARRISTER.

[45154.]—**Abyssinian Tube Wells.**—They may be used most successfully in any likely spot, but especially through clay. It is astounding through what obstacles the tubes may be driven; in fact, stones, except large, do not seem to be insuperable obstacles. One great item in their favour is, that if the water be required for drinking purposes, should the first spring that is tapped be polluted with sewage or organic matter, by driving down again, it is generally found that pure water can be got; the iron tubing effectually stopping off water from surface drainage, or impure sources nearer the surface. As far as first cost goes, if the locality be at all likely, I should not care to sink a well at no little cost, if one of these could be used.—SUNLIGHT.

[45155.]—**Water raised by Windmill.**—This really depends on the class of country a good deal. In some parts of England it would be simply absurd to fix a windmill—whilst in others great use could be made of them. The conformation of the country of the Western States of America is very much in favour of the utilisation of wind power, and windmills are neater in appearance on large plains. Take for instance Salisbury Plain. You will find lots of windmills grinding corn on that plain, inasmuch as the elevation above the sea-level and the rolling nature of the ground surface, the wind can be made good use of. There are several engineering firms in this country who make a speciality of small wind motors for agricultural purposes, such as pumping, chaff-cutting, grinding, &c. If you want such and cannot get at the makers, a query to me would always elicit the desired information.—SUNLIGHT.

[45157.]—**Breaking Coke.**—If some little loss, owing to the crushing action of the machine, would not be a fatal objection, would not one of the patent stone-breakers do what you want?—SUNLIGHT.

[45159.]—**Small Engine.**—For general plan of engine refer to page 192, Vol. XXXII., and for size of same you will find full mention on referring to page 144, same volume. You will find that the cylinders described are 2½ bore. You would do well to increase this to 3in. The boiler, as given at 192, would still be large enough, as the engine made from the sizes, &c., I then gave, cannot use all the steam, and you would also be able to set the slide to cut off a little sooner. Several engines that have been lately made on this plan are all giving satisfac-

tion, and cost but little to make, owing to the small number of parts. The great point is to get the guide path and cylinder in perfect line, or the engine will run stiffly, as it feels any imperfect lining out acutely; but once carefully erected and set true, it will require no further adjustment for years.—SUNLIGHT.

[45161.]—**Economy of Electric Light.**—There has been no progress made in economising incandescent lighting *per se*, nor is there likely to be. Improvements in the working duration of the lamps have been made, and will progress; but the economy of the actual light is a matter of simple physics: so much energy as electric current producing so much temperature in the conductor, and so much light. No invention or improvement can alter these relations. Economy, regarded as relative force, is a matter affected by the conditions in each case. Inventors, for instance, say they can produce the light at less than the cost for gas. The statement means nothing. Gas costs 2s. 6d., 6s., and 12s. 6d. per 1,000ft. Whether an electric light of 16 candles will cost more or less than an Argand gas-burner of equal power depends upon two conditions. 1. The cost of gas per 1,000 at the spot. 2. The cost of production of the equivalent electric current at the spot. As far as I can learn, the incandescent light under favourable circumstances of generation compares with gas at a cost of 6s. per 1,000ft. What the comparison will be when the light and its source are separated, and the electricity is distributed, no one can say at present; but the cost of distributing gas is a very large element of the price, and electricity will not be made distributable without considerable cost.—SIGMA.

[45164.]—**Lenses.**—If I had no restriction as to price I should purchase either a Ross's symmetrical lens or a Dallmeyer rectilinear, the first costing £6 and the second £5 10s., for whole-plate size. If I wanted to economise I could get made in Paris or Berlin a lens that would do all that either of the above would at far less cost. The only difference is the name. If a person wanted to sell either of the two first mentioned make, a good price is always obtainable. If the last named, it would be not so likely, as it would only fetch its second-hand value although, as far as definition goes, it would favourably compare with the others. There would be a little difference in speed, but for still life that is not so much an object to my mind as microscopical definition and depth of focus. To photo such subjects as you name, you also want a camera with rising front, &c., as the space between the object and camera is not always excessive, and it is handy frequently to place the instrument above or below the plane of the object.—SUNLIGHT.

[45165.]—**Faure's Battery.**—The reaction is precisely the same as that which occurs in the Planté or its modification by De Meritens. The oxygen arising at one plate from the decomposition of water produces peroxide of lead; the corresponding hydrogen reduces the other plate to a lower state of oxidation. When the battery is put to work the tendency is to equalise the two conditions of oxidation by transferring half the oxygen across the liquid. Of course these conditions are only imperfectly realised; other reactions occur according to the state of the plates, and both the gases are to some extent held mechanically, while part escapes altogether in bubbles.—SIGMA.

[45167.]—**Firewood.**—Beech, unquestionably; it burns freely and steadily, and does not fly, and lasts nearly as long as an oak log.—ANTARES.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last J. Brown, Belfast, has replied to 44518.

- 44552. New Violin. To "Oasis," p. 95.
- 44561. Bicycle Bearings, 605.
- 44564. To Mr. Kennedy, 605.
- 44565. Wire Spring, 605.
- 44583. To Mr. Rankin Kennedy, 605.
- 44585. Photographic, 605.
- 44587. Adjusting Loco. Engines, 605.
- 44589. L.B. and S.C. Engines, 605.
- 44590. G.E.R. Engines, 605.
- 44599. Amateur Clockmaking, 605.
- 44774. Dynamo-Machine Magnets, p. 75.
- 44797. Lathe-Making. To Mr. J. M. Evans, 75.
- 44-12. Claudet's Method, 75.
- 44816. Electric Gas-Lighting, 75.
- 44818. Dynamo-Electric Machine, 75.
- 44820. Patent Wrought Nails, 75.
- 44822. Comets, 75.
- 44827. Water-Wheel, 75.

QUERIES.

[45173.]—**Melting Brass—Drift** have been watching the answers to "Founder." Being about to build a new like to attach a fine for melting brass, wards. Would some chimney do for be draught from one to the other? A sketch of information would be a great favour. A my shop will be close to a large street water-wheels; the nearest wheel is 100ft would be the best or cheapest way to dr: stone, &c.? A wire rope (say ½) or shd wheels to make two corner turns as requi large stream, is there any simple ar a float-wheel, or any other device not a JEFF.

[45174.]—**Atlantic Cables of 186** this meet the eye of any of our electe accompanied the expedition sent out som to examine and report on the above, I sh obliged if they would kindly give me, columns, some information as to the el which they were then found, and the reas repair. I may add that my object in aski tion is solely in the interests of science, any detailed account in the papers at the dition returned.—E. H. B.

[45175.]—**Poultry.**—Will subscriber recommendations as to best means of wooden fowl-house, 5ft. by 5ft. during co COCHIN.

[45176.]—**Boiler for Launch.**—Wou spondents kindly tell me what is the best for a small launch running in salt wat boiler is a vertical without any tubes. I replace it with a locomotive, but am told a size the tubes could not be got at a deposit of salt would cause them to burn time. Launch is 28ft.; single cylinder engi stroke. Size and form of boiler, with any o tion, would oblige. "Sunlight" could be —ONE IN A FOU.

[45177.]—**Fret-Saw Machines.**—I lars as to construct a fret-saw machine various parts, how best made? It refer numbers of the MECHANIC is made, give the volume. I have not a lathe, so cannot motion. Simple drilling attachment als L'EXTREME.

[45178.]—**Chilled Extremities.** Edmunds kindly reply as to the means to prevent my extremities (hands more espec cause greatest inconvenience) from getting besides their general inconvenience: I a player in temperance band, and, as grad can only be executed when hands are in go anxious to prevent these hindrances which s from hindering my usefulness in ab Have usually cold hands and feet, and thes annoyances as the winters roll round winter. I am specially anxious to avoid, a help, if possible.—ANTI-NARCOTIC.

[45179.]—**Corns.**—What is the best counteracting the morbid secreting actor after a corn has been extracted to prevent tion? I have tried a number of topical re are generally too slow in their action to be service—nitrate of silver being the only ex I have discarded as it often sets up inf CANCER.

[45180.]—**Slide-Valve.**—Can any give me description of a "Patent Circular Slide-Valve," Church's patent, applied r sively a year or two since by Messrs. Fowler their traction and ploughing engines, but discarded? Messrs. Marshall, of Grant used it. Have they discarded it? And, i THOMAS J. SCOTT.

[45181.]—**Recovering Metal from Ashes.**—Will some kind reader of "our best method of getting the metal (less founders' ashes?—ONE WHO WISHES TO KN

[45182.]—**Leather Rollers.**—Will any how I could prevent water or oil from stick rollers?—OVERLOOKER, Bradford.

[45183.]—**Heating Steam Launch Mineral Oil.**—I shall be glad if "Sunl naval engine-r, will kindly inform me sufficient head of steam (to drive a 25ft. b be generated and maintained by using m: fuel? And, if so, what would be the best f to employ for the purpose? I am aware t ments have been tried, but I do not know F. M.

[45184.]—**Multipurpose Lathe.**—I m the "Multipurpose Lathe" of Mr. W. E. described by him in his "Lathes and Tm Northcott mechanism appears to me to do: the eccentric and oval chucks, and, als, engine, and to combine in one lathe (as so many correspondents seem to wish to do) the metal work as well as ornamental. Before add this mechanism to my lathe, I wish to have the opinion of your readers upon it. lathes succeed? Mr. Evans's opinion on it would, I think, be valued by many.—F. A. M.

[45185.]—**Valve-Chest of Pump.** contains double beat valve; top of valve-chest perforated with 4in. holes and disbed 6in. above this a disc of indiarubber 4in: cover on this; in cover a reverse valve, so pump is forcing water it closes, and when drawn in on the top of indiarubber. What the indiarubber serve to foot-valve? The net doing so well as they ought, so would before I move in the matter, the why and The pumps are of the piston plunger type, and valve in head 17in., with stroke of 3ft. do not work full until from 6in. to 10in. at

ag to diagram taken from pumps.
at a reasonable price on large pump-
sides Hughes in Weale's Series!—

Pin.—Will "Seconds" Practical
any other correspondent, kindly in-
ure jewel pin in lever roller, as I cannot
rmament!—WATCHMAN.

Boiler.—I have a vertical steam
such dirt accumulates. When the
ned an incrustation of a calcareous
t the bottom. There is a small
f the mud-boles, through which the
anyone remedy these defects? Is
atter to inspect steam-vacuum!—

g Ornamental Pottery.—Can
are the proper glazes to use to pro-
s? how they are applied? Is there
subject!—BRACHAMP.

unt Flow of Liquid from a
no reader of the ENGLISH MECHANIC
the best methods of obtaining a con-
from an outlet in the bottom of a
of the height of the level of the
REN.

Piano.—The hammers in my piano
s after striking instead of dropping.
There are nearly twenty keys that
this cause. I called in a tuner, who
and stood it before the fire, which
that day, but next day it was as bad
no maker anywhere near here, so, if
can tell me how to remedy this, I
obliged. I am quite ignorant of the
the different parts of the piano.—

ing.—I want to find some composi-
or force gently into a plaster of
when taken out, would resemble (as
good). I have tried a mixture of saw-
hat mixture seemed very long setting,
old and shrank. Perhaps a few bints
der would save me much trouble. I
a mould of plaster of Paris which I
or iron. It appears that the plaster,
nthes the air and spoils the casting.

t. Engines.—Could "Perth," or
the "E.M.," answer the following
dimensions of 8ft. 6in. coupled
(2) Are 320 and 325 like 319? (3)
is of 723 class, and how many are
The dimensions of the large-wheeled
ely mentioned by "Carstairs"?—

on's Method of Measuring
Vol. XXX., p. 619, the Rev. Mr.
hod of measuring the powers of eye-
box 20in. long and a dynamometer.
the box, and done as I think exactly
actions given, but I can make nothing
s (Huyghenian) have their foci in-
itly. I cannot see an object 20in. off.
by helping me in this matter!—

Marble to Stain Black.—Can
helped be stained jet black? Paint
likely to scratch. The mantelpieces I
ove.—E. E. H.

ble Turkish Bath.—I should be
in making a portable Turkish bath for
r.—GAMMA.

—Can any of your subscribers in-
any paper made that will not fade
posed to the sun? At present I have
the paper, which prevents the fading
it this method is too costly and takes
M. R.

and L. Engines.—Can any-
principal dimensions of the Man-
and Lincolnshire four-coupled bogie
at brake is used by that company?—

I. N. W. Engines and Sheds.
oblige me with the numbers, dates,
following, and where stationed!—
Castle, Quail, Redbreast, Ring-
moor, Mammoth, Menai, Langdale,
21 shed St. Helen's or Sutton!—

iding Picture Frame.—This
ed and answered, but in such a con-
bat I think there can scarcely be many
onset the readers of the "E.M.," or
ot that they will not part with it.
other-reader tell us exactly how it
how it is done in the trade!—LOCK-

pin.—I have an old brass coin dug
About size of halfpenny, very thin,
no side a ship in circle; other side
round. Round the ship looks like
d several times; other side, lettering
an any reader say what it is, and

nd N. W. Engines.—Can any
information as to where "Raven"
"B2," and "Dwarf" are now
design they are, and dates?—FOX

ic Bells.—What is the best alloy
if bell pushes, platinum being too ex-
No. 1.

mo Machine.—(1) Should the
mature be equal to that of the lamp
cabinets? (2) Could field-magnets
l lengths with same size wire as an
give any desired resistance, and would

such arrangement of coils be advantageous? (3) What
is best position of brushes on the commutator? (4)
Is the current in a Gramme machine squeezed out as it
were at the poles of the armature or at the neutral
points? And, lastly, what is the best book on Electricity
as applied to lighting? I wish to go thoroughly into the
matter, and any information will be thankfully received
by—SUB. FROM NO. 1.

[45204.]—**Bichromate Batteries.**—What would
be the probable loss of current if several batteries were
connected up for intensity in one vessel of solution!—
SUB. FROM NO. 1.

[45205.]—**Small Circular Saw.**—I wish to set up
a small circular saw to be driven by a treadle, and shall
be much obliged if one of my fellow-subscribers will give
me the following information:—What is the largest
sized timber I can cut with a foot-power saw? and what
sized saw would be required to cut it? I want the saw
for the most part to cut inch pine or deal boards. What
would be the best-sized saw for this work? What should
be the size of the pulley, and the size and weight of the
fly-wheel? Does any firm make such saws? I do not
want one in connection with a lathe or fret-saw. If
there is an affirmative answer to the last question, I will
advertise for maker's name in advertising column.—J.
R. W.

[45206.]—**To "Sunlight."**—I have a launch with
single cylinder engine 3 1/2 in. by 3 1/2 in., steam cut-off
6-10ths of stroke, propeller 30in. diam., pitch 3ft. 4in.,
exhaust steam turned into pipes under bilge, which is
perfectly condensed. I have not an air-pump yet. I
can just manage comfortably to hold steam with a small
jet of blast. What I want to know is, if you would be
so kind as to tell me, the size of a compound engine that
would not take any more steam, and, if I could get better
results, also the size of air-pump for same. I intend,
during the coming winter months, to make the above
engine, if you think there is an advantage. I may state
I have about 24ft. total heating surface in boiler. I can
also put a propeller 24in. if required. An early reply to
above would greatly oblige—AMATEUR.

[45207.]—**Re-wiring Pianoforte.**—I have an old
five octave piano and would like to have it re-wired.
Will any reader kindly tell me how to start, where to get
wires, sizes and prices of same?—F. R.

[45208.]—**Harmonium Queries.**—I have an
Alexandre harmonium with 4 1/2 rws of reeds. It has the
usual fault of such an instrument: viz., that it is irre-
pressible. This should surely be curable. Most of the
sound comes through between the keys, and I do not see,
as there is a double set of pallets, how to inclose the
levers and pallets. One result of this is that the swell
(worked by the heel) and the Forte stops are of small
value. Will someone be good enough to say how pedals
are attached to the harmonium? I am at a loss to see
how the trackers are to be carried to the levers. Lastly,
How is the movable keyboard connected with the wind-
chest (the Clavier Mobile advertised in Harmonium lists)?
—M. D.

[45209.]—**Ostrich Feather Dyeing.**—Will any-
one kindly give me a recipe for dyeing ostrich feathers a
good black? Also, a good dark maroon for feathers!—
ISOTA.

[45210.]—**Dressing or Refining Oider and**
Perry.—Will any of our correspondents kindly give me
instructions how to dress or refine oider and perry?
And, also, say whether the process is the same? if it is
intended to be kept one, two, three, or more years!—S.
C. W.

[45211.]—**Gas from Fluid Hydrocarbons.**—
Will someone give me directions to make gas from fluid
hydrocarbons which would not require the purifying
process, by using the common apparatus for making gas
from coal?—O. S.

[45212.]—**Lathe.**—I want to turn out some cast-iron
cylinders, but find that after the slide-rest tool has cut a
little way in, it seems to slip and I cannot keep it in cut,
it merely scraping the surface. Can any reader tell me the
cause of this?—A. R. R.

[45213.]—**Electric Motor for Punkah.**—I see
advertisements in your columns of electric motors for
working sewing-machines, &c. Will anyone of your
correspondents give me an idea of how to apply one to
pulling a punkah in hot climates? The work to be done
is to pull a hanging beam of wood about 7ft. long and
4in. in diameter, with canvas about 2ft. wide attached to
the lower side, so as to swing it about 2ft. from the
perpendicular each way. The pull is only one way, the
weight of the beam giving it sufficient back swing. A
coolie will do the work for about 2s. a month, but he
generally goes to sleep during the night, so that one is
awoke by the heat to find oneself covered with mosquito
bites. Any of your correspondents who could suggest a
means of performing the work by machinery at a reason-
able cost would confer a great favour on others besides—
EASTERN CIVILIAN.

[45214.]—**Manufacture of Bourdon Tubes.**—I
would supplement query 45103 by asking how these are
made. Are they sold, drawn to a flat section, or brazed up,
or what? If brazed, where is the joint? I suppose it
would be on the inner side.—GLATTON.

[45215.]—**L. and N. W. Engines.**—I shall be
extremely obliged by the numbers and classes of the
following:—Macedon, Peel, Prospero, Violet, Waterloo,
Zygia, Londale, Sultan, North Western, Litona, Trevi-
tick, Patterdale, Sanspareil.—W. B. P.

[45216.]—**Model Steam Engine.**—I have made
a horizontal steam engine, 1/4 in. bore, 1 1/2 in. stroke. All
the parts work easy, only, when the top port is open, it
does not act, and the steam escapes by the exhaust. The
bottom port works quite right; the valve is set equally.
Will any kind reader reply?—A. C. A.

[45217.]—**Aspirator.**—I am endeavouring to make a
small steam aspirator. If any reader can give me any
hints, or a sketch of a good pattern of aspirator, I shall
be greatly obliged as I am at a full stop in putting
together some apparatus for the want of an aspirator.—
SEC. SCIENTIFIC RESEARCH CLUB.

[45218.]—**L. and N. W. R. Engines.**—Can some
correspondent give me the dates of the following en-
gines?—Mabel, Brendalbane, Prosperine, and The

Auditor? Also, are these tender brakes worked by power
as well as by hand, the engines being fitted with a power
brake to coupled wheels?—E. W. J.

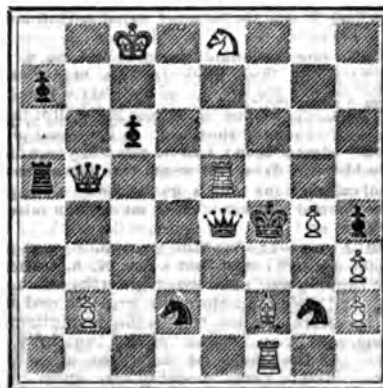
[45219.]—**Clark-Webb Brake on the L. and**
N. W. R.—Can some correspondent tell me whether
the chains in the above brake are ever so attached to the
vans placed at each end of a section that the brake can be
worked from either van?—E. W. J.

CHESS.

ALL Communications for this department must be
addressed Chess Editor, 22, Chancery-lane, W.C.

PROBLEM DCCIX.—By F. F. BEECHER.

Black.



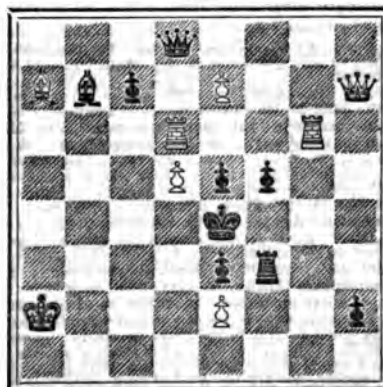
White.

White to play and mate in two moves.

PROBLEM DCCX.—By A. F. MACKENZIE.

(From Brentano's Chess Monthly.)

Black.



White.

White to play and mate in two moves.

SOLUTION TO 705.

- | | |
|-------------------|---------------------|
| White. | Black. |
| 1. B to B 5. | 1. K to B 6 or (A). |
| 2. Q to Kt 2. | 2. Anything. |
| 3. Q to B 2 mate. | (A) 1. R takes P. |
| | 2. Anything. |
| 2. B to Kt 1. | |
| 3. Q to B 4 mate. | |

SOLUTION TO 706.

- | | |
|---------------|---------------|
| White. | Black. |
| 1. Q to R 6. | 1. Anything. |
| 2. Mates acc. | |

NOTICES TO CORRESPONDENTS.

CORRECT SOLUTIONS to 705 by J. W. Jubb, H. Planck,
S. L., and W. W.; to 706 by J. W. Jubb, H. Planck,
S. L., and W. W.

W. J. J. (Forest Gate).—Thanks for communication.

G. N. (Stratford-on-Avon).—Your request has been com-
plied with.

CHESS ITEMS.

MR. J. H. BLACKBURN, the winner at the late Berlin
Congress, gave, on the 26th ult., an exhibition of his
wonderful powers of blindfold play, being the first
instance such a feat has been performed at Brighton.
Nine players were opposed to the blindfold player, and,
at the conclusion, the result was that Mr. Blackburne
won four games, drew three, and lost two. The two win-
ners were Messrs. Edmunds and Smith, and those who
were fortunate enough to secure draws were Messrs.
Erskin, Markwick, and Martin. Mr. H. W. Butler
acted efficiently as teller. On the evening following Mr.
Blackburne's performance was in contesting simul-
taneously seventeen games. Mr. Blackburne won of
these no less than fifteen, losing one to Mr. F. W. Mark-
wick, and drawing his game with Mr. G. E. Downer; both
of the successful contestants are well known as clever
problem composers. The proceedings were held at the
Pavilion, and terminated successfully with votes of thanks
to Messrs. Blackburne, Butler, and Booth.

ANSWERS TO CORRESPONDENTS.

. All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, Tavistock-street, Covent Garden, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

. Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 2, and unacknowledged elsewhere:—

REV. H. ALGAR.—Lt.-Col. Kendall.—Rev. S. R. Craig.—T. Clarke.—J. W. Grimshaw.—Rev. N. S. Godfrey.—A. Monckton.—E. S. Hindley.—S. Martin.—H. A. P.—A. S. Lukin.—R. C.—S. J. M.—J. W.—Young Engineer.—Senex.—P. W. C.—D. P.—Young Prism.—A Fellow Workman.—J. G. B.—Dr. Royston Pigott.—Joseph Green.—Dorothy.—J. Cherry.—Electric Miller.—X. G. Z.—Devoniensis.—Loco.—On Guard.—J. F. B.—York.—Juvenis.—Bicycle.—B. Morris.—T. N. C.—A Travelling Exhibitor.—Z.—H. W.—Joshua.—A. M.—W. H.—A. G. Hays.—Jno. B.—Carstairs.—No. 70.

TRICYCLES.—It is impossible for us to insert all the communications we receive on this subject, and we must remind our readers that, while ready to devote all available space to letters containing useful suggestions or the discussion thereof, we have no room to spare for thinly-disguised advertisements of makers or mere personal controversy.

METEMPSYCHOSIS. (Your description of Ruhmkorff's last coil is scarcely of sufficient interest for insertion. In answer to your questions.—1. No doubt, but what would be the advantage? The power depends on the zinc surface. 2. No, utterly unsuited, as the wires should be of the purest and softest iron. 3. Perhaps you will find an answer to your question on p. 297, Vol. XXXI. 4. In the usual way. Illustrated many times. See pp. 106, 151. 5. Yes.)—ALFRED BOOTH. (What speed can you get out of your manumotive tricycle? Have you really tried it, and where do you keep it—in a stable? It is more than 5ft. wide by 9ft. long.)—D. MOORE. (You will find a velocipede to be moved by the hands on p. 462, No. 590; but as you say you can use your legs, we should think the blacksmith in your town could readily adapt one of the old-fashioned velocipedes to your requirements.)—OMEGA. (Assuming ordinary black rosin is meant—colophony, it is soluble in alcohol, and as the latter evaporates you can have the solution as thin or as thick as you please.)—J. C. SMITH. (Lead.)—T. H. E. (The *British Journal of Dental Science* is published by Messrs. Churchill, New Burlington-street, W., price 6d.)—A FIVE WEEKS' READER OF THE E. M. (It is a metal used for the purpose in the form of wire or ribbon; but judging by your question about colours we suspect you mean something else. 2. It is called etching. The surfaces are protected with wax or varnish, and lines traced through the coat. Acid is then applied and the metal eaten away. See the indices. 3. The cheapest way would be to send it to the dyers.)—C. J. H. (If your friend has not sufficient money to patent it and bring it into use by gratuitously fitting up an experimental train, &c., he must seek the assistance of a capitalist.)—JOHN SUEWAX. (Surely you do not really think it is "new." Anything that will scratch a line will do.)—CHEMIST. (Lockwood & Co. publish a "Dictionary of Terms in Engineering, Architecture, Mining, &c.," but there is no book that answers exactly to your requirements.)—GALILEO. (It entirely depends on the arrangement of the music. Sometimes there would be several, sometimes only one. As you do not know anything about music, you had better learn the rudiments at least before you attempt to set out tunes for barrel organs. You will then be in a position to put a more definite query.)—A STUDENT, Durham. (Richardson and Watts' "Chemical Technology," Chateau's "Traité des Huiles," "Destructive Distillation," by Prof. E. J. Mills; and "Friction and Lubrication," by Prof. R. J. Thurston, are the works of reference mentioned in the syllabus.)—E. D. MITCHELL. (You could see the apparatus employed by calling at any optician's in Manchester, or you could consult our back volumes, even the last number. It is not altogether free from danger, and the consumption of oxygen would vary from 6 to 8 cubic feet an hour, hydrogen just double, but you would use coal-gas for that.)—ONE IN A FIX. (A good hydro-incubator was illustrated on p. 465, No. 773, and p. 311, No. 793; Halstead's (a favourite in the United States) on p. 141, No. 812. Consult the indices of earlier volumes, and the book issued by Christy and Co., Fenchurch-street. 2. Prepare the wire by pickling in acid. Wash and dry, then plunge into a bath of melted zinc.)—H. A. S. (You do not specify what is the matter, but you can scrape and polish or wash with weak solution of ammonia. 2. For methods of dressing moleskins, see p. 380, No. 715.)—G. R. DURRANT. (We know nothing of the makers of the pump named. The former part of your query is very vague. What is the size of the town it is proposed to supply, and what is the average consumption of water?)—TRALEE. (There is no such journal published.)—R. G. L. (Genuine, we believe; that is, it is not one of the "sundial" "sells." As to the value of the

watch we express no opinion.)—WINTER. (They do smell, and our personal experience is that they are not suitable for an invalid's bedroom.)—W. H. TOYE. (You were replied to on p. 173.)—G. CALVER. (We agree with you to a considerable extent, but still think the first-named correspondent errs more from a disposition to fads than want of good intention. With regard to your own query, if only two or three correspondents answered you the list would take a column at least, and then how much wiser would you be than with the musiceller's catalogue before you? The firms we mentioned publish cheap collections of standard works, from which you will readily find a selection to suit you.)—H. T. (Employ a respectable architect.)—A CONSTANT SUBSCRIBER. (You had better see a solicitor before you quit the premises, and before you attempt to touch the sheds, &c. Your landlord evidently means mischief, assuming your story to be true, and in such circumstances a landlord has always more power than his tenant.)—T. B. J., Chicago. (The composition of the cements to which you refer are kept secret by the makers, but in most cases they are rubber or gutta-percha dissolved in bisulphide of carbon.)—INVALID. (We illustrated and described the ocarina on p. 420, Vol. XXVI. It is made of earthenware or porcelain, and has a tone something like that of a soft whistle. The notes are produced by blowing, the pitch being varied by means of finger-holes.)—LIZZIE. (Why not write to the maker himself? You will get an honest answer. At any rate, we have not room for such a discussion. Whoever told you that the green flame is due to volatilisation of copper is—well, mistaken, for you can see the green flame when the dome is of tin-plate or of iron. Copper or nickel-plated iron is used because it is not oxidised as iron is in the intense heat.)—WISSEAT. (Glycerine coloured with one of the aniline dyes; but how a fall or rise would be "greatly magnified in tube at" is beyond our comprehension, as it would be exactly the same as in the large tube.)—W. H. D. MACLEWEN. (Use oak varnish, not paint. If you have a propeller you must work it by hand, as an engine and boiler would swamp such a boat.)—H. L. F., Heidelberg. (We have received several similar queries. The answer is that if there is room in the "frame," the acetate of soda warmers can be utilised, but it is purely a matter for experiment. You will find calculations as to the units of heat on p. 140, and if you will compare them with the cooling surface of the frame, you will be able to calculate how many warmers will be needed.)—HARMONIUM. (See back volumes, especially Vols. XX. to XXIII., or go to one of the good makers.)—ELECTRIC MILLER. (Yes, the only difficulty would be excess of current. The engine would do, unless it is working under such a load that there is no surplus power. But why not put the questions direct to the makers of the Swan lamps, who could answer them down to the minutest details.)—Z. (Your stone is not clean, and consequently does not take the water. Your rollers are probably spilt. They should be well saturated with lard or tallow or some grease that is of a less drying nature than the varnish in the ink, then roll in strong varnish several times, with alternate scrapings. For keeping, clean all ink off, rub in tallow, and wrap up.)—ONLIGATION. (The remedy is to apply to a surgeon to open the duct. Only personal examination can possibly lead to any good results.)—H. M. WARD. (There are plenty of makers in both London and Coventry who would be happy to make you a tricycle on which you could carry all the paraphernalia of a photographer.)—OSTRICH. (They are cleaned by washing in a lather of soap-and-water, warm, rinsed through blueing water, dipped in a cold solution of starch, and shaken dry in the air. For curling, each filament must be taken between the finger and thumb and passed over a sharp edge such as a book knife.)—J. G. T. (It is mixed with sulphur and subjected to heat and pressure.)—G. FAYRA. (The water is made to propel a piston in a cylinder. The piston is connected by suitable linkages with the lever of the bellows. See p. 159, Vol. XXVI.)—HOMO. (Greater strength and less weight. 2. Consult the indices, or one of the engineering pocket-books. Similar question answered many times.)—ONE IS DIFFICULTY. (Clearly a case of disease of the eyes, but what no one can say until they are examined by means of the ophthalmoscope.)—OBLED. (Use varnish black, to be obtained at the oil-shops, or the black varnish used with positives.)—PUZZLER. (See p. 451, Vol. XXVII., but there are plenty of different devices kept by fitters-up of electric appliances.)—SUNVEYOR. (Get one of Lockwood and Co.'s catalogues, and select the works you want. Without knowing your attainments, how could any one advise a course of study?)—SKULLBUBBS. (Try rubbing with camphorated oil. See pp. 198, 221, 243, Vol. XXVI. 2. Only by a most expensive process, if you really mean "pure." 3. Zinc is not an alloy.)—A YOUNG SHOPKEEPER. (A simple test for butterine is to pass a knife through it, and look at the peculiar appearance of the "threads" which hang from the edge, as seen when held up to light. Compare with genuine butter, and you will soon learn to recognise the difference. 2. The second question is beyond us. If you cannot find out whether you are making a profit, no one else can. Get a manual of bookkeeping.)—H. (Either dipped into heated sand or steamed for several hours. They are tied in bundles and subjected to heat for some time afterwards.)—R. P. BRIDGE. (Possibly an advertisement in the "Sale Column" might bring you the address; but if we are not mistaken, the authorities object to the sale of such things except as curiosities, when out of date.)—A CONSTANT READER. (You must try the "Address Column." We regret to disoblige any reader, but such queries would soon occupy all our space.)—T. C. (Very likely, but the original reply is not before us. More corrections of replies about numbers and stations, and names of locomotives reach us than in connection with any other subject. They tax our space very severely, and the queries and replies being for the most part of such limited interest, we fear we shall have to exclude them altogether.)—A. H. H. (There are no such books published by the railway companies.)—J. HART. (The correspondent you appeal to expresses elsewhere his willingness to communicate privately with readers who advertise their addresses.)—TOM. (The plan has been patented and described in these columns, but the specimens sent to us were practically useless.)—W. WILLIAMS. (Any of the "graph processes" would suit, we should think.)—J.

L. F. (They have already been asked answered. See our reply to "T. C.") at (Any definite query on the subject shd a vague request for "six pages on that what has appeared, is inadmissible.) (You may retard it by dressing the creosote, or other preservatives, but ventilation is still defective, and, nothing will effect a permanent cure (Pitman's).)—DELL AND CO., J. C. CLO

HOTTER WATER.—J. Cherry.—Devoniensis: T. C.—Wm. Wright.—M. M. I. Sc. S.—R.—Old Log.—Alphard, and others have already similarly or adequately answer

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Throat Irritation.—Soreness and inflammation, inducing cough and affecting these symptoms use Epps's Glycerine Jujubes, these agreeable confections, being in proximity the moment they are excited by the act of actively healing. Sold only in boxes, 7d. and 1s. JAMES EPPS and Co., Homoeopathic Chemists, letter received.—"Gentlemen,—It may, perhaps, know that, after an extended trial, I have found Jujubes of considerable benefit (with or without ment) in almost all forms of throat disease. To clear the voice.—Yours faithfully, Gordon Hock Senior Physician to the Municipal Throat and Ear

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The charge for Exchange Notices is 3d. for the first and 3d. for every succeeding 5 words.

Splendid 3-plat., heavy-cased, Silver Watch, jewelled, accurate time, new; value £12. mutual approval.—JAMES SOUTHERN, Wellington, New

Wanted, exchange, small Planing Machine to plane 12 feet.—Geo. ANDERSON, Engineer, Glasgow

Wanted, Nod's or Guthrie's "Electric" change Sprague's ditto, quite new, to equal value CLOVER, Springfield, Sudbury, Suffolk.

Wanted, about 350 feet 3in. Metal Pipe having core holes for 4 bolts in each flange. Delivery fast.—Offers.—JAMES S. BROWN and SONS, 11, Bedford

Lathe, strong, all iron, 6ft. 6in. 5ft. 6in. by 18in. 18in. clean; offers.—ENGINEER, 71, Leadenhall Lane

Complete "History of the Franco-War," 36 Vols., unbound; quite clean. Exchange to King useful to value.—Cow and 22, Hill Millon, Dublin

and contains 96 teeth. This fitting must be very carefully managed, or it will look very unsightly when finished. The wheel itself must, of course, be cut in a separate chuck made for the purpose, and when it is fitted to its place it may be removed and the nose, Fig. 1, cut down to the size of that on the mandril, as all the same chucks may be used if necessary on the dome chuck as well as the mandril. Having the wheel fitted into its place, the tangent-screw must be now fitted. This is made of steel, and before cutting out the bearing into which it is fitted, the top cap should be fitted on, and the two screws got into their places. We now come to that part which necessitates great care and a proper tool, as we have to cut out a recess between the two bearings for the screw itself. To do this properly a tool must be either made, or at all events, obtained somehow. It consists simply of a small piece of steel turned to the desired size of the recess, and made into a cutter. It is a thing very easily done, and may be either cut with a cutter, in conjunction with a horizontal cutting-frame, or it can be filed out into sufficient number of teeth to effect its purpose. It will be observed that the screw is not visible, and consequently no dirt can get to its working parts.

The tangent-wheel is held in its proper place by a screw with large head and thin steel washer, as seen in engraving. The washer is fitted on a square filed on the pin of tangent-wheel. There is little more to be said upon the construction of this tool. If used a great deal, it is a good plan to have what is termed a transfer chuck for the purpose of placing the work truly upon either the nose of the mandril or of the dome-chuck—it is a great convenience, and saves all chance of the work being in any way out of truth. The engravings will give what further instructions may be required, so I will not occupy more space upon this subject.

OBTAINING AND MEASURING VERY HIGH VACUA.

FOR several purposes nowadays a simple method of obtaining very high vacua is a desideratum of the physicist for researches on radiant matter, which Mr. Crookes has introduced, as much as for experiments with incandescent carbons for the electric light, which that scientist has also been making recently. Geissler's and Sprengel's pumps are well known, and we gave on p. 117, Vol. XXXII., a combination, remarkable for its complexity, which Edison is reported to have used in obtaining a vacuum in his incandescent electric lamps. The ordinary Sprengel pump, even in unskilled hands, will produce a vacuum of 1-5 millionth, but some time ago Mr. Crookes obtained a vacuum of 1-20 millionth (see p. 439, Vol. XXIX.), and it was then thought that a much higher vacuum would be impossible of attainment. By modification of the apparatus, which is based on the principle of the Sprengel pump—the flow of mercury in tubes—much higher vacua have been obtained, especially by Prof. Ogden N. Rood, Professor of Physics in Columbia College, U.S. With a modified form of Sprengel he obtains easily vacua of 1-100 millionth, and has reached the 1-390 millionth without arriving at the limit of the possible action of his apparatus. The latter is fully described in a recent number of the *American Journal of Science*, and assuming that no error has been made in estimating the degree of vacuum it is certain that the results obtained by Prof. Rood are remarkable considering the simplicity and inexpensiveness of the appliances employed. The 1-20 millionth of an atmosphere corresponds to the 1-100th of an inch in a barometrical column three miles high; so, if Prof. Rood

has succeeded in obtaining a vacuum of 1-390 millionth, he must, one would think, have obtained as nearly perfect a vacuum as it is reasonable to imagine possible. That stage is reached, it may be observed, when the leakage of the apparatus is equal to the amount of air that can be removed in a given time, and although a vacuum of about 1-400 millionth was once observed in Prof. Rood's experiments, such a degree as that would not be maintained for many seconds. Without a number of diagrams, it is impossible to make clear the actual arrangements adopted by him, but the principle can be readily understood, and applied in various ways. In the apparatus used by Edison, illustrated on p. 117, Vol. XXXII., we have a complicated arrangement of tubes and bottles, with stopcocks, bulbs, &c., but in Prof. Rood's, stopcocks and grease are dispensed with, a movable column of mercury being employed where it is desirable to have the facilities usually afforded by a stopcock. The reservoir containing the mercury is an ordinary inverted bell-glass, with a diameter of 100mm., and a height of double the diameter, the mouth of which is closed by a cork carrying the tube and painted with a flexible cement. The tube enters the reservoir to the extent of about 40mm., but just above the cork, which rests on a shelf and supports the reservoir, it carries a piece of sheet-iron, shaped like a watchglass, and with its convex side towards the cork. This cup-shaped piece of iron, which is closely cemented to the tube, prevents the small air-bubbles which creep up the tube from finding their way to its mouth, and is probably a not unimportant part of the apparatus. The flow of mercury is regulated by means of a steel rod and cylinder connected to a lever attached to the board which closes the upper end of the reservoir. The lower end of the steel cylinder is filled up with a piece of pure rubber, which, after a little use, controls the flow of mercury accurately. When the mercury leaves the reservoir it falls into the vacuum bulb, where it parts with most of its air and moisture, and passes along a bent tube to the junction with the fall-tube. The arrangement of this part is, according to Prof. Rood, by no means a matter of indifference, for the tube leading from the bulb should fall for some little distance and then turn up to the point of junction where the drops of mercury are broken off, in such a manner that a horizontal line drawn from the proper level of the mercury in the bulb passes through the point where the drops of mercury fall off. The diameter of the vacuum bulb is 27mm., the length of the inclined tube from it 150mm., and that of the rise to the fall tube 45mm., the junction being made with a good curve. The bore of the tubes is about the same as that of the fall tube, 1.78mm.; but it does not appear that any special merit attaches to these dimensions. The fall-tube has a length of 310mm. when it bends out and returns sharply with a good loop, and then continues for a further length of 815mm. These bends form a fluid valve preventing the return of air into the pump, and the play of the mercury in them greatly facilitates the passage of the air downwards. The top of the mercury column representing the existing barometric pressure should be about 25mm. below the bends when the pump is in action, a point which is easily regulated by means of an adjustable shelf, which supports the tube into which the fall-tube dips. For measuring, Prof. Rood uses a modification of McLeod's gauge, the tube containing the compressed air having a diameter of 1.35mm., and being closed at its upper extremity by a glass rod, which is cemented in place. The object of this is to obtain the compressed air in the form of a cylinder, and to allow of the cleansing of the tube when necessary. The capacity of the gauge-sphere was that due to a diameter of 60mm.; but it is ad-

visable to increase the capacity to double, as small spheres make the probable error large. The gauge-tube dips direct into mercury in a cylinder, which can be raised and lowered at pleasure, and thus enable the experimenter to graduate the pressure to a nicety. By the use of a cylinder filled with mercury, instead of the usual india-rubber tubing, small bubbles of air are prevented from entering the gauge along with the mercury. All the tubing is supported at a distance of rather more than 2in. from the woodwork by means of adjustable supports and clamps, the object being to facilitate heating with a Bunsen burner without risk of burning the wood; but where the glass is of necessity fixed closer, the wood is protected with metal or coated with a solution of alum. The tubes, of course, must be properly annealed, which Prof. Rood effects by exposing them in heavy iron tubes to about the temperature of melting zinc for five hours, and then allowing an hour or two for the cooling process. So far he has not met with an accident, although drops of cold mercury have frequently fallen on portions of the glass heated considerably above 212° Fahr. The cement used for luting and for joining the tubes is made by melting Burgundy pitch with from three to four per cent. of gutta-percha. It should, when cold, be so hard as to resist the impression of the finger-nail. It is applied by heating the parts to be joined and then touching them with a fragment of the cold cement, which runs in and forms a joint which is transparent, and which can be examined with a lens for the colours of thin plates which always precede a leak. Prof. Rood has had such joints in use for two months at a time without a leak making its appearance, and no appreciable amount of vapour is yielded by the resinous compound, which, however, is melted several times before it is used. For drying material, he prefers caustic potash that has been fused just before it is introduced into the drying tube. During the exhaustion experiments the caustic potash can be heated nearly to the melting point, but if actually fused in the drying tube the glass invariably cracks. The various parts of the apparatus are kept hot by moving a Bunsen burner to and fro close to them; and at first starting, bubbles, mainly of vapour of water, are observed for fully a quarter of an hour. Without this precaution of heating, a higher vacuum than 1-25 millionth was found impossible; while constant using of the pump and gauge was found to gradually eliminate the air. One of the most important elements in the production of high vacua is leakage, which after the air is detached from the walls of the pump becomes and remains nearly constant. Thus the average of a number of experiments which had a duration ranging from eighteen hours to seven days shows that the pump leaked .001266 of a cubic mm. per hour, the pressure being 760 mm. One quarter of this leakage Prof. Rood says occurs at the top of the column of mercury; but the total leakage is four times as great when the pump is in action as when it is in a state of rest. The leakage of a plain Sprengel pump without stopcocks, and arranged as far as possible like Prof. Rood's, was for a mean of four experiments .06180 cubic mm. per hour, and the highest exhaustion ever obtained was only 1-5 millionth. Sixteen experiments made with the improved pump arranged in groups of four gave a mean of 1-74,853,449 with a probable error, with reference to four means, of 2.28 per cent. of the quantity involved. A higher vacuum measured in the same way gave a grand mean of 1-178,411,934 with a probable error of 5.42 per cent. Five readings at still higher exhaustions gave a mean of 1-381,100,000 with a probable error of 10.36 per cent. of the quantity involved. Without using potash, but taking care to

A DIAGRAM SHOWING THE DISTANCES BETWEEN THE COLOUR LINES IN EQUAL-LENGTH SPECTRA.

	B	C	D	E	F	G	H
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							

	B	C	D	E	F	G	H
1.							
4.							
6.							
8.							
9.							

tion of the kinds of glass which leave the least outstanding colour. Among the first ten, the best effect would seem to be obtained by combining No. 6 with either No. 9 or No. 10; and among Chance's glass, soft crown and light flint appear to give the least secondary spectrum.

(To be continued.)

THE ORGAN AND HOW TO MAKE IT.—XIV.

By J. DRESSER.

The Action-Work.

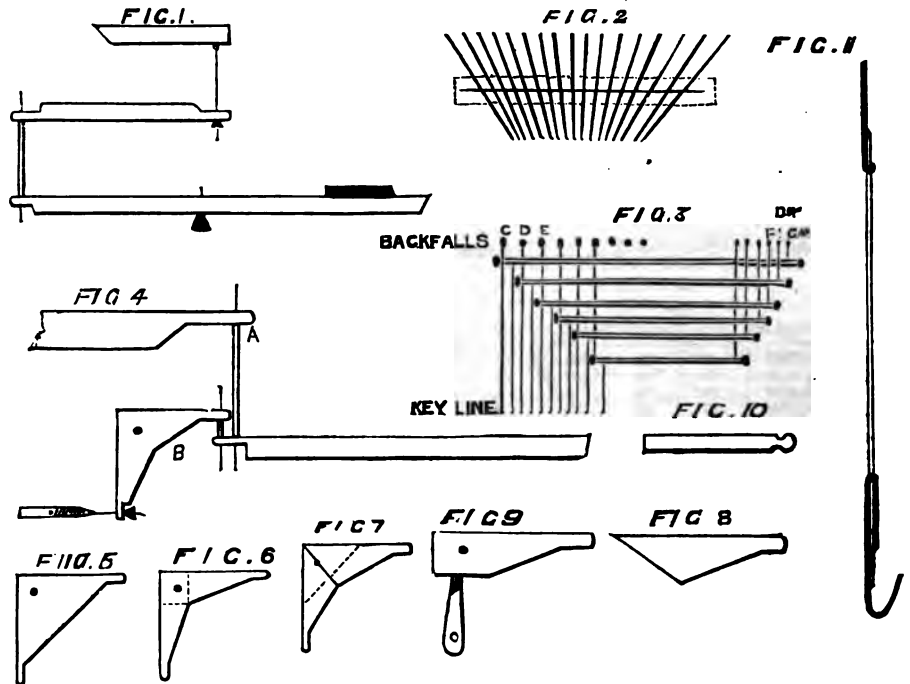
THE action-work is the movement connecting the pallets to the keys, and consists of stickers, trackers, levers, squares, and rollers, variously attached and applied to suit the requirements of the particular organ. A *sticker* is either round or square in section, and about a quarter of an inch thick; it is generally found on the tail-end of the keys, where it pushes up the end of a lever or a square. A *tracker* is also a thin strip of some light wood, generally pine; it is sometimes round, at other times square, but more generally flat, about three-eighths by one-eighth of an inch; its action is to pull down either a roller-arm or a pallet. *Levers* or *backfalls* are generally made of mahogany or other hard wood; they vary in length from a few inches to two or three feet, and the size is generally one and a half inches wide and a quarter inch thick; these levers are usually let into a grooved rail, and fixed in that by a wire through the middle of the lever, the wire forming a centre for the lever to work on. This hole is generally *bushed* or lined with cloth to prevent noise in working, and, difficult as it may, at first sight, appear, to line a hole an eighth of an inch in diameter, it is in reality an extremely easy affair: cut a strip of fine broad-cloth, say, the remains of an old coat, rather over a quarter inch wide, and ten or twelve inches long, cut one end to a point, very similar to a steel pen, put the point through the hole and draw the cloth through; it will take the form of the hole and completely line it; touch the cloth with glue where it is to remain in the hole, then cut the cloth off neat and clean on each side.

In small, one-manual organs the action is very simple, and consists of the keys, stickers, and backfalls, as shown in Fig. 1; the pressing down of a key throws up the further end of it and pushes up the sticker, this pushes up one end of the lever; the other end being, consequently, depressed, pulls the pallet down and allows the wind to enter the pipe. If the pallets were the same size and distance apart as the keys, the backfalls would simply be straight levers; but in practice it is very seldom so, and various plans are adopted to overcome the difficulty. The most usual plan is the fan-shape, in which the levers spread out at the bottom, and the other end they are straight. Fig. 2 shows such an arrangement of the bass notes of the soundboard; the number is

usually six for small organs, and the pipes so transferred are the alternate notes of the lowest octave—thus, CC, DD, &c., are on the left-hand or bass side, and CC sharp, DD sharp, FF &c., are on the right-hand or treble side; when this plan is adopted there are six more levers or backfalls beyond the range of the keys on the treble side; the motion to these levers is carried by a roller, which is of such a length that one arm is exactly over the end of the key, and the other arm is under the lever, Fig. 3.

are out off: this is easier for the general amateur than the preceding, and equally as strong, but takes considerably more time; if two or three sets are required the bevel and tongue plan is best. Another, and still easier plan, which, perhaps, gives one the idea of cheapness and nastiness, yet answers its purpose, is one good wood arm, and to form the other arm a short screw-arm of wire is inserted. Fig. 9 will explain itself.

Round stickers are run off with a bead-plane.



Before going further it may be advisable to more fully explain the different parts, and how they are made. When a keyboard is fixed, the stickers are generally round, unless a lever coupler to a second manual is used; then the stickers are flat either half-way up or the full length. When a keyboard slides out, the stickers must be oblong in section at the lower end, even if they are rounded further up, as they then work through a register or guide rail to keep them in position when the keys are moved. Fig. 4 shows the end of a fixed manual with stickers to a backfall at A, and to a square at B. Squares are to an organ-builder what bell-cranks are to a bell-hanger—they change the line of motion from a horizontal to a vertical, or from a straight to right or left as required. Squares are made of any hard wood, but mahogany is generally used; sometimes they are cut out of one piece of board and shaped like Fig. 5, at other times they are made out of two pieces and halved together as shown by the dotted lines in Fig. 6, and frequently are mitred together, and a sawcut being

Get a clean piece of best pine, and plane it to a quarter inch thick, then with a quarter inch bead-plane run a bead down each side of the board, as Fig. 10; the round bead will be so nearly detached that it will crack off; clean off the ridge with a smoothing plane, and then sandpaper, when a nice-looking round sticker will be the result. When flat or square stickers are required, a cutting gauge is used instead of a bead-plane, and they are cleaned off with either the smoothing or trying-plane. After the stickers are cut to the exact length, a wire is inserted at each end, and projects two inches. This goes through a small hole in the end of the square or backfall at one end, and a similar hole in the key. A small circular washer of cloth is put over the wire, to prevent rattling by the end of the key and sticker touching each other.

Trackers are long thin slips of pine, and of any length from 10 or 12 in. to as many feet. A piece of clean sound pine is planed up and cut off to the required length, and the trackers cut off with a cutting gauge, seven or eight should

made, as shown in Fig. 7 by the dotted line, a piece of tough veneer, such as maple or beech, is firmly glued in. In making the last form of square, a piece of one and a half inch mahogany is cut off the end of a wide board as long as the length of the square, generally four inches; this is planed down to the shape of one arm of the square, Fig. 8, one end being bevelled to a true mitre; another piece is got out the same way, and the two are carefully glued together and well dried. Next make a sawcut every three-eighths of an inch, and let in a piece of veneer, according to Fig. 7; when all is dry, clean off the stuff, then saw the squares apart, taking care the sawcut is exactly between the veneers. Another plan is to leave the end of the block square, Fig. 6, and have each arm together after the arms

have placed small hinges on the upper edge of this lid, and upon these hinges hangs the cocoa box, three inches deep. I have not found it necessary to place any fastening on the lower portion of the box, because it closes, and remains closed, of its own accord.

I have cut a circular opening, opposite to the condensers, for the lens, and have made two tubes of millboard, each two inches long, the one sliding inside the other for focussing purposes. These were constructed in the same way as the condensers, by passing a couple of circular rings out of half-inch brass—the one about a quarter of an inch wider in diameter than the other. The larger one is screwed on at the cocoa box, and then a strip of millboard has been tacked round to form the outer tube. The other ring has a similar tube tacked upon it, and carries the flange of the lens. This, I think, comprises the apparatus. The whole has been constructed with the view of enlarging a quarter-plate negative up to the size of a whole sheet of Morgan's paper, and the common paraffin lamp, with an inch and a-half wick, gives ample light for the purpose. I fasten the paper upon a drawing-board, by means of drawing-pins, and place it at a distance of three feet four inches from the lens.

The negative we are using to-night is of even character, and we need not, therefore, mask any portion of it during the exposure. Having focussed carefully, through a sheet of yellow glass, I hold in my left hand a piece of cardboard with an aperture of the required size, and place this about three inches from the lens, giving it a slight movement so that the edges of the vignette which it produces may be soft and graduated; then, with the right hand, I remove the yellow glass and commence the exposure. This will, of course, vary with the density of the negative, and the quality and amount of the light from the lamp. It may be readily ascertained by exposing a preliminary slip of the paper in sections of a minute each. We shall require five minutes for our work this evening.

I recommend, for development, deal trays covered with two or three coats of varnish. Pour a pint of water into the tray and place the paper upon the surface of the water. It will now become flat, and, after a few tilts of the tray, the whole surface is thoroughly wetted and ready for the developer. I next pour into a beaker two ounces of a saturated solution of protosulphate of iron, and add six ounces of saturated oxalate of potash and one drachm of a ten-grain solution of bromide of potassium. The picture soon makes its appearance, and when sufficiently developed, is well washed, fixed with hypo., thoroughly washed again, and dried, and may be mounted and framed at pleasure.

PROF. LANGLEY'S EXPEDITION TO DETERMINE THE HEAT AND COLOUR OF THE SUN.

It will be remembered that early in July last, Prof. E. P. Langley, of the Allegheny Observatory, started for Mount Whitney, in California, in order to make observations of the sun, from an altitude of between 14,000ft. and 15,000ft. above sea-level. The instrument used in measuring the solar heat is known as the bolometer, and was devised by Prof. Langley, its construction being due to the lowering of the electrical conductivity of metal through a rise of temperature. The party comprised some officers of the Signal Corps, a chemist, &c., and the following items, which were extracted from an American paper, represent the results of an "interview" with the professor. Mount Whitney is believed to be the highest peak in North America; it is the highest of the Sierra Nevada, and from the surrounding conditions was considered well adapted for the purpose in view. It is far removed from the noise of civilization, and over a hundred miles of desert lie between it and the nearest railroad, but the most authentic accounts of it described it as a place that should suit our purpose admirably. We had about 5,000 pounds of apparatus, and 10,000 pounds of quartermaster's stores to transport.

Across an Alkali Desert,

a full week's journey by wagon, and all arrangements to be carefully made in advance. We started from San Francisco, July 22, and went by the north, or Pacific Railroad to Caliente, about 100 miles from San Francisco. Some of the party disembarked here, from which point the stage line about crosses the desert to Lone Pine. Caliente is a respectable little town for a town, comprised of a hotel, a saloon, and one other house. The committee of our party went on to Mojave, about 100 miles farther, intending to cross the desert by wagon. The drive from Caliente to Lone Pine was anything but a pleasant one. The stage road was through an arid alkali desert, with nothing to see but sand, sage brush, and "side-winders," as the natives call the heaped rations from their unrelenting and treacherous disposition.

Mt. Whitney itself, probably the highest elevation of land in the Union, fronts the plains to the eastward with a perpendicular precipice 3,000ft. in sheer height, at the foot of which lies a more gradual slope of snow fields, giving place in turn to a similar slope of broken rock and debris, extending down into the canon, from which the foot-hills spring on either side. As to the exact height of Mt. Whitney, the calculations necessary to ascertain it have not yet been worked out, but it is somewhere between 14,400 and 15,000ft.

The instrument reached Lone Pine at last, and although we had read something of desert sand and its annoying qualities, we never fully realised its penetrating power until we unpacked the instruments. On the way across the desert the sand had crept through every crack and joint in the boxes, and the instruments were covered with the fine, dry dust.

We experienced great difficulty at Lone Pine on account of the intense heat. Under a simple glass cover in a blackened box the mercury rose in a common thermometer to 240 deg. Fahrenheit. It was necessary to carry on a part of the observations in a darkened tent, and the temperature in it rose so high that human nature could not endure it.

In a beautiful little valley, just above the timber line on Mount Whitney, we established our station, pitched our tents on the shore of a little mountain lake, and turned a cow which we were luxurious enough to bring with us, out in the short grass. It was already too late in the season to take our heaviest apparatus to the summit, and the main camp remains in this lofty valley, within a two hours' climb of the peak by the "Devil's Ladder."

We climbed to the top of the mountain, which affords a view of some of the grandest mountain scenery in the world. Sharp Gothic peaks spring from the waste of rocky foothills on every hand. Keeler's Needle, which was subsequently ascended, towers to a height of about 14,000ft., and is no broader at the summit than this study table. Lying full length on the flat rock that crowns the peak, and reaching out with the hand at one side, we dropped stones down into the chasm dividing it from the neighbouring mountain. They fell fully three-quarters of a mile before they touched the side of the cliff and struck upon the granite rock so far below that no sound came back to our ears.

As to results, science must wait the completion of our calculations from the data obtained. The general conclusion, however, is that the "solar constant," or absolute amount of heat the earth receives from the sun, is very much larger than that determined by Herschel and other previous observers. Further that the distribution of this heat to the earth and its effect in producing all the changes of climate, and its importance as affecting all the interests of agriculture, depend on forces which are now, for the first time, becoming fully known. The immediate consequences of this in its application to practical interests will probably be developed at large in the forthcoming account of the expedition to be published by the Government. Among incidental attainments of more strictly scientific interest may be mentioned that conclusions have been reached that will probably be accepted as finally settling the long dispute among physicians, as to the trustworthiness of Tyndall's observations as to the effect of water vapor.

With an apparatus of the simplest character, involving no care and no expense, it was found that water could be made to boil on the wintry peak of Whitney in the midst of the ice and snow, by the simple, direct action of the unconcentrated solar rays. A newspaper statement, made before the expedition started, about the theory of the "blue sun," attributed to Prof. Langley, had a certain foundation in fact, in articles which he has recently communicated to the French Academy of Sciences and elsewhere, to the effect that our own atmospheric action in modifying the solar heat and light to us, though of such enormous importance to all forms of life on this earth, was, in reality, so little understood that it was now shown by him for the first time that owing to the selective absorption of the atmosphere our sun had never yet been seen by anyone in its true colour, which would seem to us blue if the intervening atmospheres were removed.

This actual blueness of the sun, a fact so contrary to all recorded experience and so novel, was cited less on account of its own practical importance than as an indication of the immense results caused by this selective absorption, and one prominent object of the expedition was to determine by means of the bolometer, an instrument recently invented for this purpose by Professor Langley, the laws of this absorption and the resulting effect on climate. The instruments used for this purpose were many of them invented for this special end, while others were supplied by the kindness of eminent French investigators, who interested themselves in the results of the expedition. Summing up the results generally, the only way in which they can be spoken of thus early, they are very satisfactory. The report to the Government will tell the story of the work and its scientific results in detail.

COLOUR-BLINDNESS.—V.*

By R. BRUDENELL CARTER, F.R.C.S.

(Continued from page 201).

Industries chiefly affected by Colour-blindness—Engine-drivers, Pilots, Artists, Letter-sorters, Drapers, Painters, &c. Recent legislation affecting Colour-blindness in America, and urgent need for it in this country.

I HAVE already mentioned that there are a few cases of total colour-blindness, or of people who see nothing but form and light and shade, but these, and also blindness to violet, are of such rare occurrence, that practically they scarcely call for consideration. My chief business to-night is to discuss the bearing of red-blindness or of green-blindness either complete or incomplete, upon the fitness of the subjects of these defects to engage in certain industries, of which those which call for the recognition of railway and marine signals are the chief.

If we take as an illustration, in the first instance, the state of an engine-driver who is completely red-blind, and who is called upon to govern the course of a locomotive in obedience to certain coloured signals, which may be either red and green alone, or white and red and green, in accordance with the regulations of different roads, we find that the signals present to him differences by which, in many cases, he can tell them apart; but these differences are of brightness, or luminosity, and not of colour. From the white light he receives the whole of its green and violet, the red being lost to him, so that what he sees is a blue grey, comparatively feeble in brightness when contrasted with the impression made by the same light upon a normal eye. The green light will be removed still farther from the brightness by reason of its preponderance of green, and the red will only be visible by means of the rays other than red which the red glass transmits, and if nothing but red was transmitted, would be invisible altogether, so as to be what an Irishman might perhaps call a dark light. For practical purposes, however, we may omit the white lights from consideration, and may fix our attention only upon the red and green. Of these, the former, to a red-blind man, would seem darker than the latter; and this reflection would be reversed in the case of a green-blind. We may perfectly well suppose the colour-blind person, in either case, to be unconscious of his defects. He has all his life been accustomed to interpret the phrase "a red light" as meaning something which presents to him a dim or feeble illumination, and to interpret the phrase "a green light" as something which presents to him a stronger or brighter illumination. By the help of this distinction, he may pass an examination which is inadequately conducted, and he may drive his engine for long periods without accident or mistake. But the point at issue is that he is compelled to rely upon an unreal distinction, a distinction of relative brightness only; and that his judgment upon this relative brightness is liable to be misled by accidental circumstances. Anything which increased the apparent brightness of the red light, as, for instance, a better burning, or even a quite recently lighted lamp, a red glass of less thickness or slightly different tone, or of less absorbing power than usual, these and many other possible variations would lead him to mistake a red light for a green one. In the same way, anything which diminished the apparent brightness of a green light, as a thicker or more absorbing glass, a badly burning lamp, the intervention of steam, smoke, or fog, would render him liable to commit the comparatively harmless mistake of taking a green light for a red one. To the green-blind, on the other hand, the reverse conditions would obtain. To him, the green light would be comparatively dim, and the red one comparatively bright; so that any of the conditions which would brighten the red light and make it more conspicuous to the normal sighted, would render it more like green to the green-blind, and would directly serve to tempt him into danger. It has been well observed by Dr. Joy Jeffries that no right minded and conscientious person would undertake the guidance of a train, on the announced condition that, in any variations of atmosphere and weather, he was to recognise a dim light as a danger signal, and a bright light as a safety signal, and *vice versa*, and that his own life, and the lives of the passengers, were to be dependent upon his always rightly determining which was which.

It has often been maintained that we hear very little of accidents actually arising from colour-blindness; but it must be remembered that, until quite lately, this cause of neglect or mistake of signals was scarcely recognised by those whose duty it is to investigate such occurrences. At the present day, the first inquiry which would be made, in any case of over-running a danger signal, would have reference to the colour vision of the

* The substance of a series of Center Lectures delivered before the Society of Arts.

Now science possesses an eye free from these defects, by means of which ordinary vision may be made to see an object as it would be seen if the human eye could take in the image in the thousandth part of a second, or even less time, or, on the other hand, as it might be seen if the human eye could look steadily for an hour or more, gaining distinctness of vision precisely in proportion to the increase of time during which the eye was used.

For instance, in lecturing on the sun I have been able to tell my hearers that a certain photograph of the sun's surface had been so rapidly taken as to show details which no astronomer had ever actually seen or could see, even though he used the most powerful telescope ever made, and gave to the study of the sun with such an instrument every moment of his working life.

On the other hand, but a few weeks ago I was looking in Dr. Henry Draper's observatory at a picture of the great nebula in Orion which had been two hours and twenty minutes forming itself on the retina of the photographic eye of science—in other words, the negative had required an exposure of this duration. I say nothing, though I might well say much, on the mechanical skill and ingenuity required to retain the telescopic image so long unchanged in position, though all the time the diurnal motion of the earth was carrying Orion round the heavens at the rate (in reality a slightly greater rate) at which the sun moves in the skies, nor do I dwell on the optical and physical difficulties involved in the task which Dr. Draper had thus successfully achieved. The point I wish chiefly to dwell upon is this, that where such a photograph is taken, science does in reality employ an eye which can give hours to a single look. And let it be noted that we see now but the beginning of the use of the photographic eye, which can see in the five-thousandth part of a second if need be, or if need be can rest its gaze for many hours on the same object, seeing more and more as minute after minute passes on. Yet already the swifter view of the photographic eye has shown details which the unaided human eye, or that eye aided only by the telescope or microscope, could never see, while the steadfast gaze of the photographic eye has revealed what it has been given to no human eye to see by direct vision.

Note, further, that the photographic eye in seeing, delineates also, whereas often enough the eye keenest to see is but little skilled to guide the hand to delineate what is seen, and yet oftener the ordinary eye can obtain but so brief a view of an object that there is no time to draw what is seen without trusting to memory, which in such matters is too often treacherous. The finest picture of the solar rice grains as drawn by any human artist has much less value than have Janssen's instantaneous photographs of the sun's surface. The best picture of the great Orion nebula—which, despite Mr. Delarue's opinion in favour of the view taken with Lord Rosse's telescope, I consider, to be unquestionably Mr. Trouvelot's picture taken with the great Washington telescope—shows no details which are not clearly recognisable in Dr. Draper's beautiful negative, while skilful though Mr. Trouvelot is as an artist, nature has surpassed him in presenting truthfully not only all details, but all grades and varieties of shading. And these are but illustrative instances, belonging to the beginning of the application of photography to science.—By R. A. PROCTOR, in the *New York Herald*.

Composition of Aerolites.—Dr. Hahn, of Tübingen, has recently given the results of some researches which he has made into the nature of aerolites, which he examines by splitting some specimens into sections, thus rendering them transparent. He states that, generally speaking, aerolites are of two species, the one containing iron only, and the other iron and stone together. In a few instances, however, stone is the sole component substance. Dr. Hahn's researches tend to confirm the accuracy of the observation of Wöchler, as to the existence in these meteoric stones of hydrocarbon produced by the decomposition of organic substances.

THE United States Commissioner of Patents has forwarded to the Secretary of the Interior his report of the operations of the Patent-office for the past fiscal year, and his estimate of the amount necessary during the next fiscal year. The number of original patents issued during the first nine months of the present year was 13,084, an increase of 2261 over last year. The receipts of the office for the same period were 65,447 dols. in excess of those for the corresponding nine months of 1880. The report recommends a considerable increase in the examining corps and the clerical force of the office, and the following appropriation: 50,000 dols. to carry out the abridgment of patents and the publication of 10,000 volumes of the same; 15,000 dols. for producing burned and exhausted drawings; 10,000 dols. for photo-lithographing drawings; and 9,000 dols. to complete the *Official Gazette* for the present year.

SCIENTIFIC NEWS.

THE Dun Eoch Circular, No. 38, contains the following elements of Denning's comet, *f*, 1881, telegraphed by Mr. S. C. Chandler, jun., of Harvard College Observatory: T 1881, Sept. 13-05 G. M. T.; ω $\odot$ $312^{\circ} 1'$; $\odot$ $66^{\circ} 9'$; i $6^{\circ} 53'$ (mean equinox 1881-0) log. *q*. 9.8597. He makes the period 8 years 4 months. Dr. Oppenheim's ephemeris to Nov. 15 is also given. For Nov. 13 the R.A. is 10h. 29m. 47s.; N.D. $15^{\circ} 8'$ Berlin midnight.

Astronomische Nachrichten, No. 2395, contains an article by Prof. Vogel, giving an account of his observations at Potsdam on the spectra of comets *b* and *c*, 1881. All parts of Tebbutt's comet (*b*), even the most remote parts of the tail, showed the band spectrum distinctly, while the nucleus yielded a spectrum so brilliant that the colours were easily recognised from line C to far beyond G. Schaeberle's comet (*c*) gave the usual three bright bands more distinctly than Tebbutt's, but the continuous spectrum was discernible only in the nucleus, and was faint there.

In consequence, it is said, of a pressure of other duties Prof. Huxley has resigned the secretaryship of the Royal Society. Prof. Michael Foster is mentioned as his successor.

The Photometric Committee appointed by the Board of Trade have issued their report, in which they recommend that Mr. Harcourt's air-gas flame should be employed as the standard, instead of the sperm candle.

The Autumn meeting of the Institution of Mechanical Engineers was held at Manchester, on the 28th ult., the most important papers being Mr. Copeland's on Bessemer Steel Plant, with special reference to the Erimus works, and that on "Compressed Air in Tramways," by W. D. Scott-Moncrieff.

The specification of Prof. Gamgee's invention for "using a liquefiable gas or vapour at low temperatures as a motor fluid," has been published. It is No. 1451, 1881. The "engine," it will be remembered, is known as the "zeromotor."

No news has been received of the *Jeannette* from any of the vessels sent out to look for her, and some alarm is felt as to the safety of Mr. Leigh Smith's expedition in the *Eira*, as it is known that Spitzbergen, Novaya Zemlya, and even the Bear Islands have this year been unapproachable, being surrounded by a thick barrier of Polar ice. The *Eira* was provisioned for about 15 months when she started last June, and it is probable that her owner may have determined to winter up north.

Prof. G. de Helmersen has issued an elaborate report on the little-known coal-fields in Russia, from which it appears that the annual output has now reached 32,000,000 tons. There is a vast region in Siberia very rich in coal seams, which at present are worked only where they are easily accessible.

Some experiments have recently been made in Revel with a view to test the efficacy of a fire-extinguishing powder, which, coming into contact with the burning materials, produces heavy fumes which arise in such quantities as to stifle and overwhelm the fire itself. Fire having broken out inside a naphtha and petroleum store, the fire-brigade immediately upon their arrival closed up all openings, stopping up completely the doors and windows. A few boxes of the powder were then thrown into the burning shop, and after the lapse of two hours the doors and windows were opened. Copious and heavy fumes issued, by which the progress of the fire had been completely arrested. The results of this experiment have been declared eminently successful. The powder is the invention of an officer in one of the Revel fire-brigades, who is endeavouring to protect it by patent. The powder is expensive, but, as a Russian newspaper remarks, not so expensive as conflagration.

At a recent meeting of the lately established but already well-known Gresham Angling Society, a paper was read by Mr. C. S. Bentley, F.R.M.S., on "The Sense of Pain in Fishes." The conclusion the author arrived at (which received much corroboration during the course of the discussion) is that a fish having a peculiar nervous system and very small perceptive brain

(cerebrum) coupled to the fact of its being cold blooded, precluded it from having a high degree of sensibility. The paper, which was copiously illustrated by diagrams and microscopic preparations, was well received, and the Gresham may be congratulated upon having set an excellent example to similar societies. We may add that the meeting was well competent to pass an opinion on the subject, Dr. Brunton (in the chair), Dr. Lloyd, Mr. T. Crumphen, Mr. Alfred Jardine, and other well-known experts being present.

While lately occupied with the Climatology of Rio de Janeiro, M. Cruls was struck with the great variation in the annual number of thunderstorms. Thus, in the quarter of a century from 1851 to 1876, the number oscillates between 11 and 49. M. Cruls finds in the curve of those variations, a remarkable correspondence to the sunspot-curve (see *Comptes Rendus*). For each year he took the average of three consecutive years, e.g., for 1852, the average of 1851-52-53. A curve of thunderstorms at Toronto, which M. Cruls also made out, presented less variations, but had the same character as that for Rio. On this subject, M. Faye made some remarks (in the French Academy) by way of caution. Thunderstorms arose from gyrotory descending movements, generated in the upper parts of our atmosphere by the heat of the sun, and strongly deflected by the earth's rotation. The period of spots could thus be reproduced in that of thunderstorms only if the spots sensibly affected the heat sent us by the sun. Now, so far as he knew, no trace of an eleven years' period in annual temperature had yet been proved. The conclusion is that solar spots and terrestrial thunderstorms are not in the relation of cause and effect. M. Faye thinks a closer identity, and for a longer period, would have to be made out before the connection could be accepted. Still, he recognises the value of such observations as those of M. Cruls, and urges an extension of them.

Among some lecture experiments lately brought by Herr Rosenfeld before the Berlin Chemical Society, is one for showing the change of weight in bodies through chemical processes. He uses an areometer with a wire extending upwards 10ctm. from the weighted glass body, and surmounted by a glass cup, on which a piece of sheet platinum is placed. To show the gain of weight in iron through oxidation, e.g., a little finely-divided iron is put on the platinum, so that, the instrument floating in water in a glass cylinder, the wire is slightly immersed. Then the platinum with its charge is removed with a pincette, heated over a strong flame, cooled, and replaced. The areometer now sinks as far as the cup (it may be). In other cases, metallic oxide is put on the supporting-plate, and after reduction, the instrument rises the whole length of the wire. Herr Rosenfeld describes other variations of the experiment; also, modes of showing the combustion of ammonia in oxygen, and the synthesis of water.

The observation has been recently made by Herr Bornträger, that if dry amorphous selenium be heated in a combustion-tube, the open end of which is stopped loosely with asbestos, or glass-wool, the sublimated selenium collects in the stopper, and one obtains a large number of selenium crystals, while only a small part of the selenium unsublimated leaves the tube. The largest crystals were 2mm. to 3mm. in length. Herr Bornträger is not yet able to say what are the best conditions of experiment, but he considers that a number of other substances may be brought to crystallisation in this way.

Recent official statistics show that in 1880 there were 235 shipping casualties on the German coast, affecting 271 vessels (there being 36 collisions). This number has been exceeded, since 1873, only in 1875. Of the 271 vessels, 24 steamers, and 152 sailing ships carried the German flag; 126 were stranded, 9 capsized, 31 sank, 72 were in collision, and 33 had various other accidents. The total of lost was 112, partially injured, 104, uninjured, 41, and in 14 cases the result is unknown. The loss of life, so far as ascertained, was 58. The cause of the considerable increase in these disasters last year lies in the hurricanes that occurred on the German coast from October to December.

The *D. A. Polytechnische Zeitung*, calls atten-

tion to the usefulness of the "Universal Drawing Apparatus," devised by Gast of Cologne, and which depends on the principle of the total reflecting prism; this prism being placed at the apex of a pyramidal chamber, on the floor of which it throws an image of the object to be copied, which image can be followed by pencil, the observer looking through a side aperture and introducing his hand by another aperture. Herr Gast has improved the instrument by addition of an enlarging arrangement, which renders it (according to the paper named) by far the best apparatus of its kind.

A single zinc-copper or zinc-carbon element in dilute sulphuric acid, will not, it is known, decompose water, supposing the two electrodes are of platinum. It has been found, however, by M. Tommasi, that it will produce the effect if the positive electrode be formed of a metal which, under the influence of the voltaic current, is capable of combining with the oxygen of the water—e.g., copper.

A number of measurements were recently taken by Herr Fischer on locomotives of the Hanover Bremen railway, with a view to ascertaining the amount of combustion of fuel. The gases were drawn off at different times from between the plate over the fire-tubes and the steam outlet above; they were conducted through a caoutchouc tube to a gas apparatus in a waggon behind the tender. A graphite thermometer gave the temperature under the steam outlet. The fuel was coal. Putting aside those samples that were taken while the door was open en account of excessive steam, the smoke-gases during one journey are shown to contain about 12 per cent carbonic acid, at a temperature of 300° to 350°. When the locomotive was standing still, the CO₂ increased to 17.5 per cent. (owing to less draught); the oxygen disappeared almost wholly, and there was some carbonic oxide, while the temperature fell to 250°. Similar figures were got on other trips. There was never more than 2.1 per cent. of unburnt gas. Considering the disadvantageous condition of working locomotive as compared with stationary boilers, the results are regarded as highly favourable. The table shows that on one journey, only 15 to 20 per cent. of the entire heat was lost through the chimney, whereas, with stationary boilers, twice as much is often so lost.

It appears that the hunting of alligators in Florida is carried on to such an extent as to threaten an extirpation of the species there. Nothing is used except the skins on the belly and legs. The rough scaly plates on the backs are rejected. The heads are cut off and buried for a few days, till the tuks can be detached. It was announced lately that one person had collected alligators' teeth to the amount of three hundred and fifty pounds. This will give some idea of the destruction going on. On the St. John's river a new method of hunting has been devised. A dark lantern with a powerful reflector is used on suitable nights; and no difficulty is experienced in approaching the quarry. The animals seem bewildered with the strong glare, and make no effort to escape. The gun is held within a few feet of the head—a touch to the trigger, and there is one "gator" less in Florida. This process is very effective, and the hunters are enabled, not only to kill, but to secure their prey. Large numbers of these animals are slain annually by tourists for amusement only, besides those slaughtered for profit. Further, many young alligators are stuffed as specimens, or sent off alive as curiosities, while myriads of eggs are blown or disposed of by dealers.

The first apple-cargo of the season arrived the other day at the Hotel-de-Ville quay in Paris. These boats (we learn from *La Nature*) come regularly during five months, amounting to nearly 130 in one season. The average cargo is about 300,000 apples. This, multiplied by 130, gives some 39 million apples brought by water to a single point in Paris. The departments of Sarthe, Maine-et-Loire, Mayenne, Aisne, and Marne, figure most prominently in this traffic, which is of the most active character, and generally without intermediaries.

For some years past, at the observatory of Campidoglio, careful measurements of the horizontal solar diameter have been made by Signor Respighi, and several other skilled observers. The results will be worked out for a determination of the diameter, and the influence of seasons and at-

mospheric conditions. A portion of the material has been lately utilised by S. Respighi, for ascertaining the influence of seasons on what is known as the "personal equation." There were four astronomers simultaneously taking observations in 1879, of 122 solar transits. From the figures obtained, it appears that, however the personal equations may vary from one season to another, their sign (positive or negative) remains constant. This indicates that each observer has the habit, independent of atmospheric conditions, of approximating or separating the moments of contact of the two edges of the solar disc with the wires of the net, while the difference of atmospheric conditions, or the varying circumstances of the solar limb, can only influence more or less the amount of this approximation or separation.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 51, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made Payable to F. PASHMORE EDWARDS.

* * * In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pitance of him, will undertake to write the whole body of physics: a vice from whence great inconveniences derive their origin!"—Montaigne's Essays.

LUNAR PHYSICS.

[19386].—AN OBSCURING MEDIUM.—Although the existence of anything on the Moon's surface capable of effecting an alteration in the appearance of objects has in former years been doubted, and Schröter has stood alone in his view of those selenospherical effects which he has described, now the subject has once more presented itself to the attention of lunar observers, it may not be without interest if we examine a few of Schröter's records for this especial purpose; for if we find evidence that may legitimately bear the interpretation of an obscuring medium, the two series will tend eventually to support each other.

On December 11, 1788, 1d. 12h. before Full Moon, Schröter saw on the north-east portion of the walled plain Cleomedes, a circular bright spot, which he delineated at *m* in Tafel xxxvi., Fig. 1, of his "Fragments"; and on January 7, 1789, Schröter saw, 2d. 10h. before full, "a large bright spot," apparently in the place of *m*, which he delineated in T. xxxvi., Fig. 5, and described "as not so distinctly defined." Five days afterwards, on January 12, 1789, at 2d. 15h. after full, he saw an extremely brilliant and moderately large crater, of at least 7° of brightness. It is probable that the light spot seen on Dec. 11, 1788, and January 7, 1789, may have concealed the mountain and depressed ring, seen afterwards by Schröter on January 29 and 30, 1789. On Jan. 29, 3d. 10h. after New Moon, he records a mountain of ordinary brightness, with shadow as on December 2, 1788, with level ground around; and on January 30, 4d. 12h. after New Moon, he says "the mountain *a* had a considerable shadow on the 30th, with a higher Sun than on the 29th." This would indicate the probability of Schröter's mountain *a* being the south-west wall of his large crater *a*. The greater extent of shadow on the 30th, with a higher Sun, is remarkable, and seems to point to something existing in the crater *a* which concealed his crater *β* and the greater part of *a*.

On the 31st of March, 1789, five days after New Moon, Schröter observed the mountain *a* as a long hill with shadow, as seen on December 2, 1788, and January 29 and 30, 1789, with possibly a little unevenness to the east of it, but no trace of a crater. [The indications of unevenness on the east may be contrasted with the observation of January 29, in which Schröter speaks of the mountain having "level ground around." It is questionable if this level appearance was really that of the true surface. Should the depression *a* and the crater *β* have been concealed by any means, it is quite possible that the upper surface of the concealing medium might have presented the appearance of level ground.]

[A brilliant crater in the locality of the northern spot seen by Schröter on December 11, 1788, and

January 7, 1789, is strongly indicative of this spot having been of an obscuring character. On December 14, 1788, one day after Full Moon, also 12 hours later, at 1d. 12h. after full, Schröter drew the appearance of Cleomedes, which is reproduced in T. xxxvi., Fig. 2, of his "Fragments," in which the circular spot *m* is not only contracted to a mountain-like object, but is placed further west than its position on December 11, 1788, probably the northern spot of Schröter on this occasion, December 14, 1788, indicates the position of his crater *β*. It is very likely that this change in the appearance of the objects in the northern part of Cleomedes was produced by something of an obscuring character. It may, however, be supposed that the white spot of December 14 was all that remained unobscured of the larger objects *a* and *β*, and even that portion of it, as it would seem, impaired in brilliancy, for Schröter says nothing as to any especial brightness there; he merely refers to December 11, to the effect that the north bright spot was not occasioned by Trolles, as this latter was again visible of a grey tint. He is less circumstantial here than might be wished, but it is hardly to be supposed that his north spot could have had on December 14, 1788, the brilliant aspect which surprised him on January 12, 1789, as new.]

The above extracts from Schröter will show that similar phenomena occurred on the surface of the Moon nearly 100 years ago as are observed at the present time. In letters 19272, October 7, and 19346, October 28, allusion is made to a certain "white spot" seen on the Mare Crisium, to which, if I mistake not, the white spot on the northern part of Cleomedes, seen by Schröter, bears a strong resemblance. In letter 19272, it is stated that the probable initial phenomenon produced by "an obscuring medium" would be "a spot." During my observations in the decade of 1860–70, a white spot was seen which seemed to bear the interpretation of "an obscuring medium," and in 1788–79, the white spot of Schröter seems to bear a similar interpretation.

The following table may assist in observing the Moon when she is illuminated nearly in a similar manner as when Schröter observed it:—

AFTER NEW MOON.			
d.	h.		
+	3 10	Jan. 29, 1789.	Mountain.
+	4 12	" 30, 1789.	"
+	4 21	Dec. 2, 1788.	"
+	5 0	Mar. 31, 1789.	"

BEFORE FULL MOON.			
d.	h.		
–	2 10	Jan. 7, 1789.	Large bright spot.
–	1 12	Dec. 11, 1788.	Bright spot.

AFTER FULL MOON.			
d.	h.		
+	1 0	Dec. 14, 1788.	Spot contracted.
+	1 12	" 14, 1788.	"
+	2 15	Jan. 12, 1789.	Brilliant crater.

A discussion of the observations by Schröter, Birt, and Durrad, will be found in "Selections from the Portfolios of the Editor of the Lunar Map and Catalogue," second issue (W. Wesley, 28, Essex-street, Strand, W.C.)

ERRATUM.—In letter 19347, for "A. T. Williams," read A. S. Williams.
Leytonstone, E., Nov. 3. W. B. Birt.

ASTRONOMY FOR OCTOGENARIANS.

[19387].—"In the downhill of life as I find I'm declining"—being near eighty years of age—"The snug elbow-chair, and its easy reclining" are sometimes more enticing than the charms of the observatory, more especially when a warm fireside is added.

To combine the pleasure and comfort together I have thought of the following plan, and, before putting it into execution, I ask the opinion and experience of my fellow-readers as to the effect of reflection from a plane mirror on the definition of stars and planets that are reflected into a telescope from it. Also for their criticism on the proposed method for mounting the telescope that I may proceed in the most economical manner:—Now, although my cot does not "overlook the wide sea," yet it fronts the east, and the back sitting-room has the fireplace in the south wall. Outside the wall is the lawn for croquet or tennis, and, beyond that, "A nice plot of ground for the use of my spade, too," so that I have plenty of sky east, south, and west of the prime vertical.

Now I will describe my telescope, and its proposed addenda.

The object-class is 8in. diam., and 11ft. focus. The tube is of mahogany; but I shall substitute one of stout sheet-iron. This will be attached by screws to a strong iron bar, 10ft. long, which will be fixed firmly into the brickwork of the house, and carry the telescope and its accessories.

On the object and eyepiece of the telescope are two stout rings of brass, turning smoothly on the ends, and having cogs on their outside, to be moved by two pinions each, fixed one on the top and the other

on the bottom of a rod, moving in bearings fixed to the iron bar carrying the telescope; the upper ring having the 24 hours engraved on it, and each ring having a hole pierced through it longitudinally—in which a rod turns—having a worm on its lower end, which engages into a wheel moving a plane mirror to open or shut over the object-glass, and to reflect the image of star or planet into it. The other end of the rod carries a circle with figures of declination engraved on it.

The mirror moved by this rod is to be 8in. wide and 24in. long. The telescope is to be built into the wall of the house, pointing downwards, and parallel with the polar axis of the earth. The eye end of the telescope, placed at a convenient distance from the fire, so as to be looked into by one sitting near the fire.

The hole in the wall is then to be covered over, so as to exclude draughts; but so that the telescope may at any time be got at for examination, &c.

By adjusting the mirror and the circle on the top of the rod to reflect a star of a given declination into the telescope, when the index points to that declination figure, any star or planet so placed as to be reflected by the mirror may be followed by turning the two rings, and the mirror by the rod and two pinions gearing into the rings at the top and bottom of the telescope.

And any star or planet may be reflected into the telescope by placing the mirror at the right declination and the hour-circle at the right ascension of the star or planet, and its course followed as long as desired.

Supposing the room for the observer to be at the top of the house: a long telescope, having a non-achromatic object-glass of long focus may be made use of, and a larger aperture obtained, at a comparatively small expense.

The mirror would be inclosed with a case to act as a dew-cap, and a cover would be placed over the projecting end of the telescope, to keep it from rain, &c. Such is the method I think of adopting, and shall feel grateful for any suggestions for improved alteration. As also for indication of errors that I am about to commit.

Philip Vallance.

GRINDING AND POLISHING GLASS SPECULA.

[19388.]-I WOULD wish here just to thank all who have suggested anything in the way of help, and observe that a notice of each individually is evidently out of the question, for this would take too much of our valuable space. All I can promise, is to consider all suggestions, and to try any that I may think likely to answer, and report any help received, for the good of all, through our columns; so I hope any I may not otherwise notice or refer to will not feel slighted, but will understand that their intention to help is fully appreciated by me, and that perhaps they have rendered help, only the time to acknowledge it has not yet come, for I intend to sum up at the end, and report all help I have received, and improvements achieved through the correspondence now going on in our columns.

In answer to "Prismatique's" questions in letter 19264, I would say that I learned from the trade over 20 years ago, that the ultimate shape of the lens or speculum, in fact the surface of the glass we are working, will be influenced by the shape of the edge of that surface, so I have never commenced to work a large lens or speculum without bevelling the rough edge, so that the face is not only fairly round, but round to within 1-16th inch. Now my late investigations have enabled me to explain this, by learning how this comes about, and thus justifying my previous precaution. I agree with "Prismatique" that the open cell mount is the best for many reasons, and I hope to receive shortly from Chance Brothers and Co., a light glass speculum, yet strong, adapted for this form of mount—i.e. to give freedom from flexure when supported from the edge, which I am to work and test. I agree with "A. J. S." (19131, par. 6), that no support fitting the back of the speculum can be free from flexure, as it must be formed of different material from glass; then, as he justly points out, we get unequal expansion, and therefore strain, with every variation of temperature.

And now as to the forms of specula (19320, par. 2): I may just observe that it is impossible to support the speculum in the telescope in exactly the same position as when being worked, for in the latter case it has the weight of the tool on it, moving about, and therefore must be supported accordingly, so as to meet this condition; we may reduce the weight of the tool by counterbalancing it to a certain extent, but still it must have some weight, or it would not act. And further that it is not necessary to work the speculum "in the identical cell in which it is to be used," unless we have the speculum much too thin: this I have proved over and over again experimentally. I think the reasoning in par. 3 is very good, if we decide to keep the speculum on the supports we work it on, and that Fig. 3 would then be

mount is the one now used by all makers of note, and their experience is not to be ignored, this Fig. 3 form is not the best for this kind of mount. The form I have suggested to Chance Brothers and Co., and which they are making, is the best form I know for the cell mount. As to Fig. 2, and par. 4, it would never do to have a speculum of two metals, except we adopt "A. J. S.'s" plan for the sterling silver mirrors, where he has the reflecting metal on the surface of the body of the speculum, only a little thicker than paper, which cannot appreciably warp the main body of the speculum. To form it as "A. S. L." suggests, would be to make it like the ever-varying compensating pendulum, altering its shape with every differing temperature. Could any correspondent give us an outline of the Whitworth experiments on perfect planes, and their best form of ribbing to keep them from flexure?—this may help us much.

Now I must proceed with the subject of my last letter, 19237, where in Fig. 1 I try to make plain to the eye the manifestly more influence flexure has in causing bad definition than different lengths of zone foci. I will now show this by calculation, and our time will not be lost by thus lingering over this part of our subject, if the mind of the amateur is only more impressed with its importance. Now let us ask the question. What amount of flexure would be about as injurious to definition as aberration to the amount of the focus of the outer zone A B being 1-10in. shorter than the focus of the centre F for a 6in. diameter speculum and 60in. focus. Now this amount of aberration is enormous, and ought not to be tolerated, we ought to be able to get freedom from perceptible aberration to within 1-100in. with the utmost ease and certainty: this I hope to explain the way to do in future letters. Well now the 1-10in. being the 1-600th of 60in., the size of a point or the thickness of a line, instead of appearing nothing, would appear the 1-600 of 6in. i.e. the 1-100in. This would be the amount of confusion caused by the aberration to the amount of 1-10in., therefore that general flexure, produced by bad supporting while working, or bad mounting in the telescope, that would throw about the various images of a point or line, formed by the various parts of the speculum, to the extent of 1-100in. would create just as bad definition as aberration to the amount of 1-10in.; i.e. flexure is to be dreaded ten times as much as aberration. And when we consider that the rays of light travelling from the speculum are like so many levers being moved at their extremities A, F, and B, it will be seen how small an amount of flexure there would throw them out at their other extremity to the amount of 1-100in., and this amount of flexure is apt to be produced every time the tool moves from one side to the other of the speculum, unless it be properly supported and of sufficient thickness. Now this flexure is the enemy we have to face in our working and conquer, or else he will annoyingly show himself every time we look through our telescope, and remind us that he is still our master. I do not know a surer way of avoiding this enemy than the plan I show in Fig. 4 and 5 of letter 19237, and which I have adopted for about 18 years both for lenses and specula. I should like to know how Mr. Calver supported and mounted his 37in. diameter, that is described in Vol. XXX., page 351. Will Mr. Calver, or anyone else that knows, please help us to this information?

We will now return to our experiments where we left off describing them. It was with a 6in. speculum 3in. thick, and a polisher 4lb. weight. Under these conditions it showed when silvered a slight though distinctly perceptible flexure. I now further reduced the weight of the polisher by counterbalancing to one half its former pressure, i.e. to 2lb. I polished and figured so as to have no aberration, and tested; the flexure was, I should think, reduced in the same proportion as the weight, to about one half its former quantity; the definition was the best I had ever had with that thickness of speculum, yet there was a perceptible amount of flexure, in fact the speculum was too thin, as proved by my next experiment, which was as follows. I took a glass disc 1in. thick that had been chipped round, and ground roughly by the glasscutter on his wheel to the curve; I rough ground this with what is called here No. 1 emery. I then, with a pair of compasses with black lead in, struck as large a circle as possible so as to exclude the rough edge. I then with a file, not very rough one, bevelled the edge beyond the circle to an angle of 45°, being careful to file from over the centre to the outside, so as not to splinter the face of the speculum; thus I reduced the face of the speculum to a circle, for the further grinding &c. I easily got it a parabola as I had done the 3in. one and tested—in fact I was continually testing it during polishing and producing the figure, so that at the end of about 7 hours' polishing I had figured it as well. Now it was delightful to see the freedom from flexure the extra thickness gave, proving beyond a doubt that 1-6th its diameter is as thin as we ought to have any speculum. Of course it was the same size as the previous one—viz. 6in., and the polisher pressed with 2lb. weight, and worked under the same conditions.

And these conditions I now rest in, as giving the best results, and think that any less careful supporting and working, or a thinner speculum, is a loss of time, as the best results cannot be thus produced. I would speak strongly upon this point, for the good of others, that they may not waste their time. I have done my best to reduce the whole process to its greatest simplicity, consistent with perfection of figure. I have had more or less to do with it for 20 years, and for the last nine months I have most perseveringly worked at it, to discover the laws that govern the various steps, for we are only foolish to attempt what the laws of nature will not admit of, while we may be quite sure of success if we only conform our efforts to these laws that we have to work under; and to discover one law, and to make it known, is of more value, than by hit or miss haphazard working to produce the most perfect speculum that ever was made. Amateurs are so apt to think that this or that or the other plan is not necessary, and I partly don't wonder at it, seeing the various ways described by those who have not set themselves the task of discovering the laws they have to grapple with, but only some mode of doing something in an indifferent way, which satisfies them, upon the principle of saying, that "everyone has a way, and everyone's way does"—yes, for their ideas of perfection; but everyone's way cannot be the best way. Now we want the best way, and this we can only discover by patiently studying the laws that govern the various processes that we have to use, to arrive at the desired end.

We have now ventilated the subject of the supporting of the speculum during working on the face plate of the machine: we will now leave the face-plate and examine the machine itself, and see if we cannot find out what is the best form of machine—the straight stroke of Herschel and Rosse or the curved stroke of Lassell. To discover this I have worked and studied each principle; the results and conclusions I purpose to give in my next letter, and with the help of our correspondents, I hope this matter will be settled to the general satisfaction of all, and to their benefit consequently. There are some who have ideas to ventilate, that would not venture to write in our columns. I should be glad to receive a letter from them privately, and they may depend on my kindly consideration of their communications.

In answer to "Prismatique's" request (letter 19362), I would say I fully intend to give a thorough explanation of the Foucault's test, in its proper order—that is, when I come to treat of the polishing; but as that will perhaps be some months yet, and as "Prismatique" is not a novice, he will not want elementary explanations. I think, therefore, he had better send me his address, when I will explain just what he is deficient of. A few letters between us will do it all for him, and then I shall be free to pursue the even tenor of my way, without anticipating the full explanation of the improvements and refinements I have introduced into the Foucault's test. H. A. Wassell.

Addenbrook Villa, Love-lane, Stourbridge.

[19389.]-I PERHAPS ought to offer a little explanation in regard to several points in my letter of Sept. 16 (19187). First my advice to amateurs not to use a machine unless it could be obtained without cost of making it, would be the best kind of advice in this country, for I am certain a machine of any account whatever could not be made here at less cost than six or eight pounds: and while that might not be a prohibitory price to some of your readers, yet I venture to remark it would be to the majority. The letter was written to prove that a speculum could easily be made by hand, and hence amateurs need not be deterred from making one, as I had been for some time, on account of not wishing to construct a machine. "J. C. L." objects to the curved blade of a razor for cutting off the light. I find on inspection that the blade curves perhaps 1-60in. between two points an inch apart. As the pinhole had a diameter of 1-60in. and the image would be the same size, all the curvature there would be in only 1-60in. would be about 1-200,000in., which disposes of this objection. My failure in Foucault test is not from want of experience, as I am perfectly familiar with it, both in theory and practice, but I want variation enough in the light on the surface to enable me to detect irregularities. I can get a good approach to the parabola, but am troubled with little irregularities arising probably from unequal pressure on the polisher. The eyepiece test enables me to increase these variations in light and shade, by simply drawing it out very slightly until the image is not quite so large as the angle which the mirror subtends at centre of curvature. A correspondent in these columns who has made a great many specula of excellent figure, lately informed me he always finished his specula on machine, and never resorted to retouching or figuring if he could possibly help it, as irregularities were almost sure to be formed. I believe machine-made specula are generally quite good to very near the edge, and this is one advantage which the machine has over the hand-process; but by combining two methods of

to be of a velvet blackness. A pyramidal mountain standing about 6,000ft. above the plain (9,600ft. according to Schroeter), and casting shadows of three peaks, is, nevertheless, a difficult object to define properly. I know it completely baffled a very fair Wray of 5½in. object-glass and 100in. focal length. Mr. Wray, however, has surpassed himself by a 6½in. lately supplied to me. In this glass the Moon is a mass of frosted glittering silver, surpassing a silver on glass reflector if the mirrors are the least tarnished in the wonderful purity of the achromatism. May be long delight us amateurs with such glasses! Mr. Nasmyth says that five or six small craters of very perfect form, though very minute, are discernible on favourable occasions, at the base of the mountain. These I have not yet seen. He delineates them as about a mile in interior diameter, but one of them much

JUPITER'S BIG SPOT OVERTAKEN BY SHADOW SPOT.

[19394.]—THE unusual phenomenon of a black shadow spot overtaking the Big Jovian mark, induces me to send you a sketch of the observation. The *Nautical Almanac* gives,

Oct. 30.—I. Sh. I. 8.58
I. Tr. I. 9.20
I. Sh. E. 11.11
I. Tr. E. 11.31.

At 9.30 the black round shadow dot had well entered upon the disc. The Great Spot had not reached its central position. Observing that the shadow progressed faster than the spot rotated, it occurred to me to watch when the shadow dot should just overtake the Big Spot. The former reached the Jovian Meridian at about a quarter

FIG. 1



FIG. 2



FIG. 3

larger than the other. About 400 diameters on a very still night, with first-rate definition, is required to show them satisfactorily. I hope, when Mr. Calver has furnished me with an 18½in. mirror, to be able to give an account of these niceties. Occasionally the air of Eastbourne is all that can be desired by astronomers; exceeding, I hope, Sir Wm. Herschel's dictum, that there are only about three nights of the year of superlative quality for observation. The very fine filamentary shadows projected from several minute Lunar peaks, encourages me to hope that our locality here will be favourable for viewing great astronomical delicacies like the fifth and sixth stars of the Trapezium in Orion, and the satellites of Neptune. On looking through very fine instruments, the minute granular surface of the Moon, which I can aptly compare to the white surface of a bride-cake, as well as the fine granular markings on the Solar surface, and the precision of the definition of flaring points on the deep black of the Moon's night-surface, combine in presenting tests of telescopic perfection of a high order of excellence.

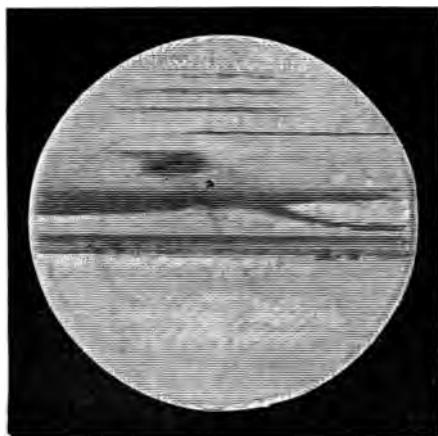
Mr. Webb informs us that Sehm thinks the profile would not be very striking—quite inferior to the steeper Alps or even the Niessen above the Lake of Thun. I have several times been there, and certainly admired the Niessen; but my view of Pico the other night has impressed me with a much grander idea. Indeed the Niessen summit is much below the line of perpetual snow and covered with grass to the top, and under no circumstances, except under wintry snows, could shine forth with that wondrous lunar sheen ever constant in our planet. Fig. 2 is a view of Pico two days older.

The turrets or spires on Plato's wall were finely depicted on the internal plateau as intensely sharp western black shadows of needle-like tapers (Fig. 3). About six may be counted, the central one being the tallest. By comparison of the views given by the Calver glass with Nasmyth's photographs, a power of 300 appears during inspection to precisely represent the objects taken by that laborious selenographer.

G. W. Royston-Pigott.

past ten, when it just caught up the "following" extremity of the Great Spot. The unsteadiness of the air only permitted occasional glimpses of the transit of the satellite which was seen about 9.45 p.m., like a pearl.

The last few evenings I have noticed a great disposition in Jupiter's equatorial belts to assume a very pale steel-blue colour, edged with light brown,



evolving serpentine cloudlets rather spherically formed. The whiteness on the southern borders of the darker markings was very conspicuous. On the whole, the Big Spot appears to me paler this year than last; but at times, when the air admitted "fits of easy transmission," a thin light band or border appeared to gleam weakly around this spot. The drawing was made by the aid of a Calver figured 8½ mirror.

G. W. Royston-Pigott.

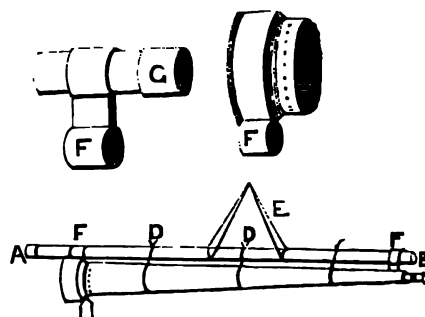
Eastbourne, Nov. 1.

A PORTABLE TELESCOPE.

[19395.]—At page 303 of the *ENGLISH MECHANIC* of 3rd December, 1880, is an illustration of a design for a combined camera-stand and alpenstock. I have, since writing the description of the above, fitted on to the alpenstock a 2½in. object-glass and an eyepiece, connected by a black cloth tube, which form a powerful telescope.

This form of telescope (as a makeshift) is useful when travelling in places where portage is limited, and where every additional ounce of baggage is important.

The sketch sufficiently explains the design.



References: A B, gaff handle; C, tube of black cloth distended by wire rings at D D D; D D D, string to suspend tube; E, string to suspend telescope; F F, split rings to attach object-glass and eyepiece-tube to A B; G, tube and screw for eyepiece.

Biela.

WOOD-TURNING.

[19396.]—"A COUNTRY PARSON" (letter 19369) will be thanked by scores of turners besides myself for his letter. Can he not induce Mr. Coulson to contribute to our columns? Such designs as his are what we amateurs want, and if we get more of them, together with such admirable practical instructions as those given by Mr. Evans, the *ENGLISH MECHANIC* will long uphold its position as the journal of the lathe and lathe-workers.

Old Chuck.

THE SLIDE LATHE AS A DIVIDING ENGINE.

[19397.]—HAVING occasion to construct some apparatus which required a divided circle of rather greater accuracy than is readily attainable by hand alone, and having no dividing plate on my lathe, it occurred to me to make the set of change wheels belonging to the lathe available for either dividing or wheel-cutting; and the query, No. 43834, on p. 292 of Vol. XXXIII., and subsequent answer by Mr. Wenham, suggested the possibility of such a method being useful to other subscribers to the "E. M."

I wished to divide the degrees, and also to construct a vernier to read to six minutes.

The circle to be divided having been accurately turned between the centres, either on a true mandril or on its own spindle, and the distinguishing lines carefully turned in a little deeper than the divisions are intended to be, the carrier or dog is securely lashed to the driver so that the lathe spindle cannot move in either direction without moving the circle.

The scribing point is a fine V ground to a knife-edge and polished on an oil-stone, the edge being slightly rounded in the direction of its length, laid in the tool-holder with the edge horizontal and exactly centre high.

The bed and slides must be nicely cleaned and oiled; and whichever slide is used should have the screw removed and a hand-lever adapted, and a stop fitted with a screw or some handy arrangement by which is insured only the necessary traverse of the scribing point.

The slides must be very carefully adjusted to slide with a slight stiffness and no shake. It will also be necessary in lathes which have no reversing gear on the headstock, to remove the studs which support the end stop. The spindle must be adjusted by means of the loose cone, to move quite stiffly. To prevent any back-lash, it will be necessary to adapt some kind of brake to the plain part of the guide-screw, a stout cord, one end of which is fastened to the headstock, the other taken once round the guide-screw in the direction the screw will turn, and a weight hung to it will answer the purpose.

Meanwhile, the train of wheels has to be calculated. In the first place, it is required that for one entire revolution of the spindle, the guide-screw shall make three hundred and sixty, or what is the same thing, one revolution of the guide-screw shall cause the spindle, and with it the circle to be divided, to move just one degree.

more I become used to the latter little machine, the more I like small wheels. At first (as I said in my last letter) I thought the work too slow; but I can get a much higher speed now, and with greater comfort. 56 Inch.

404.]—I SHOULD not have written again on subject, except to try and clear up one point which "Sunlight" appears to be particularly puzzled about. Perhaps the best way will be to take an example. Suppose a tricycle having one wheel circumference and another wheel 5ft. circumference, then in 100ft. the one wheel would make 20 revolutions and the other 2. But the circumference of the first wheel is double that of the second, and consequently any point in either wheel is at the same speed; the speed of any point on a big wheel being 10ft. by 10 revolutions = 100ft., and the speed of any point in the small wheel being 5ft. by 20 revolutions = 100ft. I think "Sunlight" reads through the above carefully and will see that, in this direction at any rate, my "a" are tight enough. J. H.

RE METALS—FAURE'S BATTERY.

405.]—I DID not reply to query No. 45006, as it was directly addressed to Mr. Allen, but am glad to add a few remarks to what he has said in week's number, although I can scarcely be called an "authority" on the subject. The atomic weights which he has given are mostly correct; but study of the metals of the yttrium group has not been so much complicated lately by the discovery and reputed discovery of new members, that I can never be sure of having any particular metal in the pure state. Of the metals of this group the existence of the following is more or less definitely established:—

	Scandium ..	Sc = 45 (Nilson).
	Yttrium ..	Y = 89 (Bunsen and Cleve).
ably	Phosphor ..	Ph = 111 (Delafontaine).
ical.	Unnamed metal of Soret	
	Thulium of Nilson ..	
ably	X. of Soret ..	
ical.	Holmium of Nilson ..	Undetermined.
	Jerbium ..	Jr = 147 (Marignac).
	Decipium (?) ..	Dp = 159 (Delafontaine).
	Erbium ..	Undetermined.
	Ytterbium ..	Yb = 172 (Marignac).

A reason why the atomic weight of erbium is not known is that what were previously supposed to be pure compounds of this metal are now found to be mixtures of the compounds of erbium, bismuth, &c.

The oxides of these metals are most probably of composition E_2O_3 , as they are all isomorphous with one another and with those of the cerium group.

With regard to the cerium group,—cerium, lanthanum, and didymium,—these are much better known. The best authorities (including Bunsen) give the following atomic weights:—

Cerium ..	137
Lanthanum ..	139
Didymium ..	147

Erbium is supposed metal of altogether different character—more resembling copper. It has been heard of it since its reputed discovery, and its existence seems very doubtful. I am happy to give a fuller account of these metals and their compounds should the Editor think sufficient general interest.

I regret to see (p. 188) that your correspondent "N. Dor." should have thought it necessary to have provoked the querist of No. 44732. In the first place, the paragraph referred to on p. 188 was published a fortnight after the query was received, and secondly, I defy anyone to make a more complete modification of Faure's battery according to description there given. Anyone who has to make a Faure battery knows that although easily explained, there are difficulties in the details of local action, &c., which are not so easy to come. I cannot say that my experiments were successful, and we have also heard that "Sunlight" and I believe Mr. Lancaster, did not obtain satisfactory results.

It would like to repeat the query, and ask if anyone can give us a plain working description of a battery, whether modified by Meritens or not? As "N. Dor." seems to be in the secret, perhaps he might enlighten some of us less fortunate.

J. S. Humpidge.

DESFORD JUNCTION ACCIDENT.

406.]—THE adjourned inquest upon the bodies of the unfortunate persons who lost their lives in the recent collision at Desford Junction has just concluded. The facts of the case are very simple indeed.

At Desford West Junction there is a siding which can be entered direct from the up main line through a pair of facing points, and the true root of the whole evil is the existence of such points.

The signal-post having a week before been blown down and not replaced, the interlocking was rendered useless.

The signalman, Butler, opened the points to turn a coal-train into the siding, but unfortunately forgot to close them; an express train following was, therefore, turned into this siding, and after running a distance from the points of about 225 yards, came into violent collision with the rear of the coal-train.

The driver of the express would also be able to see for about 50 yards that the points were wrong before getting to them.

The carriages forming the train were fitted with the Sanders' and Bolitho brake; but the engine, No. 101A, was not.

There is no doubt whatever, that with an efficient continuous-brake the driver might have stopped his train, and thus avoided the accident; and with even any form of continuous brake, under the control of the driver, the force of the collision would have been greatly mitigated.

Such a fact as this should have been most carefully considered by the jury, when consulting upon a verdict.

The signalman was greatly to blame, but under the circumstances of the case, much surprise is expressed that the following verdict should have been returned:—

"After consultation, the jury returned a verdict of manslaughter against Thomas Butler, censured the officials of the company for not re-erecting the semaphore earlier and the original one more securely, recommended the disuse of facing-points at sidings as much as possible, and that express trains should be fitted with continuous brakes."

This "censure" upon the company passed by the jury shows at a glance that the *quid pro quo* is far more to be blamed than the man, and there can be no doubt that at the trial he will be acquitted.

Clement E. Stretton.

Saxe-Coburg-street, Leicester, Nov. 7.

THE LEYDEN JAR FOR MEDICAL PURPOSES.

[19407.]—I HAD proposed to send a few lines to point out the facilities that the Voss induction machine afforded for the use of frictional electricity for medical purposes, and after reading the article in your last issue, tried a few experiments. I find that by merely disconnecting the outer coatings of the two small condensing-jars fitted to the Voss machine, and attaching any ordinary electrodes, such as used in the common medical machines, to these outer coatings, all the effects described in your article are readily produced, and that the strength of the discharge from the outer coatings is very easily regulated by increasing or decreasing the distance by which the terminal balls of the discharging rods of the machine are separated. My machine has a ten-inch plate, and is far more powerful than is necessary. The Voss machine is easily taken to pieces and put together again: it is consequently very portable, and it gives no trouble. H. B. T. Strangways.

5, Pump-court, Temple, E.C., Nov. 7th.

DOUBLE BOATS, CATAMARANS, &c.

[19408.]—THE following particulars of catamarans, &c., may be of interest to some of your readers. The first is one I am building myself: two pontoons 12ft. long, 1ft. broad, and 1ft. 4in. deep, built of pine (planks 4in. broad by 3in. thick), flat-bottomed, and pointed at both ends. The frames, including stem- and stern-posts, are of oak, 1 1/2in. by 2 1/2in. These boats, being square, are without keels, but have each an iron stringer (1in. by 3in.) top and bottom, running from end to end, holding the frames, ribs, &c., in their respective places. These stringers also act as knees for the stem- and stern-posts. The planking having been laid on (carvel build), a strip of oak (3in. by 3in. by 12ft.) is fastened with nuts and bolts to the top of each pontoon. On to these beams are fixed eight or ten cross-bars, those at the bow and stern being double the thickness of the intermediate ones. The decking comes next, which is of oak planks, 3in. broad by 3in. thick, and above this is a gunwale 1ft. high, coming to a point at each end. The pontoons have a rudder each, coupled with a connecting-rod, and worked by a small wheel amidships. Paddle-wheels, 3ft. 6in. in diameter, are also fitted to the catamaran, and are worked by a pair of half-horse engines, driven by a small multitubular boiler. With these arrangements one man can attend to the machinery and steer at the same time.

The following are a few extracts from "Yacht and Boat Sailing," by Dixon Kemp:—"In 1873, the late Mr. Melling had, what he termed, a safety yacht, constructed on the double-hull principle; he thus describes his boat—'All is of

pine, light and buoyant, having no ballast whatever. . . . She can accommodate herself to draw only 1ft. of water, although of the size of 15 tons. . . . Her pontoons are 30ft. long and 2ft. 6in. diameter, representing enormous floating power, and it is almost unnecessary to say, water-tight pontoons or air-chambers are the most powerful principle of buoyance known. . . . In the spring of 1868 Mr. John Mackenzie, of Belfast, constructed a double-boat, but without dropping keels. He thus describes her:—'There are two boats of equal size, each 21ft. keel, 3ft. beam, and 3ft. deep. . . . A keel is provided to each boat 15in. deep at the stem (or keel), diminishing forwards to 6in. Bolted to the keel are strong iron stanchions which rise through the deck on which the rail is fixed; to these stanchions the cross-beams connecting the boats are fixed, the timbers or ribs also rising through the deck for a similar purpose, where the cross-beams are placed. The skin is 1in. thick, being in one board on either side of the keel; the sides are in two, each 18in. deep, the seams being covered by a continuous strip of wood. By this method there are only four seams in each boat which require caulking, so that leakage is rendered nearly impossible. The boats are connected by five trussed beams, a space of three inches being left at either side to allow air, compressed by a cross-sea, to escape from underneath. . . . A helm is attached to each boat, and these, being coupled together by a connecting-rod, are worked by a tiller in the centre. . . . The greatest speed attained was ten knots an hour.' . . . The Duplex (catamaran) has been brought to this country, from America, by Mr. H. W. Custance. Her dimensions are:—Length, 30ft.; breadth of each hull, 2ft.; distance between the hulls, 12ft. Each hull is fitted with a centre-board and rudder. These catamarans are quite unfit to be sailed in wave-water, as the lee boat is almost certain to go bow under, and then, if the sail were not instantly lowered, the whole construction would be torn to pieces. Off the wind, they have attained a speed of sixteen miles.

Nemo.

REPLIES TO QUERIES.

.. In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[44654.]—Air-Vessel.—I am quite aware that the air does disappear from the air-vessel of a pump. The reason is a most simple one—viz., that the air is, in consequence of the pressure, gradually absorbed by the water, and the gradual change of the water naturally, in a short time, carries off the air. And it is this property of water, being able to hold air or gas in suspension, that the manufactures of gingerbeer, soda-water, &c., are based on. The effervescence of the fluid when the bottle is opened being due to the escape of the air which was previously entangled in the water. Therefore, an air-inlet valve, frequently termed a snifting-valve, is needed, so that air is drawn in which, rising by gravity, is fed into the air-vessel on the delivery to supply the waste. In the case of a large pump I had to do with some time back, we used to let the air pass away gradually until a certain volume of water showed in the gauge-glass. It was then simply a matter of opening a petcock on the pump-barrel as the ram made the outstroke and closing it as it made the instroke, and in a short time we had abundance of air again in the air-vessel.—SUNLIGHT.

[44686.]—Even Temperature.—I do not think you would find much improvement by using superheated steam, nor from copper instead of iron. Superheated steam contains more heat per pound than saturated steam, and is made by passing steam from the generator through a "superheater," an arrangement of tubes or plates heated by the gases from the furnace. I think your best plan will be to reduce the size of your containing vessels—or rather the thickness of the pitch between two heating-surfaces. Cannot you place them so as to get steam all round them as well as through the coil?—NUN. DOR.

[44760.]—Fitter's Bench (U.Q.).—This querist omits to say whether he requires a portable bench or a fixed one. If the latter, he should cut two holes in wall, both one height, removing half a brick; cut one side of holes straight and the other side slant, the widest part inside. Now take two pieces of wood, 3in. square, saw a piece out to form a half dovetail; this will match the holes. Take two more pieces for legs, and, if possible, let them into the floor; if not, fasten them well to floor, cut the cross-pieces and legs half away where they unite, put cross-pieces in holes cut for them, drive a piece of wood in the straight side of hole, which will secure them there. Now screw legs and cross-pieces together with strong screws, and upon

these screw the top, which should be 3in. thick for the front plank; 1in. will do for the back one. Now you can fit your shelves underneath, and put doors to it, if need be. The height must be ruled by your own height, bearing in mind the top of vice must not be higher than your elbows. Fasten vice well to bench with coach-screws, and the leg of vice to leg of bench on left side; use a hook and nut, say 1/2in. See your vice stands straight and square, put the hook through leg of bench, screw up the nut, and you will have a bench qualified for anything a fitter requires.—LOCKSTITCH.

[44761].—**Batchet Brace (U.Q.)**.—Bore out the end of socket true, and put in a bush with square hole true in it; or, still better, weld the socket up, drill fresh hole, and drift it out square. If much worn, put new screw and spindle altogether. If these plans are too much trouble, you must forge drills to suit the error.—LOCKSTITCH.

[44770].—**Tube Stoppers (U.Q.)**.—For locomotives we use cast-iron plugs, slightly taper, to fit inside ferrules of tubes. The plugs have a square piece, smaller than the plug; this fits a socket on the end of a rod of iron. Having put a plug into the socket of rod, insert the taper end in tube, and drive it fast. Be careful not to drive the tube through the plate into boiler (a mishap that sometimes happens), and always stop the chimney end first. If this idea is any use for marine boilers, you are welcome to it.—LOCKSTITCH.

[44830].—**L. & N. W. Engines**.—I do not understand "Fortuna's" remark about 805 being a 7ft. 6in. Ramsbottom "not a completed engine"; he must be misled by the fact that 804, Soult, and 806, Waverley, are 7ft. 6in. engines. 805, Cyclops, is a 6ft. coupled Ramsbottom, date Sept., 1873, and was at Shrewsbury shed (30). I have seen it myself several times.—DIOMED.

[44842].—**Paper-Staining**.—Your querist might try carbolic acid, salicylic acid, oil of lavender, or oil of cloves, or corrosive sublimate; but I cannot say whether they would have any effect on the colours. Should think not. It is understood that the mixture must be kept for a fortnight, I suppose; otherwise it would be better to mix only as wanted.—ESSAR.

[44845].—**Cleaning Lacquered Curtain-Rods**.—Try a weak solution of ammonia; but probably it would be best to send them to be relacquered—that is, if they are worth anything at all.—J. T. M.

[44847].—**Mathematical Works**.—Why not take the works recommended in the Syllabus? Todhunter's, Hamblin Smith's, are good.—CAMB. B. A.

[44851].—**Biscuits**.—Only the fine white flour and water, with thorough mixing, are needed. "Arrowroot" biscuits cannot be made without sugar; for if that is omitted they are simply plain biscuits.—T. P.

[44859].—**Balance-Weights in Loco. Wheels**.—I know of no formula for calculating the counterweights in loco. driving-wheels; but your correspondent may be referred to Forney's "Catechism of the Locomotive," published here by Trübner, I believe. The subject is too long for your pages, and is, moreover, a difficult one, for it is clear that a counterweight which just balances the weight of the crank and reciprocating parts at one speed, will be too heavy or too light at other speeds. A counterweight suitable for inside cylinders will not be the best for outside cylinders, and vice versa. It is, in fact, a very complicated problem.—ESSAR.

[44866].—**Phosphatic Manure**.—"Dunrod" says nothing as to his conveniences for plant-culture at this season, but I think he will find turnip radishes the best and most easily-raised plants on which to experiment. If he can keep them in a temperature of, say, 60°, they should be ready to eat six weeks from sowing. Apply the manure as surface dressing, and water in.—SAIL RYKA.

[44869].—**Faulty Battery**.—If this querist would only give a description of his battery—stating what the elements are—he might obtain an answer.—TANTO.

[44870].—**Railway Rolling Stock**.—This query is a riddle. The wheel-base is ascertained by measuring, of course; but perhaps the querist means how does the engineer know what wheel-base to give a certain size wagon. The answer is by certain rules founded upon past experience, to which may be added that they are very elastic, and that a shorter wheel-base would be given on lines abounding in curves.—NUN. DOB.

[44872].—**Waterproof Paint or Ink**.—They are merely the colours ground up with printers' varnish and more or less turps. They are not used as paint, but as ink, and printed. If made sufficiently thin to use as paint would probably require addition of driers.—ESSAR.

[44879].—**Secondary Battery**.—This query is answered on p. 442, last volume, the illustrations

showing the terminals about which the querist asks.—T. P.

[44881].—**Bath**.—Take the paint off by means of caustic potash or soda, and polish up the zinc. Paint always cracks off. The only thing is to enamel the zinc, and that would need a suitable oven.—J. T. M.

[44892].—**Connecting-rod**.—It is not quite clear what "J. F. M." means by the "so-called angularity" of the connecting-rod, nor of what he wants a demonstration. He has only to draw a crank and a crosshead in different positions, with the connecting-rod as it must be, to understand what is meant by "angularity"; and if he wants to know how to find the length of a connecting-rod, he may read a paper by Joshua Rose on p. 455, Vol. XXIX.—NUN. DOB.

[44930].—**Cosmorama**.—For the further information of "P. D." and other interested readers, I may suggest that the bottom of cylinder of the zoetrope may be made of metal instead of wood if preferred. It may be made of tin, zinc, or brass. The pipe or small tube on which the cylinder revolves can be soldered in the centre. Any respectable metalworker or tinman would, no doubt, make the cylinder complete (with the exception of the white enamel and japan) for about three or four shillings. It requires but little ingenuity to make the polished stand. In my previous replies to this query, I omitted to mention that there are books published by Mr. J. Clarke containing three chromotopes each at 6d. per book. Each chromotope contained in one book is of different designs of circular form. They are intended to be placed at the bottom of the cylinder on the inside, and on looking through the slits when revolving, they have or produce a similar effect as those employed in the magic-lantern. The zoetrope, if properly made, will afford a variety of amusement to the family circle for the winter evenings. There has been a goodly number of books published containing the slides, but I am not certain that they can all be obtained at the present time. All information respecting the slides can be obtained of Mr. J. Clarke, whose advertisements have appeared from time to time in many of the back numbers of the "E. M."—G. FRYER, Swansea.

[44940].—**Boat**.—"T.B." will be able to bend his ribs in the following manner:—Procure a piece of iron pipe, of from 3in. to 8in. diameter, and about the length of the longest of the ribs; plug (watertight) one end, and press it into the ground; secure the pipe in a vertical position by means of stays of wire, to pegs in the ground; and then, after filling with water, light a fire, of chips, &c., round the heel of the pipe till it boils; then put in the ribs and let them boil for at least twenty minutes, they can then be bent to almost any shape required. Before putting into the pipe secure with a piece of string, else tongs will be required to get them out. This is the way fishermen often do, but is rather a primitive style. Boatbuilders have tanks for the purpose. "T.B." may possibly be so situated that he can use a large boiler, if so, do so, but see that the ribs are quite in the water all the time. If "T.B." likes to advertise his address, I can show him plans of building without ribs at all, a plan not in common use, but one I have proved a success.—W. REKES.

[44961].—**L. & N. W. Engines**.—Thanks for corrections: *Druid* is 1144, I have seen it several times; 444 was a misprint.—DIOMED.

[45039].—**Gas-Stove**.—With not the least intention to either champion or advocate any one special article in the market, I feel it but justice to notice the statement made by "J. M." The name, if it be a very fine one, is not of my bestowing, but that of the inventor's, I believe. Therefore, I have nothing to do with that; but when my veracity is directly questioned, I am bound to take up the matter. In the matter of assertion, what I stated both then and now is that from the construction of this form of stove the products of combustion are condensed; and since "J. M." is so positive I would tell him that it has been proved that the condensation is sufficiently perfect that in ten hours the fluid products average 40 fluid ounces, and consist of water, sulphuric acid, sulphurous acid, carbonic acid, iron, ammonia, and some organic matter. What other products does he expect beyond these? And further still, "J. M." notwithstanding actual use in greenhouse, which is a very delicate natural test, proves that the stove is perfectly innocuous to vegetable life. The most careful observations fail to show the least escape of poisonous or deleterious gases, as such are condensed and collected in the watery product named. Therefore, I am quite within the mark in stating it does not need a flue or chimney.—SUNLIGHT.

[45044].—**Oxyhydrogen Microscope**.—I hasten to protest against the reply given by Mr. Lancaster, and with the less hesitation because his replies are mostly so instructive, and so obviously given with the view of helping an honest inquirer. Why, none of the lenses, or "powers" sold with

the ordinary microscope "fronts" for an optical lantern, are fit to hold a candle (let alone a lime-light) to good low power microscope objectives. I have been accustomed to use for some years, in the oxyhydrogen microscope, an inch and a half, and a two-thirds of Beck's best series, with excellent results, one giving 80 and the other nearly 300 diameters of magnification on a screen at 14ft. distance, and I have a specially good two-thirds by Dallmeyer, made expressly for projection, which gives a somewhat larger field, with great flatness and clearness. Zentmayer's "gas-objectives" are very good also, but a fearful price. The shop lenses are not achromatic (and could not be expected to be at the moderate price charged for them), nor will their definition at all approach that of such objectives as I describe. By using the latter, too, the whole range of microscope slides are available, within the limits specified of magnifying power, and when polarised light is brought into play, with which the attractive articles of Mr. Lewis Wright have made us familiar, there cannot be a comparison between the exhibition of suitable objects, as shown by good achromatics and by ordinary "powers," and they are just as superior when used with solar light from a heliostat such as I described at p. 496 of Vol. XXXI. In either case the alum trough is wanted to intercept as many of the calorific rays as possible, and even then it is not prudent to expose a valuable slide too long. The management of the converging rays needs a little care; the brightest field seems to be obtained when the diameter of the cone of rays at the object-glass is equal to the diameter of its front lens. With solar rays this can of course be regulated to a nicety; but with the lantern a circular disc of light about 1/2in. in diameter is the nearest approach to a focal point that can be got. For polarised light the air angle of the o.g. should not much exceed 25°, or the analysing Nicol will cut off some portion of the edge of the field, and that is just about the general aperture of a good inch and a half, whose true focal length will most likely prove on examination to be not more than an inch and a quarter. A polarising Nicol about 1/4in. long will cut off hardly any of the rays from the condenser, if rightly placed. It should be brought up as close to the object-glass as possible, only leaving room between the two for a rotating plate of selenite. It should also have facilities for rotation through at least 90°, and therein lies one great advantage over this method of polarisation compared with the bundle of glass plates at the proper angle in an elbow piece, for the latter, of course, cannot be rotated but with the former arrangement, polariser, selenite, and analyser can all be rotated, and these various combinations of angular movement ring the changes of colour in a gorgeous and gratifying degree, frequently displaying structure which has been invisible with ordinary light, as in the cuticle of *Equisetum*, for example.—ANTARES.

[45054].—**Cleaning Firearms**.—Wash the barrels out well with a piece of tow, dipped in warm water, at the end of a cleaning-rod; then substitute an oiled rag for the tow, and pass up and down till the barrels are quite bright inside. It is not detrimental to leave the barrels for a day or so without cleaning, but the sooner they are cleaned the better. I prefer the Snider action to the Martini-Henry for rock-rifles, but such weapons are mere toys, and the action immaterial. A rock rifle should strike a mark the size of a brick, at thirty and sixty yards distance, with the same sight taken full. If it does this, it is good enough, no matter what its action is.—X. Y. Z.

[45065].—**Chemical and Microscopical Test of Silk**.—In reply to "Mercur," let him "tease out" the ultimate fibres of the fabric he wishes to examine. Place the sample on a glass slide, cover with thin glass, and examine under a half-inch power with the microscope. The silk will appear as a cylindrical thread without structure, not unlike a smooth stick of barley-sugar. If mixed with flax, hair, wool, or cotton, he will find the first three named admixtures more or less of a cylindrical form, but having special characteristics that I need not now enter into, as "Mercur" can easily make himself familiar with them by examining undoubted specimens of each kind. Cotton fibre presents the appearance of flat bands, but to make sure about the silk, let him now apply a drop of sulphuric acid with a glass rod to the edge of the covering-glass, so that it may run in by capillary attraction, while he is still viewing the object, and he will perceive that the silk will be entirely dissolved in the acid, like sugar in hot water, while the flax, which looks more like the silk, will become more or less blackened, but not be dissolved, and but little change will be observable in the hair or wool if present. If my memory is not at fault, silk is also soluble in a strong solution of acetate of copper.—GAMMA SIGMA.

[45072].—**Percussion Action**.—I beg to thank Mr. Fryer for his advice, but it is just because I cannot get a sight at a percussion action that I troubled him with the question, and, as I made the harmonium myself from the hints I got from the ENGLISH MECHANIC (without ever seeing the inside

Then the total strain tending to separate the two semi-cylindrical surfaces is $p d$ (taking the length of the boiler as lin.)

$$\therefore \frac{Pd}{2} = ts \therefore S = \frac{Pd}{2t}$$

From the foregoing, we see that the strain longitudinally is given by the equation—

$$S = \frac{Pd}{2t} \dots \dots \dots (1)$$

Now, transversely, the bursting strain is $\frac{7}{4} p d$.

The resisting strain is $\pi d t$.

$$\therefore \pi d t s = \frac{7}{4} p d \dots \dots \dots (2)$$

The latter strain is evidently half the former.—J. F. B., York.

[45114].—“Brushing-out” Gold Designs on Glass.—“C. J. U.” is quite right in thinking it some kind of stencilling, for that is exactly what it is, only the stencils are the reverse of the ordinary ones; for instance, the spaces between letters are removed, the letters remain; whereas in the ordinary stencil the part representing the letters is removed; the part of the stencil above and below the letters or border, of course, is left, to keep the design in place. Having gilded with very weak isinglass (or other size you are in the habit of using) a sufficiently large piece, lay the stencil on the gold, and with an ordinary h-g-hair nailbrush you can easily remove the gold from the exposed parts. When this is done, remove the stencil, and finish by scraping the gold that remains (other than the design) away with a ruler and a piece of hard wood sharpened to the shape of a narrow chisel. The individual from whom I learnt the above, charged me 10s., but if the directions I have given are not explicit enough, I shall be happy to give further details, or will send “C. J. U.” a stencil, on his advertising his address (gratis, of course).—A. N. H.

[45115].—Estimation of Alcohol in Tinctures, &c.—Into a small flask with a tube passing into a condenser, or a small retort would do, introduce 50cc. of the liquid, having a perfectly dry flask as a receiver. A low light is now placed beneath the retort, and much as possible distilled over. The distillate is now made up to its original bulk (50cc.) and the specific gravity taken, which upon reference to proper tables gives the alcohol in 50cc., which, multiplied by two, equals the per cent. This process answers very well, and is very accurate, provided none of the tincture is volatile. The following is a rough way for the estimation of the alcohol. Put 5cc. of the liquid into a graduated tube, add 3cc. of a saturated solution of carbonate of potash, shake well, allow to stand for some time, when the alcohol will float on the top and may be read off, which multiplied by 20 equals the percentage.—J. C. BELCHER.

[45121].—L. & N. W. Engines.—The following engines were at Warrington (23) shed last time I saw them:—Ambassador, Alchemist, Emperor, Empress, Hardinge, Linnet, Peregrin, Rose, Snake, St. Arnaud, Sunbeam, Vesta, and Windermere; all 6ft. singles outside cylinders. Euxine, Narcissus, Tartarus, Terrier, and Zamiel, 6ft. coupled Ramsbottoms. At Preston (27), Columbus, Cromwell, Franklin, and Scott, are all 6ft. 6in. coupled Ramsbottoms. Eden, Henrietta, Martin, Woodlark, and Waterloo are 6ft. coupled Ramsbottoms. At Carlisle (29), Cosack, Cerberus, Colossus, Druid, and Levens, Webb's 5ft. 6in. coupled Ramsbottoms. The Duke of Edinburgh, 6ft. 6in. coupled Ramsbottoms.—DIOMED.

[45131].—Softening Gold and Silver.—If the gold and silver be pure, the metal will be sufficiently soft after melting, without further annealing, unless it has been overheated in melting. To anneal gold and silver, heat up to a red-heat, and cool off in clean cold water.—EDWIN.

[45135].—Mathematics.—I send solutions of two equations:—

No. 1.—Multiply 2nd equation by a , and we have—

$$ahz + ay = cQ$$

$$\therefore ahz - x = aQ - P.$$

Again, multiply 4th equation by c ,

$$cdx + ct = cS$$

$$z + ct = R.$$

Using the two equations thus found,

$$ahz - x = aQ - P$$

$$-ahz + abcdx = abcS - abR$$

$$\therefore (abcd - 1)x = aQ - P + abcS - abR$$

$$x = \frac{P - aQ + abR - abcS}{1 - abcd}$$

and hence—

$$z = \frac{R - cS + cP - abcQ}{1 - abcd}$$

The value of the other letters may be found by substitution.

No. 2.—Multiply 1st equation by c' , and the 2nd by c ,

$$\frac{ac'}{x} + \frac{bc'}{y} + \frac{cc'}{z} = c'd$$

$$\frac{ac}{x} + \frac{bc}{y} + \frac{cc}{z} = c'd'$$

Subtract

$$\frac{ac' - ac}{x} + \frac{bc' - bc}{y} = c'd - c'd'$$

Similarly from 2nd and 3rd equations.

$$\frac{a'c' - a'd'}{x} + \frac{b'c' - b'd'}{y} = c'd' - c'd''$$

Multiply the first of these by $b'c' - b'd'$, and the second by $b'd' - b'c'$, and subtract, and the value of x is found.—T. PERKINS.

[45135].—Mathematical.—(1) The fourth equation here should be $t + dv = S$.

$$\begin{aligned} x &= P - ay = P - a(Q - bz) = P - aQ + abz \\ &= P - aQ + ab(R - ct) = P - aQ + abR - abct \\ &= P - aQ + abR - abct(S - dv) \\ &= P - aQ + abR - abctS + abcdv \\ &= P - aQ + abR - abctS + abcd(W - cv). \end{aligned}$$

Or,

$$x(1 + abcd) = P - aQ + abR - abctS + abcdW,$$

$$x = \frac{P - aQ + abR - abctS + abcdW}{1 + abcd}$$

$$y = \frac{P - x}{a} = \frac{Q - bR + bctS - bcdW + bcdP}{1 + abcd}$$

Similarly we get,

$$z = \frac{R - cS + cdW - cdP + cdvQ}{1 + abcd}$$

$$t = \frac{S - dW + dP - deaQ + deabR}{1 + abcd}$$

$$v = \frac{W - cP + caQ - cabR + cabS}{1 + abcd}$$

(2) If x', y', z' be written respectively for x, y, z , we have

$$x' = \frac{d(b'c' - b'd') + d'(b'c - b'd) + d''(b'c' - b'd')}{a(b'c' - b'd') + a'(b'c - b'd) + a''(b'c' - b'd')}$$

by ordinary elimination of y' and z' .

$$x' = \frac{a(b'c' - b'd') + a'(b'c - b'd) + a''(b'c' - b'd')}{a(b'c' - b'd') + a'(b'c - b'd) + a''(b'c' - b'd')}$$

y and z may be found in the same way.—H. J. B.

[45141].—Japanning Tin.—The first process with the tea-tray, which is made of sheet-iron, is to scour it well with a piece of sandstone, which process removes all the scales of iron and makes the surface perfectly smooth. It is then given a coat of vegetable black, which must be mixed with black tar varnish, and thinned with tar spirits and well strained. Only a small quantity of varnish, as this coat may dry dead. The article is then put into a stove to harden. This stove is nothing more nor less than a large oven; large of course where a great quantity of work is put in at one time. The heat must be as even as possible all over the heated space, and must be free from dust. Temperature must not be much, if any, under 212° Fahr., the articles to remain in this temperature from ten to twelve hours; when taken out of the stove to be allowed to get cold. It must then receive a coat of black tar varnish which must in no case be thinned except it be so thick as to be quite unworkable; and in that case tar spirits should be used sparingly. A stiffish bristle brush with short bristles should be used, such as are generally bound with iron ferrules. The varnish is distributed evenly all over the surface, and must be put on so sparingly that it cannot “run,” as japanners say, which it is sure to do immediately it gets warm, particularly on upright articles, if too much is put on. Two coats of this varnish on the top of the vegetable black is very often sufficient when done by an expert hand, but a third coat improves the work, and very frequently is indispensable. Ten to twelve hours’ hardening is requisite between each coat. It is likewise necessary to rub down the small lumps which will appear after each coat with a piece of pumice-stone, first made flat by rubbing it on a piece of slate. Keep dipping the pumice-stone in water. This rubbing-down must be executed very lightly, or the smooth parts will be scratched. If the article is to be decorated with burnished gold, the first process after coming out of the stove the last time is to “rough” it. This is done with very fine pumice-stone sand, applied with some kind of corded or roughish material. Russell cord does very well. Jean, or some such name, is the material mostly used. They generally obtain what they require for this purpose from marine stores. The process is very laborious, as it requires all the pressure that can be employed, and that, too, for some considerable time. It is part of the process called polishing. When the surface has been made level by this process, the next thing is to go through the same again; but this time, instead of using sand and the cutting material, black or soft rottenstone must be used, with flannel or cloth kept well wetted, as before. This process makes the surface exceedingly smooth and ready to be brightened up into a fine polish by rubbing the sand up and down. The person so employed has to keep rubbing the dry soft hand into powdered white rottenstone, and also occa-

sionally moistening the hand by placing it on a wet cloth for the purpose. The polish soon comes up under a practical hand, but under no other. All these processes are performed by women and girls. It takes months of practice in this polishing before the hand obeys the intellect. The work now passes to the ornament. After he has put on his ornaments of gold and colour, it is put into a stove with only a few degrees of heat, as much heat would destroy his work. When dry, that part only of the article which is covered with ornament now receives a coat of copal polishing varnish. This varnish does not improve the appearance, but is necessary to preserve the decoration. No polish varnish can equal that of black varnish, which is about a fourth the price of copal. This varnish put on with a flatcamel-hair brush, and will harden in a heat of about 100° in four hours. If put in a great heat, it will turn colour, and completely spoil the work. It is now ready for finish polishing, which consists of the rottenstone process again, and handing up as before, and last of all, a few spots of oil are used, with a sprinkling of water, and this is called oiling off. It requires great dexterity, or instead of adding to the lustre with the oil it will completely dull the surface. This may seem a long roundabout description, but it is only by the manner described that the “excellence of finish,” mentioned by “J. E. B.,” can be obtained. I may here mention that there are plenty of goods that do not go through all these processes and yet look fairly well. Such, for instance, as grocers’ canisters, and numerous other articles. These, as soon as they have received the second coat of black varnish, are taken straight to the ornament without being “roughed” or polished or anything, and if the varnish has been put on well and kept free from dust they look very well. When no polishing is done either before or after the ornamenting, it is frequently covered all over with the copal varnish coat. The only safe way of obtaining the proper varnish is to get supplied by those who supply japanners, of whom there are numbers in Wolverhampton and Birmingham, Messrs. Manders being about the principal firm. The best black tar varnish obtainable can be had at 4s. 6d. per gallon. The best copal polishing varnish is 16s. per gallon, inferior qualities as low as 6s. or 7s. Oil copal polishing varnish at 12s. should be good enough for most purposes. I should mention that when tin goods are to be japanned the only preparation necessary is to clean off all grease spots with a piece of dry rag dipped in turpentine, and also as to heat, when it is not too hot to disturb the solder, it will not hurt the black varnish, provided it is put on sparingly. If not, the varnish will shrivel. If “J. E. B.” wishes to try the polishing I should have to give him a more lucid explanation; but even then he would be sure to fail. If he can be satisfied with the finish he sees upon grocers’ canisters, he may easily obtain that result, as there is nothing on them but good stoving and varnishing, no polishing. He perhaps wishes to know something about coloured surfaces. They are ground in turpentine in a mill, or on a stone slab, and mixed with mixing varnish, which costs about 6s. per gallon. If an emerald-green ground is required, some let the first coat be of white lead mixed with varnish, and this is followed by two coats of the emerald-green without any white in it. The coat of white gives to the green a softness which could not be obtained otherwise. A moderate heat is required, as these varnishes will not become hard without heat, but in no comparison to the heat, nor the time required, for black varnish. A vermilion ground is sometimes first coated with orange-red, and one coat of vermilion on that should be sufficient. When the last coat is dry and hard, the whole surface should be well rubbed down with fine pumice-stone sand, which can be purchased from oil and colour shops; but it must be fine, and if necessary dusted through fine muslin. What is called a “bob” must be made of a piece of jean, large enough to hold in the hand conveniently, and must be dipped into water and then into the sand, and this rubbed vigorously up and down the work will make it quite smooth. Use freely of the water, but moderately of the sand. Afterwards wipe all off cleanly with a wash-leather; and the surface will be found to be dull but smooth. Exactly this method is used likewise for black varnished surfaces. The work is now ready for ornamenting, if any ornamenting is to be done. If not, it is ready for varnishing with the copal varnish (not mixing) which will at once brighten the surface which has had to be dulled in the operation of smoothing it.—C. J. V.

[45142].—Silvering Process.—Dissolve the parts of nitrate of silver in 50 parts of distilled water, and neutralise with six parts of ammonia; this we call solution 1. Now dissolve one part of tartaric acid in 4 parts of water; this we call solution 2. Now add 1 to 2, and dilute the whole with 500 parts of distilled water. The things to be silvered should be placed in this solution at a temperature of 50° C., for a few hours, when they

ad dried. Another; prepare ten of silver and ten grains of nitrate distilled water; now add to this a to dissolve the precipitate; to ins of chlorate of potash in ten This is a very quick process; why Mr. Holmes cannot succeed, es sugar in place of chlorate of sing agent. I shall be most happy er information if required.—H. lloway-road, N.

hear's Silvering Process.—monia to silver nitrate, we first ate of ammonia nitrate of silver, ed in excess of ammonia. If too e added, the silver is converted form. On addition of caustic ia nitrate is again thrown down rate of potash and silver, which onia again dissolves. The silver lises the solution. Upon adding tion, the alcohol and ammonia ile the grape-sugar enters into the nitrate of potash, and the ed on the envining vessel or much reducing solution is used, ination with the silver as well as rows it down as a brown mud. liberates the silver too soon in the . H. FARROW.

able Piano.—I once made just piano for a travelling entertain- ured by "Biela." The compass om 4ft. C in the bass to the 3in. e height and width 32in. over 18in., weight something under was fully equal to an ordinary strument in every respect satis- a piano a metal plate may be dis- in its place a small beech wres- t in at the bottom of the bracings : downwards; otherwise, except : space, the bracings should be : towards the plank; the general : is precisely the same. If the : an object, the strings of the ld be covered with copper wire, sized pianos. In such an instru- : obviously be no room for a sticker erefore be necessary to employ : action, or the action shown be latter for such a country as : sider infinitely preferable, as



...



ntre, it is not only much easier at from its simplicity, is almost out of order, while the spring A :o the hammer-rest at D, com- ight of the damper at B, would it to correct any tendency to the hammer centre. For full t refer "Biela" to the articles : Pianoforte," in No. 695. Vol. five following numbers.—W. H.

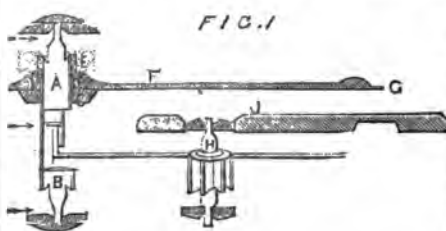
te-Burning.—Chiefly Cornish ers, with some little experience tion at sea as well. The coal elish or Forest of Dean. But on ns North Country coal, as it is used, which I found easier to us plans have been tried, such as

firing alternate sides of the furnace, firing all at the front end, and pushing the coal, which was thus coked, forward on to the bright fire. Admission of air over the fire itself, and also of air through the bridge, to help the consumption of smoke beyond the bridge, has been tried with varied results. Also a plan of making the smoke and other products pass through a sort of grating formed of firebricks, and which, being highly heated by being just beyond the bridge, tended to burn the smoke passing through. Amongst the extraordinary means used was to line the furnace-tubes for some distance from the bridge with fireclay, so that the smoke was not cooled down so rapidly by contact with the boiler-plates, and hence had time to burn. But I certainly think that careful firing has more to do with smoke-consumption than anything else, except one takes up certain new plans that have been recently patented. The application of steam-jets over the fire no doubt do good in some cases; but in dealing with cases it is necessary that it is fully proved that there is a deficiency of oxygen in the flues. Hence, with liquid fuel, where abundance of air must be used, we get no smoke at all, but in its place a flame of such length that I have known it reach right through the tubes of a tubular marine boiler. With the return-tube marine boiler, with two or more furnaces side by side, there need be not the least bother to obviate smoke. The furnace-tubes being short and draught good, all that is needed is to fire the furnaces alternately with proper admission of air, when the flame from the one furnace fires and burns up the smoke from the other. But I have found that the greatest of all difficulties is to make the firemen carry out the instructions given them. SUNLIGHT.

[45146].—**Smoke-Consuming.**—We use here double-flued Galloway boilers in our institution, and being close to laundry, had always a trouble with drying-ground from smoke. We now fire alternately—one fire clear, the other fresh fuel; result, no smoke.—ON GUARD.

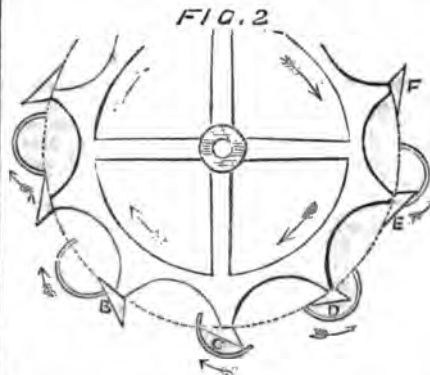
[45150].—**Leclanche Battery.**—I have charged those cells with both fine and coarse manganese, but prefer, after spending much time and money, to use gas-carbon and manganese in equal quantities, about the size of duck-shot, with all dust sifted out. I have one now of eight cells, working thirteen bells, nearly in constant use, and all that has been needed has been a little water now and then in outer cell for two years' work, and I find no flagging yet. I have fitted electric bells to my pressure-gauges on steam-boilers for safety from over-pressure, and being in a rather hot place, the pitch used in sealing porous cells used to soften and sink amongst the contents, of course spoiling the battery. I now use equal parts of pitch and resin for sealing, and have no further trouble.—ON GUARD.

[45152].—**Turning in a Cylinder.**—I have sent you instructions for putting in a cylinder and steel wheel pinion; but before anyone can put in a cylinder, they must understand how it works, so I have inclosed drawings of the said cylinder, &c. Fig. 1 represents the cylinder and steel wheel

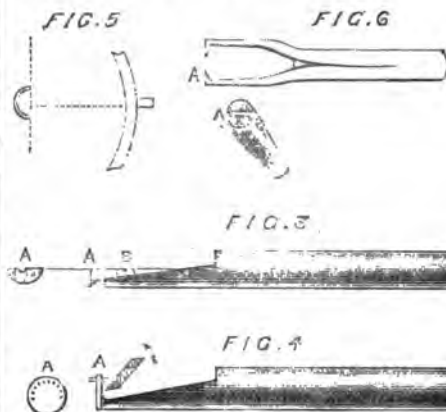


(section), which I think will explain themselves. A is the top plug; B, bottom plug; C, shoulder for balance; D, arbor for balance; E, collet for hairspring; F, balance; G, banking pin; H, steel wheel pinion; J, bar for pinion. Fig. 2 is the steel wheel and cylinder at work. The arrows show the way they are going. A is about to enter the cylinder, B is entering, C has entered and dropped on the other side (beat one); the balance now returns, D is about to come out again, E is nearly out; as soon as E gets out F will drop on the cylinder and take the place of A that will be (beat two). The first thing you want is the size. If you have the old cylinder, that will be sufficient; if not, take a piece of brass wire and file so that it will pass between two pallets, allowing for drop (see C and D Fig. 2); now cut it just long enough to reach from the bottom to the top jewel (with the ends filed true), when the cock bar is screwed down. Having got your cylinder, take a good rose or a pivot drill and broach the hole large enough to slip easily over the cylinder. Now take your rose with a pair of old tweezers, with the chamfer side upwards, lay a piece of resin on it and hold it over a light until the resin is fluid, then slip it on to the cylinder; when it is set, remove the resin

from the bottom pivot with care and a knife, and with a horsehair and whalebone bow turn for the balance as shown at Fig. 1, C and D, hollow it out slightly, so that the balance will lie true and



firm, when the balance will go about half way on, put it on one side and turn for collet in the same way; leave a burr for riveting the balance, if necessary. Now put Fig. 3 in your turns, and



with a Geneve pivoting file (David Borloz, A. Vallorbes, is the best, cost 1s., at Stockall, 6 and 8, Clerkenwell-road) make your pivot, the bottom one first; be careful and don't file it off, as the files cut rather fast, and you will lose your pivot before you are aware of it; when you get it so that it will fit tight in the hole, commence to polish it with red stuff and a bell metal polisher, &c. Now try it, and it should just protrude a little way through the hole; if it is too long, shorten it by lightly rubbing it on a fine oilstone. Now round it off, which is done by putting the pivot through one of the top holes in Fig. 4, so that the end protrudes through, and with an old nearly smooth file round it off, as shown in Fig. 5, and polish; do top pivot same. Now heat a piece of wire, put it against the rose and it will come off easy; clean off the resin, take off the inside edges of your cylinder with your graver and polish the chamfer; now lay your cylinder in a hole on the shake, and put on your balance. See that the banking pin is at right angle with the cylinder (see Fig. 6), drive on with a spring punch (Fig. 7). To put a pinion in a steel wheel is just the same as putting in a cylinder. If you can do one you will know how to do the other.—A FELLOW WORKMAN.

[45154].—**Abyssinian Tube-Well**s cannot be driven through rock, and do not work well in stiff clay, which seals the perforations in the tube. In all other soils they are very successful.—DOROTHY.

[45155].—**Water Raised by Windmill.**—In reply to "Devoniensis," windmills have been, and still are, used to a considerable extent for drainage purposes in the fens. They are also used to a less extent for water-supply where pumping has to be resorted to, but are not so reliable as water or steam-power. Hence, windmills are only used for small works where water or steam is unavailable. At the International Agricultural Exhibition, held at Kilburn in 1879, two such mills were shown by English makers—viz., Messrs. Warner and Co., of Cripplegate, London, and Mr. C. L. Hett, of Brigg. The mill made by the latter was purchased and erected at East Fields Farm, Mitcham, Surrey, where, I believe, it has since been satisfactorily working.—Z.

[45157].—**Breaking Coke.**—The ordinary stone-breaker, as recommended, will not do, making too much dust and waste. I have a machine breaking coke by the action of splitting same by

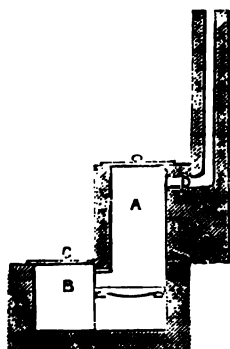
spikes, and should be glad to communicate method if querist likes to advertise his address.—**CONSUMIA.**

[45157].—**Coke-Breaking.**—If G. Church will advertise his address I will put him in the way of just the machine he wants cheap, made to break any size. A lad can work it, or it may be run with power, does the work in one-tenth the time it takes with a hammer, with less dust.—**T. N. C.**

[45160].—**L. and N. W. Engines.**—Princess Louise, April, 1877; Precedent, Dec., 1874; Skiddaw, Oct., 1874; Wildfire, Oct., 1874; Banshee, May, 1863; Violet, May, 1863; Glowworm, May, 1863; Prospero, Sept., 1873. The shed list next week.—**DIOMED.**

[45169].—**Melde's Curves.**—That there is no English translation of Dr. Franz Melde's book on Compound Vibration Diagrams, is much to be regretted. The title is "Die Lehre von den Schwingungscuren," &c., and the publisher, Johann Ambrosius Barth, of Leipzig, 1864. The illustrations are in a separate pamphlet of 11 plates, the first four of which consist of elementary diagrams, and illustrations of the earlier methods used to ascertain and indicate acoustic vibrations. The rest show initial figures of the ratios and phases of ordinary harmonic intervals from 1:1 to 1:4, as follows:—Plate 5, Vibrations at an angle of 45°; Plate 6, Vibrations at an angle of 90° (Lissajous); Plate 7, Parallel vibrations; Plate 8, Lower fundamental rectilinear, and the other elliptical; Plate 9, Higher fundamental elliptical and lower one rectilinear; Plate 10, As plate 8, but the amplitude of the lower fundamental much restricted; and Plate 11, Both vibrations doubly and equally elliptic.—**WASHINGTON TEASDALE.**

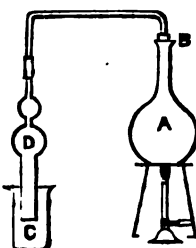
[45173].—**Melting Brass.—Driving Power.**—The usual brass-furnace is like sketch, A being a



chamber or furnace 15in. by 15in., and, say, 30in. deep to the firebars, and a space under that for ashpit of another 18in., say; B is the ash-hole, say, 3ft. by 2ft. and 4ft. deep; C is a grating to cover B, and which allows air to freely pass to the fire. The bars are carried on two wrought-iron bearers, with an arch on the masonry, as shown, to allow of the bars being taken out or replaced. D is the flue to the chimney. The plan you propose, to use the chimney for two purposes, will do so long as you have a damper to enable the furnace, when at work, to get the entire pull of the stack. A cast-iron cover is shown to close the top of the furnace, with a ring to lift it off by. Regarding the power, I should, if the stream is close to you, put up a float-wheel, with a movable hatch across the stream. This acts as follows:—One end of a stout swing-door, as it were, is carried by a pivot, and is capable of being swung across the stream obliquely. The wheel being equal to half the width of the stream when the swing-hatch is across the stream one way, the water does not drive the wheel, as the hatch being deeper, than the wheel, the water flows freely under it; but the wheel itself stands in comparative back water. If turned the other way across the water the surface flow of the water turns the wheel. If the stream be very wide a different plan would be necessary. But I should certainly prefer this plan of getting the power close at hand instead of carrying it 100ft. with shafting or wire rope. There is no engineering difficulty in the matter, so that you ought not to meet with any difficulty.—**SUNLIGHT.**

[45170].—**Estimation of Ammonia in Gas Liquor.**—The apparatus represented here will be required. Into the flask (A) measure 25cc. of the liquor, connect with the cork (B) attached to the chloride of calcium tube, hanging into the beaker, which may be standard or rough acid; the latter being the easier, I shall therefore describe that process. Into the beaker (C) put 5cc. of HCl with a little water, so as to cover the end of the CaCl₂ (D) tube; lastly, add to the flask 30cc. of caustic soda, 12 Twaddell, and replace the cork without delay. The whole now being ready to work, a low light is placed beneath the flask and allowed to boil for three-quarters of an hour, at

the expiration of that time contents of the beaker are poured into a porcelain or platinum-dish,



gently evaporated to dryness, and weighed. Calculate as follows:—

If of NH₄Cl equals of NH₃ what does Quantity found in Analysis.
53.5 17 x
The quantity found, multiplied by 4, equals the per cent. of ammonia, which, on reference to the following table, gives the ounce liquor.

Per Cent. of Ammonia.	Ounce Liquor.	Per Cent. of Ammonia.	Ounce Liquor.
.01	.046	1.70	7.82
.02	.092	1.80	8.28
.03	.138	1.90	8.74
.04	.184	2.00	9.20
.05	.230	2.10	9.66
.06	.276	2.20	10.12
.07	.322	2.30	10.58
.08	.368	2.40	11.04
.09	.414	2.50	11.50
.10	.460	2.60	11.96
.20	.920	2.70	12.42
.30	1.380	2.80	12.88
.40	1.840	2.90	13.34
.50	2.300	3.00	13.80
.60	2.760	3.10	14.26
.70	3.220	3.20	14.72
.80	3.680	3.30	15.18
.90	4.140	3.40	15.64
1.00	4.600	3.50	16.10
1.10	5.060	3.60	16.56
1.20	5.520	3.70	17.02
1.30	5.980	3.80	17.48
1.40	6.440	3.90	17.94
1.50	6.900	4.00	18.40
1.60	7.36		

—**J. C. BEICHER.**

[45175].—**Poultry.**—Heat the house by a method similar to that employed by gardeners for their greenhouses. Keep the temperature not lower than 53°, nor over 60° Fahr.—**EDWIN.**

[45175].—**Poultry.**—Your house is rather small; but if you have a fair height with it, you will find the following a good plan—at least, I have found it so. Get from Rippingille, or some other such firm, the smallest size paraffin stove they sell, only have the oil reservoir deepened, so as to contain sufficient quantity of oil to burn (for a maximum) say, sixteen hours. Use petroleum, or other mineral oil, place the stove in one corner of the house, and light it at roosting-time. It is necessary to have ventilation over the door. You will find that the fowls will greatly appreciate the warmth during cold weather, and that the stove will have the effect of stimulating laying. The cost of oil may be set down at from ½d. to ¾d. per hour.—**DEVONSHIRE SQUIRE.**

[45176].—**Boiler for Launch.**—It is a very difficult thing to advise you. A small boiler working in salt water requires very special designing, or, sooner or later, it would come to grief. My own choice would lie between a "Cochrane" or "King" boiler. But, looking at one or two points of great importance—viz., the removal of scale, &c., I should prefer the former. They make a special class of boiler, with a faced joint at the top of the shell, so that by lifting this off, the whole of the tubes can be got at, as the opening is the full size of the interior of the boiler. This, in conjunction with the way the tubes are set, would make the cleaning of the tubes and plates easy enough. The furnace crown would need arrangement to enable one to thoroughly clean it, and this could be done by three man-holes properly arranged—so that the whole of the furnace and fire-box could be got at to clean, as also the uptake to the tube chamber. Too careful precaution

could not be used to make the attend every part, and to be able to clean all too. Whilst on the question of oil mention that, for a similar requi working in salt and muddy water, I ad Paxman boiler, specially constructed, top to be lifted off with a faced joint. has been at work for some six years, now in thorough good condition. No forms on the water tubes from the rapi that goes on, and by taking off the to of both firebox crown and sides ar can be well and easily cleaned. As to boiler, I should advise a firegrate, say, shell of boiler 28in. diam., and height: the class, whether Cochrane or Davy-P any further information or sizes I w you decide on either of the types I na boiler would cost about the same price, I could recommend, with care in using, But salt water is very bad for any cla generator. Don't forget that if you allow to attain a density of more than a give the salinometer, you are running a gre matter what form of boiler be used.—**SC**

[45183].—**Heating Steam Launch &c.**—Such has been done, and the diff but slight to adapt it to an ordinary boile the usual horizontal return tube one. necessary is that arrangements be m supply of superheated steam, and that it allows a form of ejector to be so fixed the superheated steam, carrying with it the spray, may be delivered into the furnace. of firebars a series of inclined fireclay requisite, and the ashpit closed by a do air is admitted and regulated through fire-door. But the great drawback is must be either a supply of steam from pendent source at starting, or that ste up by making a fire on the fireclay; there are a few pounds of steam in t when, if carefully used, there would be difficulty, as the pressure would quickly the oil and steam were turned on. I steam and oil spray strikes on the firec where it takes fire and burns with a flame—so much so, that I have seen th tongues of flames just appearing in the s of a return tube boiler. Plenty of room in the firebox, and hence the taking ou bars and using slabs on the bottom of th tube. One of the most successful inst have on record is that of the boiler fite was originally Lord Alfred Paget's yel passing into the hands of the Governme boiler was fitted, to burn liquid fuel, by Olrick, and, having had the opportunit roughly testing the system in work, I ca so far, the system worked well, the only being the getting up steam at startu NIGHT.

[45185].—**Valve-chest of Pump.**—I pleased to give you an opinion; but unl sketch of the valve-box, I should not like a statement, as the opinion I have for your description might be entirely modifi ing a sketch. But if you like to forwar I would then try to help you.—**SUNLIGHT.**

[45187].—**Steam Boiler.**—As to the tion, the only way of dealing with that is anti-incrustator fluid, and so prevent forming on the plate. This would then down as soft mud, which you would be stated intervals. Nothing but a line would in any way prevent the forming scale or mud. There is one matter which I w the querist's serious attention to—it is the steam, as he calls it, from near one of the This is either a defect in the iron, or, w possibly a crack. In either case, I w strongly advise him to call in a thoroughly tent boiler-maker and ascertain what matter; if it was a pin-hole merely, it be at once stopped, as the plate be wasted away by the action of the leak is nothing that I regard with so much as apparently trifling leaks, unless they from a known cause, such as a badly-mad the manhole or mudhole: then we know matter, and should lose no time in y rights. If a weep in the plates the there must be either a crack or a w serious nature. Take my advice, w to at once. It may be but trifling it. Your last question I fail to you mean "is it necessary to gauge?" or what am I to under vacuum?"—**SUNLIGHT.**

[45193].—**Berthon's Metho Eye-pieces.**—If "Novice" address, I shall be glad to give him use of the Berthon Dynamom him, rather puzzled at first, but, explain it with a few examples.—

[45193].—**Berthon's Metho Eye-pieces.**—I suspect "Novice"

close to the eyelens, instead of 2 inches off. Let him discard this as a preliminary experiment on a sheet of white-gilted table; close beside the folded two-foot rule, so as to tance, on top of rule hold his eye with his eye eight inches up, look for the halfpenny by and his eye a little to and from, image of the halfpenny central, with a finely-divided drawing-hair of compasses, or (if he has a Dynamometer. I have just in this way, and the image of the 2-100ths of an inch, while a 2-100th, consequently the e.p.) on one foot, which would of 10 feet, 250 on five feet, and so on. I have just been remembering the fact from the fact-object to the eye will find between the fieldless to the end of the eyepiece itself. any e.p.'s and then checked the testing the total power of o.g. in the telescope, and have found very closely—L. L. L.

N. W. Engines and Sheds.—An only inform "Diomed" that a small Bloomer stationed at moth is another small Bloomer, ed" gave Kestrel himself only 52, a 6ft. coupled Ramsbottom. is a mistake for Penrith Beacon, cedent" stationed at Crews.—

N. W. Engines.—To "Ford Velocipede are at Lonsight a very few weeks ago. Dwarf, we, but am not sure.—DIOMED.

Electric Bells.—German silver is the electric contacts. However, it is for copper, and hard carbon is contacts should be kept clean and re.

Electric Bells.—Cannot recommend purpose. Silver answers very the price of platinum; but, rent is used in damp atmosphere is not entirely reliable. 1in. of g., costing about 8d. per inch, a pair of contacts, it would be t to use it.—R. T. LEWIS.

Comate Batteries.—If several ted together in one vessel of so would be improved; but even then one cell of a battery, not several suppose. A large vessel divided lls might be used as a battery, ntage in power over an equal e cells.—EDWIN.

Comate Batteries.—The loss w the batteries were arranged. ns and zinc couples can be im- arge round jar, if each is en- of paraffined paper, which goes of the jar, and when arranged for have nearly the same effect as if J. SUTCLIFFE.

l Circular Saw.—Very much rength of the operator as to the out. But with foot-power only, much as I should care to try. feed 2in. might be cut. I should off, a saw 6in. diameter, which large. Smaller than that would knes of bench, top and size of saw would run through deal or But a circular saw, even of small of power to drive it. If I was h a machine I should follow on had made some years ago. The diam., and weighed about 90lb.; in. diam. Mine stood on east- ample strength; but, to save be used, though not so firm. is made by a country firm at a l if you advertise your address I ostercard drawing their attention INLIGHT.

Sunlight.—You might com- engine in two ways. (1) By ndem engine; that is, taking off der, and, in its place on the on the new low-pressure one, and e present cylinder on the top, ming right through. This would er the connecting-rod and other enough to stand the increase of w low-pressure engine placed isting one, which would mean ft. And (3) if the addition of the an (1) would interfere with any ents. The first is the simplest o sizes, in the absence of any

information as to pressure in boiler, I should recommend that the new low-pressure cylinder be 8in. bore, and of course the same stroke as the present one. Air-pump must be in excess of the theoretical requirements, say, 2in. bore and 2in. stroke; would be best worked by a rocking-beam coupled to the crosshead of the engine. But do not forget that the condensed water in the condenser-pipes must flow into the pump by gravity. You would decidedly gain power to a considerable extent by compounding the engine, and if the boiler draft is at all as it should be you would not need a blower at work when the engine is running, as there would be less steam used in the high-pressure cylinder. I should not alter the propeller if the present one drives the boat all right. If you want any further information, will be pleased to give same, or any details of the arrangement to carry the high-pressure cylinder and valve-gear.—SUNLIGHT.

[45208].—**Harmonium Queries.**—This query is almost incomprehensible, therefore the querist can hardly expect a definite reply. What does he mean by saying his instrument is irrepressible? Generally speaking, the forte stops on harmoniums are entirely useless, and all that can be said in favour of them is that they may partly help to satisfy those persons who are extreme lovers of a display of stop-knobs. In the Trayser harmoniums the forte stops are of some use, as they are actuated on a different principle to most harmoniums. The querist asks how pedals are attached to harmoniums? Now, there are various ways and methods of attaching pedals. Some people like to have them merely attached to the keys, while others prefer a separate pedal organ. As I am now actively engaged in finding out a plan, which I have every hope of being successful in, of attaching pedals to harmoniums and American organs, I hope the querist will retain his patience for a week or two, when I shall no doubt be able to furnish him with all the necessary information respecting my plan of operation. There are various methods suggested in back volumes, but the plan I am engaged in will enable anyone, who is at all ingenious, to apply a pedal arrangement to their harmoniums without alteration or disarrangement of any portion of their instruments, and which can be detached at a moment's notice, if desired. The latter portion of the query I leave to those who are more experienced than myself to answer.—G. FRYKE, Swansea.

[45210].—**Dressing or Refining Cider or Perry.**—We refine cider in Cornwall by simply allowing the sweet cider to ferment in an open vessel, or in a cask with the bung left out, until all turbidity has subsided. Then we drain it off into a clean cask, or one that has held wine or spirits, and, in a day or so, bung the cask up tight. If the cider is to be bottled to keep for several years, it is best to put a little wine or some brandy with it. Good old cider is nearly equal to wine.—EDWIN.

[45211].—**Gas from Fluid Hydrocarbon.**—What you want is an air-gas generating apparatus, similar to those described in back numbers of this journal. All necessary is to get a steady supply of air at a low pressure, and pass same through a carburetting arrangement, which, by exposing a large surface to the air, causes it to become saturated with the vapour, and hence enables it to give light when burned. No purifying apparatus is then needed. By reference to the pages of the "E. M." you will find several plans that might suit you.—SUNLIGHT.

[45213].—**Electric Motor for Punkah.**—You could drive a punkah by connecting a cord from it to a crank driven by an electro-motor of sufficient power, or else by a large electro-magnet acting on a lever armature, to which one end of a cord was fastened, the other end of the cord being tied to the punkah. The battery would have to be some form of Daniell's, in order to be constant and able to do duty for a week or more without recharging. The question of expense could only be known by experiment. There have been several clockwork punkahs made, both with weights and springs; but an electric engine has greatly the advantage over clockwork, as two 7in. Bunsen batteries can do as much in 9 or 10 hours as a weight of 40wt. falling 20ft., and a clockwork machine of this power takes winding up, and is also expensive.—J. SUTCLIFFE.

[45215].—**L. & N. W. Engines.**—Peel, 127, is a 7ft. 6in. single Ramsbottom; Prospero, 414, Violet, 763, Waterloo, 748, Zygia, 418, and Sanspareil, 832, are 6ft. coupled Ramsbottoms. Lonsdale, 840, Latona, 927, and Trevithick, 492, are 6ft. singles outside cylinders; Sultan was a "Bloomer," 977, but I think it has been "scrapped." North Western, 1132, and Patterdale, 381, are 6ft. 6in. coupled Ramsbottoms.—DIOMED.

[45215].—**L. and N. W. Engines.**—I have not heard of "Macedon" before; there is a Mastodon, 479, one of Webb's 6ft. coupled engines. Peel, 127, is a 7ft. 6in. single "Lady of the Lake" class, I believe, but am not sure. Prospero, 414, is a "Pre-

cursor." Violet, 763, is a 7ft. 6in. single "Lady of the Lake" class. Waterloo, 748; Zygia, 418; Lonsdale, 840 are coupled engines, but I do not know their class. Sultan, 977, is a Bloomer, with 6ft. 6in. driving-wheels. North Western, 1132; and Patterdale, 381, are coupled engines. 1132 is a "Precursor;" and 881 a 6ft. 6in. Ramsbottom. Latona, 927; and Trevithick, 492, are 6ft. 6in. outside-cylinder engines. Sanspareil, 832, is a 7ft. 6in. single "Lady of the Lake" class.—FORTUNA.

[45215].—**L. & N. W. Engines.**—Patterdale, 381, and North Western, 1132, are 6ft. 6in. coupled Ramsbottoms. Prospero, 414, Violet, 763, Waterloo, 748, and Zygia, 418, are 6ft. coupled Ramsbottoms. Lonsdale was 840 and Sultan 977; both were 6ft. 6in. single engines. Sultan, I think, is still running from Euston to Watford. Latona, 927, and Trevithick, 492, if still running, are little engines, with outside cylinders and 6ft. single driving-wheels. "Fortuna" is in error about Cyclops, 805. She is a 6ft. coupled Ramsbottom, as "Diomed" said. This I can vouch for, as I have often travelled behind her. She used to be stationed at Shrewsbury, but, I think, is now up Preston way, unless she has gone back to Shrewsbury lately.—WILDFIRE.

[45216].—**Model Steam-Engine.**—The cause is that the steam-passage has broken into the exhaust, and hence the steam naturally takes the direction of least resistance by escaping there. Your best way is to get the cylinder off, and examine it to find the exact place, when very possibly it could be plugged with a piece of brass sweated in with solder. If you were living near me, I would put it to rights for you in a short time.—SUNLIGHT.

[45218].—**L. and N. W. Engines.**—Mabel, 619, and Breadalbane, 789, were built either October or November last year; I am not sure which month. Proserpine, 871, June, 1877.—FORTUNA.

[45218].—**L. & N. W. Engines.**—Mabel, April, 1880; Breadalbane, some time in 1880; Proserpine, June, 1877; The Auditor, August, 1878. The tender-brakes are only worked by hand, not by power.—DIOMED.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, "Lockstitch" has answered 44760, 44761, 44770.

- 44617. Vermilionette, p. 629.
- 44624. Lippman's Electrometer, 629.
- 44637. Thomson's Electrometer, 629.
- 44629. Tasmania, 629.
- 44622. Propane, 629.
- 44633. Barium Dichromate, 629.
- 44636. Boyle's Law, 629.
- 44637. Conic Sections, Fuckle's, 629.
- 44647. Iron Foundry, 630.
- 44652. Naturalists' Dredge, 630.
- 44656. G. W. Engines, 630.
- 44638. Hair Dyes, p. 98.
- 44643. Paper Type, 98.
- 44648. L. Y. R. Tank Engines, 99.
- 44653. Induction Coil Peculiarity, 99.
- 44663. To "Sperans," 99.
- 44693. Fitch of Screw, 99.
- 44691. Steam-Engine Indicator, 99.
- 44674. To "Sperans," 99.
- 44676. G. E. Locom., 99.
- 44677. Grass Snake, 99.
- 44686. Siemens' Dynamo Machine, 100.
- 44689. Case Blinds, 100.
- 44690. Midland Engines, 100.
- 44696. Paper-Making, 100.
- 44698. Jet Exhauster, 100.
- 44690. Septarian Nodules, 100.

Marking-Ink for Linen, Cotton, etc.—Red marks may be produced by dissolving 1 part of platinum chloride (platinum tetrachloride; formerly named "Bichloride of platinum," commonly used as a reagent) in 6 part of water, and to write with this solution upon the fabrics which must have been previously sized with a thin solution of gelatin or dextrin, then dried and ironed. After the writing has become dry a dilute solution of iodide of potassium is brushed over the marks. Purple marks may be produced upon linen by first saturating the latter with a solution of 10 parts of crystallised carbonate of sodium, and 10 parts of gum-arabic in 50 parts of water, drying and ironing. It is then marked with a solution of 1 part of platinum chloride in 15 parts of water, and when completely dry, the written marks are carefully and exactly traced over with a goose-quill pen dipped in a solution of 15 parts of crystallised stannous chloride (protobichloride of tin) in 15 parts of water.

QUERIES.

[45220].—**Annuity.**—Can any correspondent oblige me with an answer to the following question, which occurs on the papers for 1st B.A. and 1st B.Sc. Pass Exam. for July, 1881?—What is the present worth of a perpetual annuity of £10 payable at the end of the first year, £20 at end of the second, £30 at end of the third, and so on, increasing £10 each year, interest being taken at 5 per cent. per annum?—J. CHERRY.

[45221].—**Hanging Tubes in Fireboxes of Locomotives.**—Could any reader favour me with his experience as to the value of hanging tubes in fireboxes of engines of the multitubular class? Would it be possible to keep up a circulation so as to prevent the mud settling and caking?—Loco.

[45222].—**Indiarubber Hose and Steam.**—Would indiarubber tubing, two or three ply, be capable of standing steam at, say, 100lb. or 120lb., as delivery-hose for a water-lifter?—THOMAS.

[45223].—**Pistons of Fast-Running Engines.**—Would any of "ours" kindly give me his experience as to the best form of springs, &c., for pistons of fast running engines using dirty water like traction engines?—Loco.

[45224].—**Railway Passenger Carriage.**—Will any reader oblige by giving dimensions sketch of the underframes of a six-wheeled carriage, 4ft. 8in. gauge, with diameter of wheels, length of wheel-base, and distance from centre of axle to underside of frame?—JUVENIS.

[45225].—**Portable Oxygen Gas-holder.**—I exhibit the magneto-lantern from 50 to 80 times during the season, using the safety jet, and, in places where no coal-gas can be got, the oxy-spirit jet. I am trying, if possible, to do away with gas-bags, as they are very unhandy things to carry about: don't last long, and are easily damaged. Would "sunlight" kindly give a description of a portable gas-holder that would hold about 8ft., giving the sizes that would enable me to get it made?—A TRAVELLING EXHIBITOR.

[45226].—**Electric Fire-fly Lighting up Lamp.**—Will Mr. Lancaster, or any correspondent acquainted with the above, kindly describe its construction so as to enable me to make one? I have seen the lamp in use, but never had an opportunity of examining its interior. My idea is that it consists of an induction coil and a storage battery. If this surmise is correct, kindly state the weight of secondary wire required in the coil, and how to proceed to make the battery, with the method of charging it by a dynamo machine. The patentees, in their prospectus, say that when the lamp is fully charged it will light up 25,000 gas jets. Is this exaggeration or not?—JUVENIS.

[45227].—**Bisulphite of Lime.**—To "CHEMIST-1881."—In your reply (45223, Oct. 21) you state bisulphite of lime is made by passing a current of sulphurous acid into a solution of slaked lime, which sulphurous acid is produced by heating oil of vitriol and charcoal in a wrought-iron vessel. A fuller description of the utensils would oblige. How is the wrought iron vessel heated? and what provision is made for emptying it of the refuse? What should be the density of the solution of slaked lime? and, should the sulphuric acid be the ordinary commercial article undiluted? I want sufficient practical information to enable me to erect a plant and make, say, 50 to 80 gallons bisulphite of lime at a time.—H. W.

[45228].—**Magic-Lantern Slides.**—Wanted, to know best way to mount these for use, or description of a wood case in which glass slides could be shifted so that while one is being exhibited, another might be being changed.—JOSANA.

[45229].—**Engine Query.**—Will some of your readers kindly say which would be the most suitable kind and size of engine and boiler to put down for drawing two loaded eight-ton trucks up an incline 1 in 15 at a speed of five or six miles per hour? I may say that the engine and boiler would not have more than two hours work per day.—J. G. B.

[45230].—**Busted or Corroded Steel Ornament.**—I have a necklet composed of cut steel beads, which I lately had soldered together by a jeweller. About a week afterwards I found the steel beads at the joints covered with thick rust which I cannot remove and which must be caused by the salt used in soldering. Would any reader kindly inform me how to remove the rust, as it completely disfigures the necklet?—P. P.

[45231].—**Spring Clockwork.**—Will some independent fellow-reader help me in the following?—I want a piece of spring clockwork that will make a small hammer strike from 10 to 100 blows per second, with most of adjusting the number of blows. I have made one with 72 teeth on spring barrel, about 13-16 diam., working into a ten-toothed pinion. No. 8, B.W.G., on which is a 12in. wheel, 72 teeth, working into a six-toothed pinion. No. 13, B.W.G., on which is an escape-wheel pinion, 15 teeth moving an anchor escapement, on the arbor of which the hammer is fixed with a 1 1/2 in. shaft. This only gives me 21 blows per second, the barrel making one revolution per minute, and is not regular, and I have no better means of regulating the number of blows than by limiting the length of stroke of hammer. Is there any better action for the hammer than the one described? I am not limited to space, and want a heavier blow and quicker.—S. J. M.

[45232].—**Speed of Boat Engine.**—Will "Sunlight" oblige me by answering the following?—At what speed would an engine of 6in. stroke and 2 1/2 in. diameter, with boiler 2ft. 9in. by 12in. diameter, drive a boat 12ft. long, 2ft. beam, and 2ft. draught? Boiler pressure at 30lb.—NEMO.

[45233].—**Bleaching Oats.**—Would any kind reader of this valuable paper kindly inform me the proper way to bleach oats to make them look clean and white? State the quantity of sulphur per quarter of oats, if oats should be wet or dry, and if sulphur should be applied warm or cold, as I cannot get that nice white and clean

appearance, as I see some on the market? They call them Irish oats.—ONE WISHING TO LEARN.

[45234].—**Organ.**—To Mr. DRESSER.—I beg to thank Mr. Dresser for his reply to my query. I quite understand the arrangement, but will he kindly say why it is necessary to have the pneumatic bellows so large as 4in. by 2in. and whether they should be uniform in size throughout, or become gradually smaller upwards? I shall be glad of a hint as to how such windchests are connected with the keys?—C. W. S.

[45235].—**African Languages.**—Can any of your readers inform me how the "m" and "n" at the beginning of African words are pronounced in such words as "Mbu" and "Mpwapwa"—say the nearest approach in English sounds? I want to know if the "m" has any sound at all.—J. G.

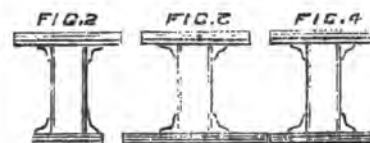
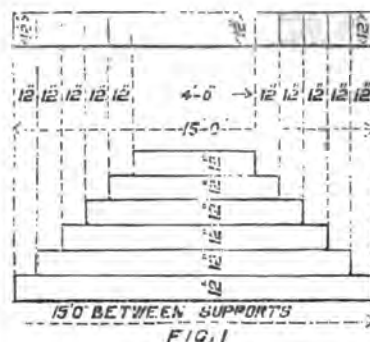
[45236].—**Dietetics.**—I have seen it stated that the Claimant now at Dartmoor has lost a great portion of his weight owing to the prison dietary, much to the benefit of his health and strength. I should like to know what the diet consists of, the quantity, and so on, and if it is generally beneficial to reduce people who are inclined to be corpulent.—J. G.

[45237].—**Lozenges.**—I want to know how to make black-current lozenges. I don't want a recipe out of a book a hundred years old, but the way they are made now. Does it require machinery?—CYRUS.

[45238].—**Raising Boiler Pressure.**—Thanks to "Sunlight" for his kind notice of my query (45041, p. 191). Would he, "Tubal-Kain," Mr. Wood, or any of your able engineering correspondents, be kind enough to assist me a little further? A-sunning the engine and boiler to be quite strong enough to stand the increased pressure, I am anxious to know what per cent I should gain by raising the pressure from 50lb. to 90lb., and where the point of cut-off would be, and the rule in plain figures for finding out the same?—NOVICS.

[45239].—**Non-Seconds Train.**—Many thanks to "Seconds' Practical Watchmaker" for his answer to my last question, No. 45079. I should feel greatly obliged if he would also mention the way to calculate a non-seconds train from third pinion 6, fourth 6, and 'scape 6. Also, if horizontals are calculated the same way?—E. P. A., Horologist.

[45240].—**Beams and Girders.**—Thanks to "M.I.C.E." and "J. H." for the information I have received from them through this paper on the above subject. I should like to know what would be the breaking strain in tons of the girders if they were in the sandwich fashion as "M.I.C.E." describes. I do not mean a correct answer, but one that will do for all practical purposes. I should also like to know what would be the breaking strain of a set of beams of oak (as in Fig. 1)



when the load is applied to the centre of them, (1) supposing the beams to be loose, one on the top of the other, and (2) when the beams are strapped together and made as if they were one solid beam. Also, could they give me a rule for finding the breaking strain of the girders (as shown in Fig. 2, 3, and 4) both for wrought iron and cast iron, and when the load is distributed and on the centre? In the wrought-iron girder there will be two webs in each, but in the cast-iron ones there will be only one web cast solid with the two flanges.—R. C.

[45241].—**Window Fernery.**—Will someone kindly give directions for warming by gas a window fernery about 8ft. by 2ft. 6in., and full height of window frame? It has tank in centre, with gold-fish; a moist heat, I suppose, is wanted. Also, will "Sunlight" kindly give description of his gas-regulator, which may be suitable for keeping regular heat in fern case.—S.

[45242].—**Small Dynamo-Machine.**—Will Mr. Rankin Kennedy, or any other of "ours," answer the following query?—Would a dynamo machine, such as described in "ours" of April 8, 1880, if constructed double the size given in that letter, generate a current of sufficient strength to light a Swan lamp? And, if so, what should be the number of revolutions per minute?—CYRUS.

[45243].—**Electro-Metallurgy.**—Will some kind subscriber inform me if, under the action of a strong current of electricity, a piece of platinum is acted on when immersed in a strong solution of cyanide of potassium and cyanide of silver, the platinum serving the pur-

pose of anode? I have tried it, and a platinum was dissolved off or corroded potash generated. Would it be so, or a HOBOLOGICAL.

[45244].—**Vertical Sawing Mach.**—make a small vertical sawing machine to lathe-bed and driven by connection with 4 1/2 in. centre, highest speed about 700 : minute. I propose to make the machine standard of beech, but do not know of what make the bearings or working parts as I melt iron or brass. I have heard that E type-metal, tinman's solder, or zinc will give castings for such a purpose, but am they would be too soft to withstand? could they be hardened by the additive stance while in a state of fusion? And, in what proportions? Will "Sunlight" gentleman, assist, and, if not asking too they would favour with rough sketch (dimension).—ROXBO.

[45245].—**Tin and Antimony.**—I obliged if you or any brother-reader could tell me the best way of melting antimony I have melted some, and I find that lump surface of the metal in the ladle: even is red hot it does not seem to affect the question is, What are these lumps? I have lumps out and broke them with a hammer as though it was some dross from the that the lumps are as hard as the antimony assistance would oblige.—E. COOK.

[45246].—**Antares Lighthouse.**—J. Lewis Wright kindly give a sketch of the lighthouse jet, with any improvement he And, will he say if the ordinary safety jet to the "Antares" jet? If so, how? I make my lantern as perfect as possible; he!—NOVICS.

[45247].—**Geology of North of S.**—What formation do the iron ores of Bilbao belong to? (2) How were these formed? the conditions under which the deposition (4) Is there any corresponding formation (5) What is the prevailing rock in the Pyrenees of some kind? (6) Which are the prime where chalk is developed both on Spanish sides? A brief reply to these queries w. T. G. F.

[45248].—**Spots on Speculum.**—Will "ours" with the necessary experience be speculum—a Brownings-With, 4 1/2 in. dia covered with spots, or rather small spaces had disappeared. I got it re-delivered six weeks ago to see the very same faults to keep it dry, never put the telescope away with the brass lid on the mirror. What is the may I prevent its extension or prevent for the future?—J. S. M.

[45249].—**Mitre Wheel Teeth.**—Will tell me how to cut the teeth of a mitre or b metal, as they are taper both in length a J. M.

[45250].—**Ice Yacht.**—Will someone be a sketch—with proportions—of an ice yacht possible and to cost two, the size of sail, also, where the runners and mast should be MAN.

[45251].—**Micro-Photography.**—A : directions wanted, chiefly with reference to dry plates be used satisfactorily, and is sun.—P. W.

[45252].—**Plaster of Paris.**—Is there process by which articles made of plaster of made to stand exposure to the weather? If one tell me the nature of such process or G. B.

[45253].—**Snider Bullet.**—I shall be glad if any subscriber will kindly give me the of flight of the Snider bullet for 100, 200, 300 yards range?—R. V. S.

[45254].—**Boiler Loco. Type.**—What is size boiler that can be made to burn coal and What is the proportion of the outside shell to the length and diameter of the horizontal ness of plates, and size of tubes to work square inch?—ROBERTO.

[45255].—**Surveyor.**—I am a teacher elementary school, but, being extremely fond of should much like to fill the office of a Local veyor. Would some of our readers kindly: course to pursue, and inform me what the duty veyor are?—OLD SUBSCRIBER.

[45256].—**Chloride of Zinc Bath.**—ROBERTO HANNON.—You stated you had a use, in No. 849, July 1. Would you please charged it, and how I can convert a bichromate—H. C. F.

[45257].—**Battery for Bells.**—To J. R. J.—On July 1 you stated you made a battery lozenge jar. In making one of these should tions be made of lead? Or, will an ordinary: ninal answer? And, would it be better if the was steeped in paraffin?—H. C. F.

[45258].—**Telescopical and Astronomical.**—To "F.R.A.S."—Can a parallel wire microscope with every eyepiece in a battery? And, also, if lens is applied to the eyepiece, is a lamp used illuminate the wires? What formula is there: lating the field of view of a telescope? We obtain the B. A. C., Argelander's, and the catalogues of stars, and Struve's catalogue of stars, and what is the probable cost of each: TEUT.

[45259].—**Surface Condenser.**—Will a brother-reader of the "E. M." inform me what of superficial feet area of tubing is necessary for condenser of a steam-engine with 17in. cylinder cutting off steam at one-third of stroke? Also,

any other information relating thereto, known.

Italian Loco. Drivers.—Would readers kindly state what prospect is for loco. driving for a young man and single, with ten years' experience in contract works?—A FIVE YEARS.

N. W. Engines.—Can any come with the dates of the following: London, Tiger, Alchymist, Chillington, Hotspur, General, Greyhound, Vandal, Diomed, Napoleon, Locke, Hero, sin, Caradoc, and Goldfinch.—FORD.

N. W. Engines.—Will some kindly give the numbers and classes of Anson, Balaclava, Boreas, Churchill, John Hampden, Di Vernon, Duke of Devon, Firebrand, Glendovey, Homer, Pinfish, Skylark, Snipe, Thrush, Ulysses, Vesuvius, Virago, Whittington, Zstock, Zephyr, Auckland, Sheldon, and "chiefly."—HAWKINS.

coal Blacking.—As I am unable to find from manufacturers, I have set up apparatus of my own: purchased the round same to an impalpable powder; satisfactory. Could any of "ours" be a cause of failure, and oblige? I used about 75 per cent. of oak.—LAWSON.

Midland Railway Express.—Some correspondent kindly give me the following engines:—No. 1472, 1473, and the two former are working the Nottingham from St. Pancras.—E.

Issues of Hardening.—Could some from experience good and practicable using gun-metal and cast iron? By so doing a great favour on inquirer, and readers of the ENGLISH MECHANIC, work devoted to the subject of hardening, would also be of great service.

Pneumatic Action.—Will Mr. A. working drawing (with sizes), and made and regulated for a pneumatic in No. 866, and how it is drawn on there any simple pneumatic action for sh.—G. H. S.

er.—Is it easier to push a carriage at or level line of railway with a load of wheels of 2ft. diam. than with wheels in correspond to answering the above from.—THOS. HANDBARTLE.

ray Curves.—Will any kind engineer tell me how railway curves are set? I have heard of setting out same by. Please explain what tangential angles are.—LAWSON.

of Fossils.—What is the probability of fossils—ammonites, belemnites, &c.—of the cliff at Folkestone?—CEPHALOP.

Cass.—Will any reader kindly make a small fern case for a kitchen: sorts of ferns I should have, with a management?—ONE IN THE COURT.

agon Card Tray.—Would any junior kindly inform me how to construct to shoot the edges of a hexagon cutting it together that the joints may be? The sides are to incline at an angle to the bottom, and make angles of 60° at each corner of the bottom. A ready assist and oblige me.—EDWD.

ro-Magnet.—To Mr. LAWSON.—me what weight of wire and battery are to make a straight magnet to lift

ng Hoops.—Will some practical best method of hardening the above to 13in. in diameter. The paper to be made of a hydraulic press, and the paper, and it is then forced through cast.—WALTER MATHER.

ground Cistern.—I desire to for rain-water in the ground about side. I propose to draw off the water on pipes fitted with metal taps. Perill inform me whether these from pipes in the brick and cement side so that large. I should be glad to adopt any plan.

r. Joseph Marples.—Many thanks full replies to my queries. The dynamo-electric couple make me anxious. Could I make a larger one suitable for? Could you procure the bars for be obtained here? If not, perhaps scribe the construction. If you would rouse your address, I would write you ANGLIAN.

ms Officers.—To C. S. COACH.—using this title, who replied to a query "E. M." kindly give me some information:—What are out-door officers of ed to Customs out-post clerks? When or the former likely to take place? see examination given? And, what shen to get placed on the list of candi-

m Canoe.—Would "Sunlight" that would be the cost of a good well-

finished boat or canoe (same as the one he proposes in last week's ENGLISH MECHANIC), including engine, boiler, and necessary furnishings to make a boat turn-out? Also, the speed it would travel (ten miles I should prefer), and number of persons it would accommodate?—NIDDALE.

[45378].—**Declination Circle—Equatorial.**—Let me assure "E. M." that I am very familiar with his instructions for the adjustment of an equatorial, and have often regretted that they came so suddenly to an end. I do not understand, perhaps, what he means when he assumes that "my declination circle has been rigidly and permanently fixed at right angles to the declination axis." In my case the circle is loose on a conical fitting, and can be made fast thereon so as to read anything. This conical fitting is on the far end of the declination axis from the telescope, and, if I am not trespassing too much on his good nature, I should like to know how to fix the circle, so that I may attribute all subsequent error to the polar axis.—J. F. E.

[46779].—**Colliery Management.**—I have a colliery in which I employ 32 men—16 men at each shift for two shifts. Am I breaking the law by having this number of men without a certificated manager? I am not certain whether the Act means that if more than 30 men are employed in a colliery a certificated manager must be kept, or, does it allow of 30 men at each shift? I am going to employ 30 men for three shifts, 30 men in all, but 30 only will be in the pit at once. Am I liable if I do not place a certificated manager over them?—VARI-TAS.

[45280].—**Lathe.**—I have a foot-lathe 3 1/2 in. centre, length of head-stock 8 in. I wish to turn squarer rollers and pick-shafts. Would some kind reader of the "E. M." inform me if the above is capable of turning rollers? And, also, could I attach an elliptical or oval chuck to the same for turning shafts? I should feel obliged if diagram of oval chuck was inserted, and how attached to back-poppet? Also, what book would assist me?—AN AMATEUR.

[45281].—**"Brush" Dynamo—Electric Machine.**—I propose to occupy my spare hours during the forthcoming winter evenings in constructing a small "Brush" dynamo-electric machine, and would feel much obliged to any of "ours" who would kindly inform me on the following points:—(1) I propose to make the armature 7 1/2 in. diameter. What size and quantity of wire, silk or cotton covered, should I require for above? (2) What sizes should the field-magnets be in proportion to the above size armature—size and quantity of wire best to use on said magnets? (3) How is armature mounted on shaft? (4) How are wires connected to the commutators? A sketch would greatly assist.—GALVANI.

[45282].—**Gelatine Dry Plates.**—To "FIXED RECIPE."—Some time ago, I think it was in the early part of Vol. XXXI., "Fixed Recipe" stated that he had tried making plates by preparing the silver bromide alone, and then adding it to the gelatine, as suggested by Captain Abney. I believe he said that the plates were dense and rapid, but that he fogged them because the dark room was not quite light-tight. I should be glad to know if he (or any one else) has tried the same method since, and, if so, with what success. The objection to this process seems to me to lie in the difficulty of mixing the particles of the solid silver bromide sufficiently intimately with the gelatine; otherwise it is, of course, a great simplification, as the long and tedious washing of the gelatine is avoided.—B. Sc.

ANSWERS TO CORRESPONDENTS.

* All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 31, Tavistock-street, Covent Garden, W. C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

* Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it. The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 9, and unacknowledged elsewhere:—

E. A. COSBOLD.—JAS. ROBERTS.—R. HENDLEY.—P. ARGALL.—J. T. GENT and Co.—W. H. BAILEY and Co.—CROSBY BROS.—J. FLAYLER and Co.—A. HUTTON.—J. W. CAMFIELD.—CASSELL, FETTER, and GALPIN.—A. HEYWOOD and Son.—A. BULLEN.—M. ROBIN.—A. CONSTANT READER.—CRESCENT.—H. BOOKER.—AN INQUIRER.—J. MAIN.—DEJECTED.—NIMROD.—PHOTOGRAPHER.—MAT.—E. T. SCOTT.—GUIDO YOKO.—JAS. BRYANT.—Geo. WILSON.—DONCASTER.—C. E.—H. C. S.—R. E. B.—DOROTHY.—AN OLD SUBSCRIBER.—A. N. H.—W. U. P.—JACK OF ALL TRADES.—IRON HORSE.—E. WILLIAMSON.—H. BARNABY.—F. T. N.—B.—W. L.—J. SUTCLIFFE.—D. H. G.

W. A. (You do not mention what metal it is; but you can either cover it with varnish of colour to taste, to be bought at any good oilshop, or coat the polished metal with lacquer. Apply the lacquer while the article is

hot, and don't go over twice with the brush.)—ALEXANDER. (Such information is to be found in the cyclopaedia. We could not afford space for it.)—DIDO. (Barium sulphide principally. About 6 to 10 hours. See pp. 471, 533, Vol. XXX.)—LAWSON. (See Messrs. Lancaster's advertisement last week.)—ENQUIRER. (Your questions were answered so recently as Oct. 14, p. 145.)—BATHWELL. (You could arrange the wires as required, but then how would you "call" the intermediate station? The Gower-Bell as transmitter, the Bell as receiver, or some of the instruments described in our back numbers. Two of the large-size Leclanché's would be sufficient. Read up what has been said in back volumes.)—H. SLOWMAN. (We fear you have not grasped the "Aperture Essays." (1) If you will turn to Parts I. and VII. (Nos. 842 and 888, p. 224 and p. 173), you will see that it is the *utilised* diameter of back lens that is to be compared with focal length, and not the full diameter without regard to what portion is utilised. If only part is at any time used, it is of course the same thing as if we had a back lens of reduced size. By varying the distances of the lenses of the objective, the utilised diameter of the back lens is varied also, i.e., the aperture. (2) In regard to the Abbe theory, you overlook the fact that the greater aperture of immersion objectives is entirely independent of any theory of vision, and that its existence is proved from the simplest laws of geometrical optics. If, however, you wish to realise a simple case showing the existence of a limit between the vision of coarse and minute objects you should read again Part IV. (No. 884, p. 511) and consider the identity of the phenomena of sound and light in respect to "shadows.")—J. THURGOOD. (No. 1 is steam regulator, and moves the cone in nozzle inside. No. 2 is water regulator. The steam is turned on by cock, and then the water, the supply of both being regulated by their respective wheels.)—SUSCARNUM. (We do not know of any books on the subject.)—J. H. MORRIS. (The *Analyst* is published by Baillière and Co., King William-street, Strand, W.C.)—G. FAYE. (Specification of the Albert Hall organ on p. 319, Vol. XXVII.; St. George's Hall, p. 320, Vol. XIII.)—SPARE TIME. (See p. 105, Vol. XXXI., for a description of one kind, and refer to p. 191, No. for Oct. 24, about cutting "music.")—F. BRANLEY. (The questions could be answered by an optician only after inspection. There is no reason why the eye-piece should not do, but it is doubtful whether it would pay to adapt the telescope to it.)—C. E. F. W. (You can use either the best copal or pale lacquer. If the latter, the parts to be covered should be made quite warm before applying the lacquer.)—J. G. (Cannot you try for yourself?)—INDIA. (You will find Ericson's solar engine fully illustrated in one of the back volumes of *Engineering*; Joy's link motion on p. 611, Vol. XXXI., and a suitable electromotor in recent back volumes.)—A. STUDENT. (There are other publishers who issue such works. Get the catalogues from Messrs. Lockwood and Co., Stationers' Hall-court, E.C.; and Messrs. Longmans, Paternoster-row, E.C.)—ANOMALOUS. (See p. 303, last week, pp. 33, 103, Vol. XXXII., and the indices generally. You will find details in No. 898.)—J. W. (You have probably an inferior make, but see p. 470, Vol. XXXII., and pp. 311, 587, same vol. Don't attempt to make emery wheels. It is cheaper and safer to buy.)—S. A. BAYZ. (To give hints how to make one of the instruments you require would occupy much space, but in back volumes you will find many described. If you can get the report for 1879 of the New York Meteorological Observatory, you will find several excellent recording instruments described, one of which we illustrated on p. 539, Vol. XXX.)—A WOULD-BE VENTURIST. (Try another firm, or advertise for them.)—KING PLUTO. (Several model printing presses in back volumes. See p. 631, Vol. XIII., for instance; but if you want to produce anything possible it will be economy to buy one of the presses advertised in our columns.)—H. A. P. (Yes, there are some notes in book volumes, but there is not much to say about it. The wood is steamed, bent to the required shape, and kept so till dry.)—E. STAFFORD. (You are impatient: as the query has not been answered, you must take it that none of our readers have made such a battery. We can, however, tell you that gas is much cheaper than the electric light produced by any battery.)—W. E. BARNOR. (You do not say what sort of a chair it is. If mounted on wheels they must be connected with levers, or the wheels must have a sort of projecting ring smaller in diameter which the invalid can reach, and so turn the wheels round.)—JUVENUS. (They are formed of sulpho-cyanide of mercury; lycopodium powder, most likely. Magnesium is a metal which readily burns when in a thin form. The other question is beyond us.)—O. A. T. ("D. H. G.'s" cutter holder was fully described and illustrated on p. 49, No. 783. That number is still in stock, and can be had post free for 3d., with index supplement.)—A. M. (It is one of the best books on the subject. As to the globes, you can buy them at many second-hand dealers.)—ELECTRIC MILLER. (Answered last week on p. 230.)—VELO APPRENDER. (What is the expensive power of the vapour of your volatile oil? and would not the cylinder and generator be heavier than Sir T. Parkyn's motor, which seems to have been extinguished by the decision that his steam tricycle must not travel at more than two miles an hour on public roads?)—P. W. K. (The oil, of course; why not ask what it is that freezes in water?)—YOUNG ENGINIERS, Bristol. (You want a strong spring in a barrel, such as those used for clocks, with a couple of wheels and pinions and a fan. You wind up the spring and regulate the speed by setting the vanes of the fan.)—GRINDER. (If both reeds and reed-box are missing, it is no doubt useless. If the reed-box is left, you may be able to get the reeds. Concertina reeds will not do. The answer last week was not for you. Search the Sale Column a few weeks ago, if American reeds are wanted.)—REED AMATEUR. (No effect upon pitch. See indices to back vols. Scales have been given on p. 568, No. 517, and elsewhere.)—W. H. (Do you mean the recipe on p. 520, No. 749? If so, it was 2lb. of shellac, 1 gallon methylated spirit, 6oz. camphor, 4oz. lampblack, and 2oz. Prussian blue.)—B. MORRIS. (See pp. 323, 346, Vol. XXIX. You require a pattern as a guide for the knife. The trade have a machine, but a brass globe and a sharp knife will serve your purpose.)—YOUNG PAINTER. (Yes, they always mean the same thing, but not necessarily the same quantity. You must study

of mathematics; but the papers commenced in Vol. XXXII. are elementary, and explain the principles of the various branches of the subject. (You can obtain full particulars of the Civil Service Commissioners. Apparently a good many think it worth while to try for a post.)—**ANSWERED** many times. Dissolve violet aniline in spirits or acetic acid, and dilute with water. If you use the acid, your pens should be preferably quills.)—**ANSWERS.** Surely the answer was plain enough. If you must use a resin varnish, you had better put on two coats, and see that no pinholes are left. What you have is probably asphaltum varnish, made by dissolving pure asphaltum in oil of turpentine or benzole. 2. If you mean Mr. Haden's paper on Etching, it is in No. 738. That was "artistic etching."—**T. W. B.** (No book of the kind. The process was described on pp. 17, 28, Vol. XXXII.)—**Tyro.** (You mean the anastatic process apparently. See p. 60, Vol. XXVII., and the index of that volume, which contains a good deal about zincography.)—**F. C.** (Details have been given in nearly every volume, and in recent numbers. It depends on the skill and perseverance of the amateur.)—**AMATEUR.** Edinburgh. (Full directions in several back numbers; but those who advertise the materials usually send out instructions. No book on so simple a matter.)—**CONSTANT READER.** (You cannot make every wheel without rather expensive plant, but you will find an account of their manufacture in No. 758.)—**W. W. W.** (White metal varies in composition, but probably you will find an alloy of tin 10, copper 1, and antimony 1, as good as any for your purpose.)—**H. A. P.** (You will find much information on the subject in back volumes. You can hardly expect a correspondent to go through the whole manufacture. What portions do you wish to make? See Fletcher's Catalogue.)—**A. B.** Some notes on the subject appear on pp. 570, 582, Vol. XXIV., but the best plan is to learn from a teacher. The clergyman of your parish will, no doubt, help you, failing others. The sound is always the same whether long or short, and is more like *u* than *i*.)—**M. F. E. WISS.** Burnt and raw umber and yellow ochre ground up with boiled oil and dryers to suitable colour. 2. Dry flour or carbolic oil. 3. Must see back volumes; polish with wax. 4. Equal parts of syrup of poppies, syrup of squills, and paregoric. A teaspoonful in water occasionally.—**W. B. D.** (See illustrations, pp. 101, 204, 327, Vol. XXVIII., and elsewhere in back volumes.)—**J. N.** (See p. 629, Vol. XXVIII., No. 468. The modern process is to effect the crystallisation while the tin is molten.)—**PASHAWAN.** (A similar query appeared last week, No. 45194, p. 219.)—**NO. G.** Sir Edmund Beckett's book on Watches, &c., published by Lockwood and Co., Stationers' Hall-court, E.C., price 4s. 6d.—**ELECTRIFIED WATER.** Medical coils are useless for the purpose unless very powerful. What size is yours?—**TOM AND HARRY.** The solicitor is in no way responsible for the non-service unless you can prove neglect, and we should think that would be a difficult thing to do.)—**ECHO.** (The "verbal agreement" will, we fear, not stand unless it was made before witnesses. You had better consult a solicitor, and tell him exactly what has transpired before taking action. After all, as only five months have been lost, it might be the wisest course to appoint the girl elsewhere, and this time not to trust to "verbal agreements.")—**HONORABLE.** (I believe and Horne, Aldenbury. 2. We utterly fail to understand how any "action of law" can apply to the case quoted, and are reasonably sure the tenant would find himself mistaken.)—**ORONUM.** (If the arrangement of the aria is copyright, of course you cannot publish it.)—**JIMMY.** There is no such book published. 2. Better write to the Secretary, Exhibition, though it is very doubtful if any such report has been made. 3. Buy and try half a pint. Surely that will be a quicker and more satisfactory solution than any amount of opinions that could be given by other readers.)—**LAWYERS LAD.** (The letter indicates no qualifications whatever, and can be assumed by anybody; but to become a "M.I.C.E." or "Assoc. I.C.E." you must join the Institution of Civil Engineers, full particulars about which can be obtained from the Secretary, Great George-street, N.W.)—**W. R.** (1, yes; 2, composition blocks are employed; but not with good results or in good work; 3, no.)—**E. COOK.** (It is impossible to ask Dr. Edmunds, or anyone else, to advise on such vague symptoms. Your friend is apparently asthmatic, and had better see a medical man.)—**CARRIERS.** J. W. H. (In type.)

F. WATSON. P. HELLON. A Band Rat. Your queries can only appear in the "Male Column."

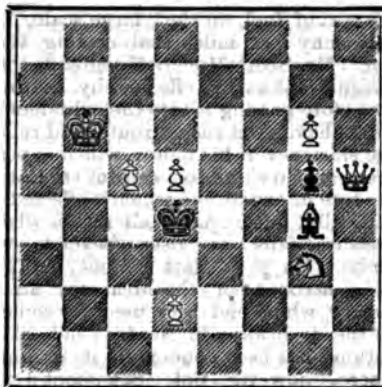
Imitation Flowers made with Liquid Films.
—A pretty experiment has been recently described by the well-known Belgian physicist, M. Plateau. He bends fine iron wire so as to present the contour of a flower of six petals. The central ring to which the petals are attached is supported on a forking stem, which is stuck in a piece of wood. After outdrying the wire slightly with weak nitric acid, the flower is dipped in glyceric liquid, so as to receive films in the petals and the central part. It is then turned up, placed on a table near a window, and covered with a bell jar. For a little at first it appears colourless, but soon a striking play of colours commences. In the experiment M. Plateau describes, the flower continued showing modifications of colour for ten hours, when dusk stopped observation. Next morning several petals had burst. The liquid used was of very mediocre quality. M. Plateau recommends preparation of the liquid thus: Dissolve a fresh piece of Marcellin soap, cut up into small pieces, in 40 parts by weight of hot distilled water. Filter after cooling, and mix thoroughly three volumes of the solution with one of Price's glycerine. The solution is then left till all air-bubbles are gone.

CHESS.

ALL Communications for this department must be addressed Chess Editor, 22, Chancery-lane, W.C.

PROBLEM DCCXI.—By C. PLANCK.

Black.

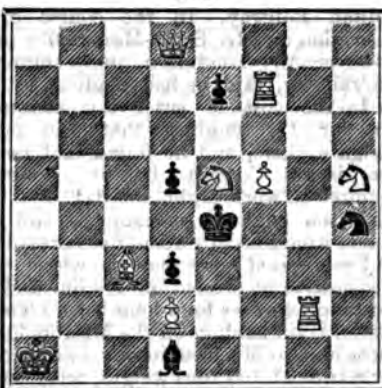


White.

White to play and mate in three moves.

PROBLEM DCCXII.—By F. C. COLLINS.

Black.

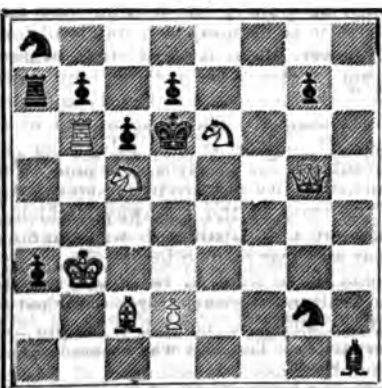


White.

White to play and mate in two moves.

PROBLEM DCCXIII.—By F. C. COLLINS.

Black.



White.

White to play and mate in three moves.

SOLUTION TO 707.

White.

1. Kt to Q 5.
2. R to Q Kt 6.
3. Kt to Kt 4 mate.

Black.

1. P takes Kt or (A).
2. Anything.
- (A) 1. K to Kt or (B).
2. Anything.
- (B) 1. B to B 7 or R 7 or (C).
2. Anything.
- (C) 1. Any other.
2. K move.

SOLUTION TO 708.

White.

1. R to Q B 6.
- Mate acc.

Black.

1. Anything.

SOLUTION TO PROBLEM BY B. G. LAWS.

White.

1. Q to Q 8.
2. Mate acc.

Black.

1. Anything.

NOTICES TO CORRESPONDENTS.

CORRECT SOLUTIONS TO 707 by W. J. Jubb, S. L., W. W., and C. Planck; to 708 by W. J. Jubb, S. L., P. T. D., W. W., and C. Planck.

H. P. (Manchester).—Yours is a true bill against 699.

"Tai."—B to B in problem 705 is of no avail if Black replies 1 B to Kt 4. In Problem 708 the Knight interposes. Problem by Mr. Laws cannot be solved as you suggest. You are right as to 706.

G. F. (Strood).—Have written you as requested.

PROBLEM 699.—Mr. H. Planck points out that this position admits of a solution not intended by the author.

1. Kt to Q 5.
2. R to Kt 6.
3. P moves, &c., if 1. K to K 1.

MR. COLLINS, the Chess Editor of *The Week's News*, has added one more to the few collections of Chess Problems in England. We are glad to be able to speak in the highest terms of this book, so far as we have been able to examine it. It is suited alike to the beginner as well as to the more advanced solver; the positions are natural, and not over-crowded; the solutions are pleasing and graceful. The best two-movers are, we consider, 3, 6, 7, 8, 12, and especially 15. No. 16 has, unfortunately, two solutions. We may mention that some of the problems have won prizes in different tournaments in England and America. The bulk of the book is taken up with three-move problems, which, on the whole, are the most pleasing class of composition. We extract one of these, not as being the best, but as a fair representative of the other seventy. The rest, making up the 107, consist of four-movers and sub-mates. The book is beautifully printed and got up. The publishers are Messrs. Wyman and Sons, 74, Great Queen-street, Lincoln's Inn Fields, and the price is 3s. 6d.

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good profit. The line would be worked on the rapid system; that is, instead of long trains at intervals, single vehicles would call at the stations nearly every two minutes; the fare would be uniform for all distances throughout Paris, and there would be no distinction of classes. Between the two stations above mentioned, is a distance of two and a half miles, and if an electric car can be worked over that length of line for fourpence, which is a small fraction more than 40 centimes, there is an important future in store for electric railways. As mentioned above, it is probable that an experiment at least will be made, most likely in the Boulevard Voltaire, which is now nearly completed, and if the Parisians are satisfied with that, they will no doubt put up with the disfigurement of their beautiful boulevards for the sake of the convenience of the railway. In this country it will be simply a question of cost, and if electric railways can be worked economically, they will settle the vexed question of motors for tram-lines.

THE THEORY OF THE TIDES.*

ALTHOUGH the phenomena of the tides have engaged the attention of scientific inquirers for many years, the subject is not yet well understood by those who are more immediately interested in it: hence the paradoxers have often worked it, to the mystification of their hearers, and it may be to their own benefit. Mrs. Somerville wrote of the theory of the tides, as she knew it in her time, as a "reproach to science," and even Whewell, in his "History of the Inductive Sciences," complained that no one had sufficiently explained the questions involved. The late Sir J. W. Lubbock wrote a treatise which may be described as the foundation of the modern theory, but that work has long been out of print, and the literature of the subject is to be found only in papers to societies, and in isolated tracts and reports, which are generally inaccessible. The "art and mystery" of calculating the tides was indeed regarded as a secret, or as a family possession, to be handed down from father to son as a sort of heirloom, and any attempt by an outsider to supply tables by which the officials of any port could calculate the tides for themselves, was resented as an infringement of the rights of property—at least, so said Dr. Whewell, who did his best to impart his knowledge of the subject by mapping what he called "co-tidal lines," or, in other words, the contemporaneous position of the summit of the great wave which brings high water to the different parts of our coast. The Rev. Jas. Pearson, vicar of Fleetwood, has, for the last ten years, made a series of observations on the tides, and has compared them with the calculations as worked out by the theory. The result is a treatise based upon that of the late Sir J. W. Lubbock, which really puts the whole matter clearly before the reader, and which moreover contains a new method of computing the heights of high-water at Liverpool, and the factors for calculating the same at other ports. This method of computation has been proved to be true, and having been adopted and tested by the Admiralty for some years, will appear in the next issue of the Admiralty Tables. So far as we can see, Mr. Pearson does not waste a line; he has condensed within about 40 pages, a clear and comprehensible theory of the tides, together with tables for computing the time and height of the tide at Liverpool, and has also contrived to make his work readable and historically interesting. All who have visited the seaside, or have frequented the banks of tidal rivers, know that twice in

each day as a rule the water rises, and becomes what is called high tide. We know that this motion of the water is connected with that of the moon, and we find that if the interval of two successive passages of our satellite over a given meridian be termed a lunar day, then there are two high tides in that interval of time—as a rule. The time of the moon's synodic revolution is, however, 29.53 days, and consequently the mean interval between successive high tides is 12h. 24m. 22s.—a fact which explains why on two days in each month there is only one high tide, instead of two. Thus, for instance, if high water occurs at 11h. 45m. p.m. on Monday, the next high tide will be at 0h. 10m. p.m. on Tuesday, and the following one will occur on Wednesday morning, so that on Tuesday there will be but one tide. The interval which elapses between the moon's transit of a given meridian, and the time of high water, is subject to irregularities, which depend mainly on her angular distance from the sun; the distances of both bodies from the earth, as also their declinations, exercise effects upon the tides, the best known of which are popularly distinguished by the terms "spring" and "neap." Thus, when the moon is in conjunction with the sun, and both bodies, so to speak, pull the waters in the same line, we have the highest or "spring" tides; when the moon is in quadrature, and pulls the waters in a line at right angles to the line of attraction of the sun, we have "neap" tides in which the water at "high tide" fails to reach the mark set by the "spring" tides. Sufficient has already been said to show that the calculation of high water is not a simple matter; but the question is still further complicated by the fact that the height of spring tides varies with the different seasons of the year, being at a maximum during the Equinoxes when the sun is near the Equator, and the moon also crosses it at full and change, and at a minimum in June and December, when the sun is furthest from the Equator, and the moon is also in a similar position at full and change. The connection between the moon and the tides appears to have been noticed in very early times, although references to the subject in ancient authors are few and scanty. Herodotus, in his description of Egypt, notes the fact that in a bay of the Red Sea the "tide daily ebbs and flows," which would be a novelty to those who were acquainted with the Mediterranean only; but Pliny not only mentions the fact that the tides of the ocean ebb and flow—he says distinctly that the cause is in the sun and moon. The venerable Bede was able to correct an error that the tide rose in all places simultaneously, by observing that on the eastern coast of Britain the great wave was propagated from the north to the south, and that it reached the mouth of the Tyne before it washed the coast of Deiri. Kepler, Galileo, Wallis, and others had theories, or rather hypotheses, of the tides, and Bacon said that the phenomena had been attributed to the influence of the moon by "common but unsupported conjecture." Flamsteed, however, when Astronomer-Royal, computed a table showing the true time of high-water at London-bridge for every day in the year 1683; but to Sir Isaac Newton belongs the honour of expounding the true theory of the tides, or, at least, the principle on which it is based. Bernoulli's treatise contained a table for computing the times of high-water, and it is probable that it was utilised by those who, at different ports in this country, made the computing of high-water tables their profession. In chronological order we next find Laplace, who devoted much attention to the general theory without applying it to the construction of tables; then comes Sir John Lubbock and Dr. Whewell, followed by Prof. Haughton, Prof. Galbraith, Sir W. Thomson, and last,

but not least, the Rev. James Pearson. The history of the subject occupies the first chapter, the general theory forms the second, and in the third we find the "new modifications" introduced by the author. Mr. Pearson recognises four sets of tides: (1) a lunar tide, swelling under the direct action of the moon; (2) an anti-lunar tide, swelling under the obverse action of the moon; (3) a solar tide; and (4) an anti-solar tide, and each of these has its peculiarities, which the author explains, as far as is possible. As land predominates in the northern hemisphere and water in the southern, it is clear that the magnitude of tides produced in the two hemispheres will be very different; and further, the direction of the Moon's motion makes a difference, far, as she advances from south to north declination, crossing the Equator at an angle of 23°, and sometimes at 18°, her line of motion approximately coincides with the general trend of the Atlantic Ocean at the time the Earth's motion brings that portion of the globe directly beneath her; while as she declines from north to south, her course is diagonal to the former one, crossing the Atlantic approximately in the direction of its breadth, whereas in the former case she crossed in the direction of its length. In outline that gives an idea of one point in the theory of the author, which is explained by means of diagrams and tables in the chapter. Another chapter is devoted to the mathematical investigations of the subject, and is accompanied by an illustration of the "tide predictor," which is shown to be inefficient for the purpose intended, unless indeed two machines are employed, one for lunar and the other for anti-lunar tides. The fifth and last chapter is on tide measurements, &c., and appendices are the tables referred to, which are identical with those about to be issued by the Admiralty. Into the actual method of computing the tables we cannot enter here, but we can recommend all who wish to understand the theory of the tides and to have it placed before them in a few words, to procure the book whose title is given below.

THE PARIS ELECTRICAL EXHIBITION.—XI.

THE exhibition will be closed on the 20th of this month. Some new machines have been recently put up. Edison's 100-h.p. machine, the largest in the exhibition, is one of the new-comers. An electrical lift, worked by a Siemens machine, is also a new addition to the exhibition. One of Edison's newest and most interesting inventions is his autographic telegraph. He makes use of a rotating cylinder and a chemical paper for receiving. The despatch or drawing is made upon an ordinary slip of paper with a hard lead pencil, and is put on the transmitting cylinder, which rotates in front of a point. Whenever the point falls into the small grooves which have been made by the lead pencil, a very delicate apparatus closes the circuit. The drawing is of course repeated point by point, as in all autographic telegraphs, the great novelty being that no special paper or ink is required for transmission. Our readers will, no doubt, have the opportunity of seeing this apparatus at the Electrical Exhibition which is about to open at the Crystal Palace. Great facilities have been given to the exhibitors for transporting their apparatus. I should very much have liked to see Crookes' experiments repeated at Paris during the exhibition; but although a few radiant tubes have been exhibited, these interesting experiments have altogether been neglected. I should also have liked to give new information to our readers upon dynamo-machines. Unfortunately, we have not much new to record. The Gramme, Siemens, Lontin, Crompton, Weston, De Mottens, &c., machines have already been described in the ENGLISH MECHANIC by able writers. I have nothing to add: no comparative experiments have been made; no measures, either

* An Elementary Treatise on the Tides. By JAMES PEARSON, M.A., F.R.A.S. London: J. D. Potter.

electrical or photometrical. A splendid opportunity of forming a trustworthy table for comparing the different machines has been lost. Nevertheless, great advances have been made in the electric light, especially in the incandescent lamps. Much progress has also been realised in telephony, and several good apparatus, which without the exhibition would perhaps have taken years to make their way, have been at once brought to light. The problem of the transmission of electricity to distance still remains open; and although electric railways have had much success at the exhibition, no steps have been taken as yet for the permanent establishment of an electric railway in Paris.

A series of lectures have been given by eminent electricians, such as Count du Moncel, Mercadier, Hospitalier, Lartigue, Gariel, &c. Unfortunately, these were "promenade" lectures, and the confusion arising from 400 persons rushing from room to room after the lecturer may easily be imagined. Why waste the time of eminent men in this way? These lectures, given in the quiet of the lecture-hall, would have been most profitable. I hope this absurd fashion, inaugurated in 1878, will be discontinued. Surely there is no difficulty in bringing the apparatus for demonstration into the lecture-hall. As to electrical tramways, and all such big pieces, a few models and diagrams will make them understood in the lecture-room.

C. Detaillé.

CROOKES'S INCANDESCENT ELECTRIC LAMPS.

AMONGST the ranks of the patentees who have devoted their attention to the production of carbons for incandescent lamps we have to rank Mr. Crookes, F.R.S., who has recently protected a method of preparing the carbon and the glass envelope in which it is inclosed. It is well known that carbons used for electric lighting should be as pure, and as homogeneous as possible, and that is especially the case when they are to be used in the incandescent form, whatever shape they may have. The chief source of impurity is the inorganic constituents or "ash." In the incandescent lamps of Swan, Edison, Maxim, Lane-Fox, and others, a filament of vegetable fibre or cellulose, either natural (as bamboo fibres) or in a manufactured state (as thread, paper, or parchment-paper), is carbonised in a space free from oxygen, by which the oxygen and hydrogen of the cellulose are driven off and the carbon is left behind. Carbon is infusible and unaltered at very high temperatures. The inorganic constituents of the cellulose, consisting, amongst other things, of silica, iron, lime, and other bases are not driven off by heat during the process of carbonisation, and remain with the carbon. These impurities are injurious in various ways; they cause the glass to become dim and the carbon to disintegrate and finally to break.

If the temperature does not rise to the reducing point of the oxides the silicates fuse and coat the particles of carbon, interfering with its conductivity, with its emissive power for light, and with the deposition of fresh carbon from the decomposition of hydrocarbons. In the arc light the carbon burns away, and the silicates and other constituents of the ash fuse and accumulate till they fall off, causing flickering or temporary stoppage of the light. Or the constituents of the ash decompose and volatilise, colouring the electric light irregularly and in an unpleasant manner. All these inconveniences Mr. Crookes claims to have obviated by previously removing the constituents of the ash, which is done either while the material is in the undecomposed state or after carbonisation. In the former case he takes the fibre of bamboo, hemp, linen, paper, thread (whether parchmentised or not), or other form of cellulose or other body containing carbon from which it is intended to manufacture the carbon, and allows it to soak in hydrofluoric acid until a sample removed and washed free from the acid leaves very little or no inorganic ash upon being burnt. A little hydrochloric or other acid may be added to increase the solvent power upon the constituents of the ash other than silica, care being taken that it is not sufficiently strong to attack the cellulose itself. Instead of using hydrofluoric acid a mixture of a fluoride, such as fluoride of calcium or fluoride of sodium, and an

acid capable of liberating hydrofluoric acid from it (but not of attacking the cellulose) may be used, or the substance to be operated on may be exposed to the vapour of hydrofluoric acid as usually generated by acting on fluor spar by oil of vitriol, or other equivalent method of exposing the substance to the action of hydrofluoric acid may be employed. After being acted upon for a sufficient length of time the material is well washed in water to free it from acid.

If it is desired to operate on the material after carbonisation, it is necessary that the carbon should be in the form of a fine powder or in extremely thin filaments or sheets, such as those produced by carbonising thread or paper. The process is then the same as that above described, the carbon being afterwards made up into discs, sticks, or rods for use in arc or other lamps. It is not practicable to act upon the sticks themselves as their thickness and density prevents the success of the process. The inorganic ash may also be removed from the carbon by heating it to redness or whiteness in a suitable vessel containing free chlorine or through which a current of free chlorine is passed. If free oxygen or an oxidising atmosphere be present at the commencement of the operation the carbon will remove the oxygen by combining with it in the process of combustion, but it is preferable to remove it before the operation commences. Hydrochloric acid will act in a similar way to free chlorine, but less energetically. The carbon must be in the same state, as previously described, in order to insure its being completely purified by the chlorine or hydrochloric acid.

In making the vacuum in the vessel containing the carbon filament of an incandescent lamp, great difficulty is experienced in getting rid of the residual gas. This gas may be ordinary atmospheric oxygen or nitrogen, or it may be carbonic oxide or carbonic acid derived from the combustion of portions of the carbon, or it may be aqueous vapour or any other gas occluded by the carbon filament or the metal conductors within the glass. When the exhaustion is carried to a high degree it is extremely difficult to predict what will be the nature of this residual gas. The bulk of the occluded gas is got rid of by the ordinary process of heating the filament electrically during the progress of the exhaustion, but this method is not capable of removing the minute traces of residual gas above referred to.

To accomplish that Mr. Crookes incloses in the bulb of the lamp, or in a chamber forming part of the lamp and connected with the bulb, a small quantity of some substance having a more or less general power of absorption of gases. Thorina, heated to a degree below redness, possesses this property in a remarkable degree, and alumina and many other earths have a similar property. If the substance used has a marked preference for some one gas, as some forms of alumina have for aqueous vapour, he exposes the substance to this gas before using it, so that it may be charged with it when first put into the lamp. After introducing the absorbing substance into the lamp he exhausts the bulb in the ordinary way and with the usual expedient for expelling the occluded gas from the carbon filament. When the exhaustion is tolerably complete, say, to the one ten-thousandth part of an atmosphere, the absorbing substance is heated by applying the flame of a spirit lamp or other source of heat to the part of the glass where it is situated and the gas occluded in it is driven off. The bulb is then re-exhausted as completely as possible, the heat being continued during the process. The bulb is then sealed off and the substance on cooling absorbs the residual gas in the bulb. By this means the exhaustion can be easily pushed to a degree that would be impracticable by the use of a pump only. Instead of putting the absorbent material into the bulb of the lamp itself it may be contained in a vessel permanently attached to the pump, so as to be in connection with the bulb of the lamp during the process of exhaustion. By the above process it will generally be found easy to produce a very perfect vacuum, such that it will not permit an induction current to pass, which will strike across several inches of air. But the process may be varied by admitting into the lamp after the first exhaustion has been effected (either with or without the aid of the process above described), some gas for which the absorbing substance has great absorbing power and then heating and re-exhausting as before. In this way many absorbing substances which

have not the power of general absorption to any great degree, but have a marked affinity for some special gas or vapour, such as charcoal, spongy palladium, or phosphoric anhydride, may be used with very satisfactory results. Incandescent lights in so high a vacuum as this last longer than in ordinary vacuum as obtained by the mercury pump.

PRACTICAL NOTES ON PLUMBING. XIX.

By P. J. DAVIES, H.M.A.S.P., &c.

Inside Work, or Sanitary Plumbing.

WE now come to the bath-room, Fig. 120, 55, which has the handles of the cocks fixed over the top part of the foot, as at 42 and 44, 43 being a pull-up quick waste. This waste discharges into the coffee-pot trap 56; also shown at Fig. 95.

It discharges into the 1½ in. B.W. (bath waste) pipe, with not less than 10 ft. of vertical pipe, to cause a draught, and from this into the waste-pipe W, and to the gully-trap Fig. 122. All the fittings in the above diagram will be referred to hereafter separately.

The bath stands upon two pieces of quartering 47, 47, and these pieces of quartering are laid upon the lead safe 48. The hot and cold-water pipe connections are made with lin. stout lead pipe 57 and 58, and with wiped joints on the linings.

At the head of the bath is fixed a washing-basin, having hot and cold water-pipes C S and H S, with taps 49 and 51 fixed over the top.

50 and 54 is a quick waste, screwed to a board below the basin, and the board fixed to the wall, &c. This quick waste should have at least a 1½ in. clear water way, and run into some kind of trap that will not momentum out, should the handle of the waste be suddenly raised and then let fall, to let out the water to a proper washing level or height.

Here great caution is necessary, for the reason that should the trap momentum out and the water-seal be broken, the gas can freely pass up and through the overflow-pipe, O F, thence through the overflow-holes in the basin. Here suppose a person to be washing his or her face, and the consequent results.

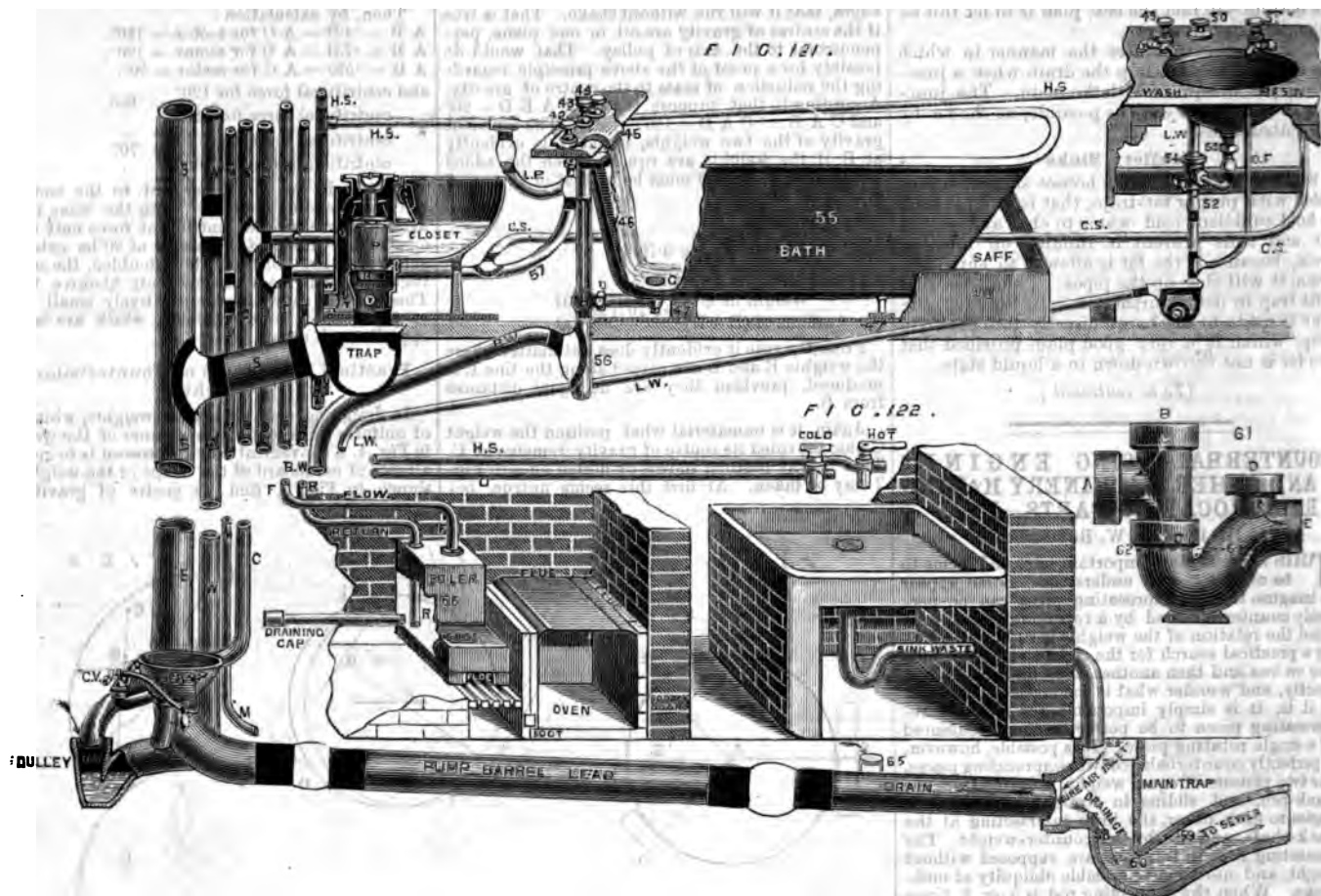
If you trace the run of the H S pipe you will notice that it is taken off the bath supply, from off the top of the hot-water tank at 23. Should you require these pipes to be always hot and the same temperature as the water in the circulating (hot-water) tank, you must take the H S pipe back again to another part of the tank; but it must be remembered that a difference in the levels must be made in order to get a flow and return; at the same time you must be very careful not to have any of the pipes trapped.

At the foot of the bath is fixed one of Jennings' trapless closets, but over a U-trap. This closet is supplied from the closet-cistern (see Fig. 120). The whole of the pipes are so arranged that not one of the pipes hides another, but may be seen or got at for repairs or otherwise at any moment.

The overflow from the bath should discharge over a head outside, as also the closet safe overflow; or if it must, as will sometimes happen, be taken down the inside of the house, let them be taken to a sink or other place where a constant supply of water can be depended upon, should there be any kind of trap employed. If the washing-basin is left unused for a season or a length of time; for instance, during the absence of the family, &c., it would be best for perfect safety to use a ball-trap like Fig. 103, but not like Fig. 102, because, as will be easily seen, one will cease to act when there is not water, while the other acts best without water.

There should at all times be a closet on each floor, and as near the staircase as possible, so that it is within an easy distance of all the rooms, especially the bedrooms. On the dining-room floor there should be a closet, urinal, and washing-basin, and the same near a billiard-room; and, if possible, in all cases keep the urinal distinct from the closet. Most of the water companies in and about London enforce the use of "water-waste preventers" to both closets and urinals, and where this regulation is enforced they invariably insist upon the use of ball-valves instead of ball-cocks.

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Servants' Closets.

Though my articles are supposed, and *de facto* are intended to instruct plumbers as to the best method of fixing any kind of work that may fall in their way, I must beg to be excused if occasionally I depart from the absolutely practical path, and endeavour to show, from moral reasons, why this, that, or the other is necessary and requisite. The question of servants' closets is more important than *prima facie* it may appear—viz., There are many servants who, whether male or female, are particularly delicate in visiting a closet if seen by the opposite sex. This is by many persons of a more obtuse temperament, considered "false delicacy," and, possibly in this respect they may be right to some extent, as of course, the requirements of nature are common to us all; nevertheless, that this delicacy does exist is beyond any argument, and as the want of closet convenience is mainly the cause of the discrepancies in the action of the liver and consequent indigestion, biliousness, congestion, &c., I have thought it politic to preface my instructions on this most important point with the reasons why they should be strictly attended to.

In large houses, where servants of both sexes are employed, it is usual to fix the closets for males and females in the basement, and where practicable, the better method is to place the closets for one sex in the front, and the other sex at the rear of the house. The advantage in this arrangement does not consist only in the sanitary advantage already alluded to; but it also tends to prevention of unseemly familiarity amongst servants that would otherwise exist. I am, of course, conscious that it will sometimes happen that on account of the construction of a house, it is not possible to follow my instructions by placing male closets at one side of the house, and the female on the other side, but at any rate they should be so arranged that they are not both within the same range of sight.

The above diagram illustrates the plumbing work in the basement of a house, showing the soil-pipe S, brought down with a bend at the bottom, and in this case continued under the house with 6in. pump-barrel, instead of drain-pipes, and carried on to the interceptor or main-trap. This trap effectually cuts off all sewer-gas from the house, which will be evident to anyone

if they will notice the water within the well or cesspool part of the trap as shown at 58 and 59. It will readily be seen that if any sewer-gas does pass from the sewer it must come through the water, as it cannot get through the diaphragm (60). Not a little advantage attached to this trap is that it prevents, to a great extent, rats making way up the drains into the house (122).

When selecting these traps it will be found best to choose like Figs. 93 and 94, having a drop from the inlet (61) to the water-line (58)—that is, when the drain and pipes run in a right line, as here shown. Mr. Buchan makes a very good trap, as also Mr. Stiff (Weaver's), and Messrs. Doulton (the Croydon) for straight run of drains; but supposing the drains do not run in a right line, or that you cannot get any of the above makers' traps, you can easily overcome the difficulty by the use of an ordinary trap and a square junction, as shown at 61. This has exactly the same effect, and in many cases answers better. Mr. Jennings being conscious of this, is making the trap and a short square junction (J 61, Fig. 122), which may be turned to suit any line of drainage. The dotted lines 62 and 63 show the water-line D, the sewer ventilating socket B, the socket to receive the round grid. A is the inlet to the trap.

Ventilation.

Now that we are at work with the main-trap it will be as well to prepare for the ventilation of the drains, soil-pipes, &c. This is a point that should never be overlooked, for however good the inside work may be, if the pipes are filled with bottled-up gases of a foul and poisonous nature the whole system is bad and unsafe, to say nothing of the rapid destruction of the leaden-pipes, &c., which otherwise will last ages. (See my letter on "Sanitary Plumbing," July 8, 1881, p. 57 of the *Building News*.)

I must now refer you to the pump-barrel drain and main trap (Fig. 122). The simplest, and, in my opinion, the best method of ventilating is the old plan, that can be seen in hundreds of our old buildings. The main drain has an interceptor trap—that shown in Fig. 122 answering the purpose. Next we find the tops of the soil-pipes are made to answer a double purpose, for taking away the rain-water and for ventilation. At the bottom, near about the stump (65), and often at the trap, is fixed a short

length of rain-water pipe, and taken into the drain, though not unfrequently is that to be found an open grating, fixed directly over the top of the drain.

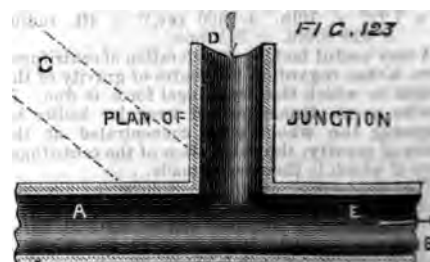
Now let us examine the much-talked-of new system of ventilation, known as "foot ventilation," &c. On again looking at the main trap you will notice "pure-air inlet." The arrows show that the air is passing down through the socket, and away along the drain, up the soil-pipe, and out at the top, which should be the highest of a building, as at 27, Fig. 120. This is a true and most simple method of ventilation, totally unfettered by patent law, and with nothing to prevent its being used in the humblest dwellings.

The only thing necessary is to fix the lead pipes with a continual rise, without a lot of bends, more especially sharp ones, as they are great enemies to ventilation. Continue the soil-pipe the same size to the highest part of the building, taking especial care that no branches enter this pipe unless they are properly trapped.

If you examine the waste-pipe (W) you will observe that it discharges over the mouth of a gully-trap, which enters the main drain. Here again is foot-ventilation, the inlet of fresh air being indicated by the arrow passing onward through this pipe, and discharging itself at 25, Fig. 120.

Servants' W.C.'s.

The servants' w.c. also also enters the main drain, but at an easy angle, so that none of the



soil from this w.c. can wash back up the main drain (this applies to all branches). Never let a branch enter the top of a 'drain-pipe, but near

the bottom—in fact the best plan is to let this be down in a bed line.

A, Fig. 123, illustrates the manner in which the sewage runs back up the drain when a junction is put in square with the main. The junction should be as easy as possible, as shown by the dotted lines.

Scullery Sinks

Scullery sinks in large houses should be provided with proper fat-traps, that is, a large tank to hold sufficient cold water to chill and set the fat, and thus prevent it running off into the drain, because if the fat is allowed to enter the drain, it will clog up the pipes. I shall describe a fat trap in detail further on. In Fig. 122, the sink is made to discharge directly into the main trap, which is a very good plan, provided that the fat is not thrown down in a liquid state.

(To be continued)

COUNTERBALANCING ENGINES AND OTHER MACHINERY HAVING RECIPROCATING PARTS.—I.*

By PROF. S. W. ROBINSON.

THIS subject is an important one, and seems to be none too well understood. Some appear to imagine that a reciprocating piece can be perfectly counterbalanced by a revolving piece, provided the relation of the weights is right. In making a practical search for the right weight, by putting on one and then another, they find none to suit exactly, and wonder what is the matter. The short of it is, it is simply impossible for a single reciprocating piece to be perfectly counterbalanced by a single rotating piece. It is possible, however, to perfectly counterbalance two reciprocating pieces, like two pistons of equal weight, actuated from one crank-pin, and sliding in straight lines at right angles to each other, the lines intersecting at the crank-shaft, and this by one counter-weight. The connecting rods in this case are supposed without weight, and not to have sensible obliquity at mid-stroke. When the connecting rod is 5 or 8 times the length of crank, the counterbalancing can be made nearly perfect, but not quite. In this case of two pistons, if the counter-weight can have its centre of gravity at the same distance from the shaft as the crank-pin is, its weight should be equal to that of one piston, piston-rod, and cross-head, the connecting rod being supposed without weight.

But let us take some of the simpler problems first.

The effect of a counterbalance should be considered with regard to the effect of its centrifugal force. This may be found by the following:

Rules for Centrifugal Force.

This force, in lbs., is equal to one thirty-second part, more exactly $1 \div g$, of the weight of the rotating mass in lbs., multiplied by the square of the velocity in feet per second, with which the centre of gravity of the weight moves in its path; and divided by the radius, in feet, of the circle of motion of the centre of gravity of the weight.

Or again, it is = 1,227 times the weight of the revolving mass in lbs., multiplied by the square of the number of revolutions per second, and multiplied by the radius, in feet, of the circle of motion of the centre of gravity of the weight.

Examples.

As an example, suppose a scythe snath weighing 10 pounds be placed inside the rim of a large pulley and tied so as to hold it in position. Suppose the centre of gravity of the snath be 5.9ths of its length from the tip end, and 4in. from the body of the snath. When tied in, suppose this centre of gravity be found, by measurement, to be 4ft. from the axis of the pulley. If this distance is 4ft., it is immaterial what position the snath may have. Then suppose snath and pulley be set to revolving at 100 revolutions per second. The centrifugal force, see 2d rule, will be.

$$F = 1,227 \times 10\text{lb.} \times (100 \text{ rev.})^2 \times 4\text{ft. radius} = 490,800\text{lb.} = 245 \text{ tons.}$$

A very useful fact, in consideration of centrifugal force, is that regarding the centre of gravity of the weight to which the centrifugal force is due. It enables us to dispose of all irregular bodies by supposing the whole mass concentrated at the centre of gravity, the calculation of the centrifugal force of which is then easily made.

The following examples follow as consequences:

1st. Suppose a balanced pulley A, with three weights riveted upon it as at C, D, and E. The centre of gravity of each is shown by a dot in Fig. 1. We usually suppose that if the system is in balance when the axis of the pulley rests on knife-

edges, that it will run without shake. That is true if the centres of gravity are all in one plane, perpendicular to the axis of pulley. That would do possibly for a proof of the above principle regarding the reduction of mass to its centre of gravity. According to that, suppose the angle A E D = 90° and C A E = C A D = 180° - 45°. The centre of gravity of the two weights, E and D, is evidently at B, if the weights are equal. Then the added weights of E and D must be to that of C, as C A is to A B.

By calculation,

$$\frac{A B}{A C} = 0.7071.$$

Hence

$$\frac{\text{Weight of C}}{\text{weight of (E + D)}} = 0.7071 = \frac{A B}{A C}$$

From the rule it evidently does not matter where the weights E and D are placed along the line E D produced, provided they are at equal distances from B.

Again, it is immaterial what position the weight C has, provided its centre of gravity remains at C. That is, any position shown by dotted lines in Fig. 2 may be taken. At first this seems untrue, be-

Then, by calculation:

$$A B = .424 - A C \text{ for sector} = 180^\circ.$$

$$A B = .734 - A C \text{ for sector} = 120^\circ.$$

$$A B = .599 - A C \text{ for sector} = 90^\circ.$$

$$\text{and centrifugal force for } 120^\circ = .866.$$

$$\text{centrifugal force for } 180^\circ = .866.$$

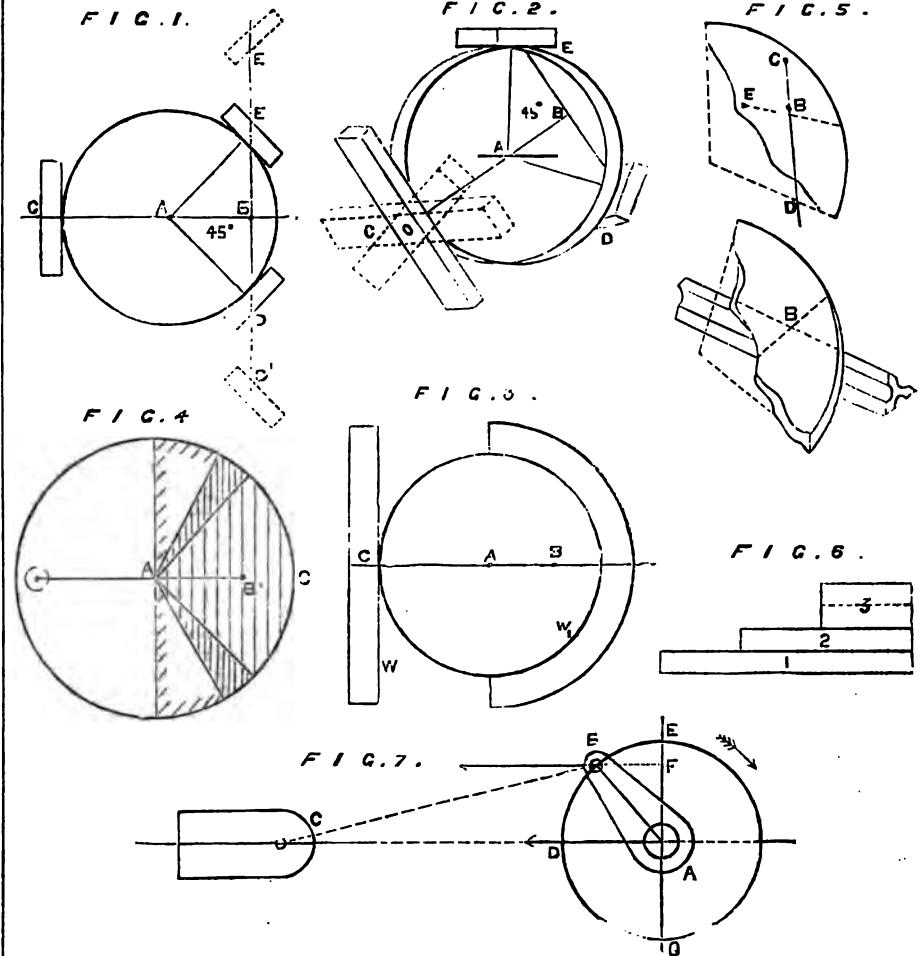
$$\text{centrifugal force for } 90^\circ = .707.$$

$$\text{centrifugal force for } 180^\circ = .707.$$

That is, if we add 50 per cent. to the sector of 120° by extending it to 180°, with the same thickness, we increase the centrifugal force only about a seventh. Again, if the sector of 90° be extended similarly to 180°, or the weight doubled, the centrifugal force will be intensified only about a third. These figures show the comparatively small value of parts of a counterbalance which are nearly opposite each other.

Practical Estimation of Counterbalance Weights.

In designing counterbalance weights, which are of uniform thickness in the manner of the weights in Fig. 4, a convenient way to proceed is to cut out a piece of cardboard of the shape of the weight, as shown in Fig. 5, find its centre of gravity by



cause the ends of the elongated weight C, for one position, are much farther from the axis of revolution than for that position where it is parallel to the axis. But the radius to the centre of gravity is constant.

2nd. Suppose weights W and W₁ attached to the pulley, as shown in Fig. 3. Let the thickness of the two weights be the same, and attached to the true rim of the pulley by rivets or flush screws so that it will not be necessary to take screw heads into account.

Then, if the thickness of the weights is 1-10th the radius of the pulley, the distance to the centres of gravity will be, as found by calculation:

$$A B = 0.669 \times \text{radius of pulley,}$$

$$A C = 1.05 \times \text{radius of pulley,}$$

$$\text{and hence } W = .6371 = \frac{A B}{A C}$$

$$\frac{W_1}{W} = \frac{A B}{A C}$$

$$\text{Hence, if } W_1 = 100\text{lb., } W = 63.71\text{lb.}$$

3rd. Suppose three cases of counter-weight of an engine or jig saw in form of a sector of a circle, 1st, of 180°; 2nd, of 120° and 3rd, of 90°, and of uniform thickness, all having the same radius as shown in Fig. 4.

hanging it upon a pin C, so that it will swing freely, then note a vertical line through the pin, by means of the plumb-line C D. Then similarly find a second line, E B, intersecting the first at B. Then B is the centre of gravity, and its distance from the axis of rotation is readily found when the weight is mounted in position. If the weight of the piece is known, the centrifugal force can be calculated easily. The centre of gravity is, perhaps, most conveniently obtained by balancing the cardboard weight on a knife-edge, and noting the line for two positions, as shown in the second part of Fig. 5.

The actual weight of the counterbalance, Fig. 5, however awkward in outline, may be found by cutting a square from the same piece of cardboard from which the above shape, Fig. 5, was cut, and large enough to represent a square foot on the same scale by which Fig. 5 card was cut. For instance, if Fig. 5 is cut "half-size," the square piece would be one-half a foot, or 6in. square. Now weigh the two pieces of card separately. Then if the Fig. 5 piece weighs $\frac{3}{4}$ as much as the square piece, the actual iron weight, Fig. 5, 1in. thick, will weigh two-thirds as much as a piece of iron 1 foot square and 1in. thick.

* From the American Machinist.

When the counter-weight has several thicknesses, we may proceed similarly. For instance, suppose one part of the weight, Fig. 5, has a certain thickness, another part twice as thick, and a third part four times as thick, as shown in Fig. 6. That is, the slices Nos. 1 and 2 are of equal thickness, while the part No. 3 is twice as thick as 1 or 2, as stated. Then cut one piece of card for No. 1, one piece for No. 2, and two pieces for No. 3. Then pile them, and stick with a little gum, so that we have the counterbalance in miniature. Then find the centre of gravity as before. Also weigh it, and weigh a piece of the same card cut to the same scale, and representing one square foot. Then the actual counterbalance weight, Fig. 6, 4in. thick, will weigh as many times the weight of a piece of iron one foot square and one inch thick, as the cardboard weight, Fig. 6, is times heavier than the card representing one square foot. Or, if a planimeter is at hand, the areas of the several pieces may be obtained before piling. Of course the relation of the areas will be the same as that of the weights of cardboard or of the iron. Knowing the weight of the counterbalance and the position of its centre of gravity, not only the amount of its centrifugal force, but also the direction of it will be readily found, the direction being that of a line passing through the axis of rotation and of the centre of gravity.

Action of Reciprocating parts upon a Crank-Pin.

Let us next inquire into the action of a reciprocating piece, like a piston, upon the crank-pin by which it is actuated. First, consider the connecting rod as without weight, and as causing no sensible modifying action, on account of its obliquity at mid-stroke. Also suppose the crank-pin to move with uniform velocity in its orbit, as when a flywheel is mounted on its crank-shaft.

Then for the position shown in Fig. 7, the piston is being dragged towards A, and the force exerted against the crank-pin will be nearly parallel to the line A C, this force being caused by the acceleration the piston is undergoing. For the crank-pin at E, the piston will have attained the speed of the crank-pin in its path, and its acceleration will be zero. At D, the acceleration, or rate of increase of speed of piston, will be the greatest; and hence at this point the pressure against the crank-pin is at its maximum. The pressure of steam on the piston in expansion, cushion, &c., is without account in causing shake, because the same pressure which is being exerted on the piston has an equal reaction upon the cylinder heads. The shake of the engine, jig saw, etc., is a vibratory motion of the frame of the machine, and is due to forces acting upon the frame. As regards a line through the shaft and cylinder, it matters not whether the whole force acts upon the pillow block, as in absence of steam, or partly there and partly on cylinder-head, in presence of steam.

A rule determined by aid of the higher mathematics, for the pressure upon the crank-pin, due to the acceleration of the piston, is to the effect that at D, the pressure is the same as would be the centrifugal force of the reciprocating parts C, were they hung upon the crank-pin and revolving with it, the centre of gravity of C being placed at the crank-pin centre. Also at other points B, this pressure diminishes in proportion to the cosine of the angle B A D. A simple diagram represents this pressure for any point in the revolution. For instance, let A D represent it for the pin at D. Then B F being the cosine of B A D, will represent it for the pin at B, both in magnitude and direction.

As regards shake, the point of application of this force is at A, it being transmitted from B to A, along the crank. It tends to pull the engine in the direction A toward D, while the crank-pin is in the half circle Q D E. But it is opposite for the next half circle, etc. Therefore, though a horizontal line from any points B to F, represents the direction and magnitude of the pressure tending to cause shake, its point of application is always at A, and hence the shaking force is completely determined.

BALLOON PHOTOGRAPHY.

At a meeting of the Balloon Society of Great Britain held last Friday at the Westminster Aquarium, Mr. W. B. Woodbury read a paper on Balloon Photography, in which he remarked that though little had been done at present in the advancement of the science of photography for balloon purposes, yet he believed the day was not far distant when they should be able to obtain bird's-eye views of all the principal towns and villages of the world, photographed and laid map-like before us for our minute inspection. Nothing, however, of a practical nature had yet been accomplished. The difficulties in the way were numerous; but they had been smoothed down by the introduction of photographic dry plates from 20 to 50 times more rapid than the means we have hitherto had at

command. We had first to consider the fact that it was not the object we wished to photograph that was in rapid movement, but the instrument with which we were working. Let them suppose a train going at express speed; if the camera were perfectly steady the rapidity of the exposure would represent the train almost standing still, but if during the same rapid exposure the camera moved only the hundredth part of an inch in any direction, the effect on the exposed plate would be that of the train as well as the whole landscape having moved some dozens of yards, which would be fatal to all ideas of obtaining anything like a sharp or clear picture. It was evident, therefore, that we required not only the most rapid plates that could be made, but also the quickest form of instantaneous shutter. Luckily, we had a great advantage in the fact that distant objects to be rendered sharp and clear required the minimum of exposure. The whole of the balloon photographer's picture was composed of distant objects, and therefore they wanted only such an exposure of plates as would give them the hard outlines with a slight amount of half tint. But they must not expect to get artistic pictures so much as plans. He next considered the relative advantages of photographing from a free or captive balloon, and gave the preference to the latter, as in the case of the former the exact tract of country it was wished to photograph could not be decided upon beforehand. A light rudder or sail might perhaps with advantage be attached to the balloon, to assist the cord in keeping it steadier. The principal difficulty then remaining to be overcome was the surging motion of the balloon from side to side in its captive condition; and this could be done away with by attaching two wires or cords to the camera at right angles to the line taken by the cable holding the balloon. He suggested the use of elastic indiarubber cords instead of ropes. The camera which he had constructed, with the special object of taking views from a captive balloon, was now at the Paris Exhibition. The taking of plans and villages was only one of many uses that such an apparatus as he described could be put to. In case of war its uses would be manifold. The outlines of fortifications, inaccessible otherwise to the view, could be obtained, and if an army were massed, though invisible to the opposing force, any movements would be easily detected by taking a series of views at intervals. By means of a sciopion or other form of magic lantern, the image of the negative directly on development could be projected on to a large sheet of paper in a darkened room, and the principal outlines rapidly sketched in crayon, so that the results could be easily and quickly examined by those in command, and enlarged photographic images subsequently obtained for more careful reference. In exploring expeditions it would be of great utility, as the directions taken by rivers or streams could be observed even though hills intervened. Also to Arctic expeditions it might prove of very great service; but in these two latter instances the Montgolfier system of balloon would, he thought, have to be adopted, as few exploring parties could carry the necessary materials for the formation of hydrogen en route. The first attempts at balloon photography were made by the late Mr. Negretti during an ascent with Mr. Coxwell. He hoped that another year would show as much advance in this particular branch of science as in others of a kindred nature.

Planing at any Angle.—A very simple method of planing at any required angle the edges of boiler and other plates where this is needed to facilitate calking has just been devised by Messrs. Wm. Collier and Co., of Manchester, and is thus briefly described by our Manchester correspondent. In the place of packing the plates at the required angle on the machine, which has been the method ordinarily adopted, the tool itself is made to work at any angle desired. This is accomplished by the introduction of a swivel-head working upon two trunnions and moved backwards and forwards by a worm and worm-wheel, and which is locked fast in any position by means of bolts in radius slots on a radial plate attached to the slide. The machine itself consists of a long bed with a raised part for carrying the plates, and above this a girder with clamp screws for holding the plates in position. The tool is carried on a slide actuated by a screw with reversing motion, and is so arranged as to cut both ways, a pair of stops which actuate a small rack and pinion turning over the tool at the end of every stroke. The machine is constructed to take in and plane simultaneously at any angle a set of plates up to 12in. in thickness and 20ft. in length.

—*T. Egerton.*
To keep machinery from rusting, take 1oz. of camphor, dissolve in 1lb. of melted lard; take off the scum and mix in as much fine blacklead as will give it an iron colour. Clean the machinery and smear with this mixture. After twenty-four hours rub clean with a soft linen cloth. It will keep clean for months under ordinary circumstances.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE November meeting of this society was held at Burlington House on Friday, the 11th inst. Mr. E. J. Stone, Vice-President, in the chair. Mr. Downing read a paper entitled, "On the North Polar Distances of the Cape Catalogue for 1880, and on the Greenwich and Cape Mean Systems of North Polar Distances." He said: I have given a comparison of the north polar distances of stars in Mr. Stone's Cape Catalogue of 1880, with the mean of the places in the six Greenwich catalogues. Also a comparison of the N. P. D. of the three Cape Catalogues published by Mr. Stone, with the mean of the six Greenwich catalogues. The great difficulty in making this comparison arises from the uncertainty of the values of the proper motions of the stars. I have also given the probable errors of the N. P. D., and it does not appear that there is any notable increase in passing from the stars which are visible to the Northern Observers to those which are beyond their reach.

Professor Pritchard was then called upon to read a paper "On a Method of Measuring the Relative Brightness of Stars." He said he believed he had hit upon a method by which the magnitude of stars could be determined with accuracy to one-tenth of a magnitude. He had at present only applied the method to some 60 or 70 stars. He used a wedge of homogeneous glass, which had been made for him by Mr. Grubb. It was about 6in. long, and about 3-10ths in. in thickness, the wedge was divided along its length with a scale reading to tenths of inches. The wedge could be slid in front of a diaphragm perforated with a small circular hole to direct the eye. There was nothing new in this contrivance, but its value depended on the use made of it. Mr. Dawes had employed a dark wedge, but had assumed as the basis of his results that a star just visible with a certain aperture was of a certain definite magnitude, whereas he had found that at Oxford a star differed as much as 6-10ths of a magnitude in passing from a zenith distance of 52° to a zenith distance of 74°, and on two different nights, though the meteorological circumstances of the atmosphere appeared identical, the same star exhibited a difference of brilliancy which amounted to nearly a whole magnitude. His method was to take a star which he assumed to be constant in brightness, he had for this purpose taken the star α Lyrae, and with a telescope of 4in. aperture, had noticed the part of the wedge which just extinguished the light of the star. The telescope was then stopped down to 2in., and the part of the wedge which now served to extinguish the light of the star was again noted. This gave an important constant, for it might be assumed that the light of the star was in the first instance four times as great as the second. From a number of readings taken in this way, the absorption of different parts of the wedge was determined with great accuracy, and it was found that the absorption corresponded with the thickness of the wedge. There was no possibility of an observer deceiving himself, as the readings of the wedge were not reduced till the next morning, and the observer could not tell what readings should be expected. In this way they had found out from a number of readings of the wedge the coefficient of absorption of the earth's atmosphere at various zenith distances, so that we can now predict the apparent variation in the magnitude of a star as it comes to the meridian and sets again. The results obtained agreed with those we have discovered to within 1-10th of a magnitude, whether the star observed is large or small.

Mr. Knobel said: I have been engaged for some time in a research similar to that described by Prof. Pritchard. The method I have adopted differs in character, but the principle is the same as that which Prof. Pritchard makes use of. I have limited the aperture of my telescope, determined the magnitude of stars by noting the aperture at which the light is extinguished. This purpose I have made use of a silvered reflector, and also of an unsilvered glass, but I do not attach the high degree of accuracy to the results I have obtained that Prof. Pritchard seems inclined to attach to his results. That my results are dependent not on changing meteorological conditions, but upon the state of the observer's eye, I have found over and over again that when one is not in vigorous health one wants a larger aperture to perceive than when in vigorous health and keen to observe. With regard to increase of magnitude at different zenith distances, I should like to know what Prof. Pritchard whether his law corresponds with the table given by Sibel as indicating the change in magnitude at different altitudes.

Mr. Christie said: Prof. Pritchard has had some reason for assuming that α Lyrae was constant in brightness; I consider a very dangerous principle to adopt. The measures I have made myself, though I do not

carry them very far, I am inclined to think that the majority of stars fluctuate slightly in magnitude, not to any great amount, but still to such an extent that we ought not to adopt any single star as a constant of magnitude, but the constant should be obtained from the mean of measures of a number of stars. In former times the Right Ascensions of all stars were referred to one star; but of late years that plan has been given up, and Right Ascensions are now referred to a place derived from the mean of observations of a number of clock stars; and some similar plan ought to be adopted in photometric determinations.

Mr. Knott said: I have not given much time to the photometry of stars; but in determining the magnitude of variable stars I have found that the method of limiting apertures gave very satisfactory results when the stars were compared with others in the same field. For example, I found that in a number of observations made by Mr. Baxendall and myself, with a few startling exceptions, we generally agreed to within two-tenths of a magnitude. I should like to ask Prof. Pritchard whether in reading the wedge the individual observations were discordant?

Prof. Pritchard: No; very accordant.

Mr. Knott: I should have thought that in sliding the wedge along till the star was extinguished, you might get different readings.

Prof. Pritchard: I should have expected the same, but it is not so; the readings are quite accordant.

Mr. Knott: That is an interesting fact. I shall be glad to study the paper in print; but there is another point, with respect to the colour of stars, to which I should like to draw attention. It is, that with a red star, on limiting the aperture, the magnitude appears to decrease more rapidly than with a neighbouring white star, so that if you have two stars, a red and a white one, which appear of nearly equal magnitude, on limiting the aperture the red one fades most rapidly, so that the method of limiting apertures will give you a difference of quite half a magnitude. Probably there is a great deal of personality in such observations.

Mr. Stone: Some time ago, I tried to determine the magnitude of some stars by extinguishing their light with two tourmalines. The observations I made were nearly simultaneous with observations made by Mr. James Carpenter, and I found that the angle at which the light of a particular star appeared to me to be extinguished differed entirely from the angle at which it appeared to be extinguished to another observer; but that, nevertheless, in making differential measures of the magnitudes of two stars, our results agreed very closely. I shall be glad to hear from Prof. Pritchard whether the observations of which he has spoken were all made by one observer. It should be noted that the value of the scale of absorption of the wedge which Prof. Pritchard has determined, all depends on the variation of light with apertures, so that, theoretically, his method cannot be more accurate than the method of limiting apertures. I should be glad to know whether the constant of absorption which he has determined is the same for different observers.

Major Herschel said: If anyone will examine the photometric observations made by my father at the Cape of Good Hope, I think that he will see that it is impossible to make anything but differential observations with any degree of accuracy. Absolute determinations made by one observer cannot be compared with those made by another. I noticed that Prof. Pritchard spoke sometimes of "we," and sometimes of "I": that might make a great deal of difference if the results are combined.

Mr. Christie said: I should like to be allowed to make a further suggestion as to the method of measuring the magnitude of stars by extinction. It has occurred to me that an objection to the method might be removed by using a moderately bright background of constant brightness, on which to extinguish the light of the stars, so that they will be brought to equality with the background, instead of being totally extinguished.

Mr. Ranyard said: Probably many Fellows of the Society are aware that Prof. Pickering has devoted himself for some years to photometric observations of the stars. He has devised several kinds of instruments by which the light of two stars is brought to an equality by means of image prisms: the instruments are reversed and readings are made again, and every possible precaution is taken to avoid errors due to the observer, as well as errors due to the persistence of the observers. The method of bringing two stars to an equality has many advantages over methods involving the extinction of the stars. And Prof. Pickering finds that observations made by different instruments of different observers appear to agree very satisfactorily.

Mr. Christie: There is a difficulty in applying the method to stars which are not in the same

Mr. Ranyard: Prof. Pickering has, I believe, devised an instrument by which stars at many degrees apart can be satisfactorily compared, and has made a great number of measurements with it.

Mr. Common: Prof. Pritchard might try to get some absolute determination of the light of stars in the way that physicists adopt. I would suggest that he should measure the light of a standard candle with his wedge at various distances from his observatory. I know that at Oxford he has ample opportunities for such an experiment.

Mr. De la Rue: As to the advisability of referring the magnitude of stars to a terrestrial standard of light, I have just returned from Paris, where the question of a standard light has been fully discussed by the most eminent philosophers of all Europe, and they came unanimously to the conclusion that it was not at present possible to fix such an absolute standard, but that it was extremely desirable that such a standard should be fixed. (Laughter.) The bougie and the incandescent platinum lamp each present certain advantages, but they fall short of what is desirable, and an International Congress of Experimental Philosophers will have to be appointed to fix a natural standard of illumination.

Mr. Christie then read several papers upon Physical Observations of comets *b* and *c*, 1881.

Mr. Rand Capron asked if in any of the observations the bands had been observed as broken up into lines, as was reported to be the case in some of the American observations.

Mr. Christie: No, as observed at Greenwich they were not absolutely split up, but with a very narrow slit there appeared to be a very sharp edge to one of the bands at wave-length 5126, which corresponds with the edge of one of the flutings of the carbon spectrum. Owing to the position of the comet below the Pole, there was great difficulty in getting at it with the great Greenwich equatorial.

Mr. Knott said: I found it impossible on first observing the spectrum of comet *b*, to detect the bands; but afterwards on the 29th, I could see three bands, so that I conclude that the continuous spectrum was at first very bright and masked the bands, but afterwards it grew fainter.

Mr. Lockyer asked Mr. Christie whether he had been able to observe any difference in the length of the bands. In the observations published there was no statement made as to whether any of the bands varied in that way; for example, whether some corresponded to the breadth of the nucleus only, while others extended further.

Mr. Christie: I cannot answer that point, because with the dispersion we used we could only see one line in the field at a time, and we gave our whole attention to measuring the position of the bands.

Capt. Noble drew on the blackboard diagrams showing the structure which he had observed in comet *b*, 1881, on various nights. The structure changed very materially from night to night. On the 24th June he noticed a very distinct ray within the body of the comet, making an angle of some 10° or 15° with the axis of the comet, and an aigrette on the solar side of the nucleus also inclined to the axis of the comet.

Mr. Ranyard confirmed the structure shown in Captain Noble's drawing of the 24th June, and pointed out the want of symmetry of all the jets with respect to the axis of the comet's tail.

Mr. Marth read a paper on an Ephemera which he had prepared of the positions of the satellites of Uranus. This year the Earth passes through the plane of the orbit of the satellites, and an opportunity will be afforded, which will not occur again for forty-two years, of observing the conjunctions of the satellites, and determining with accuracy the position of the planes of their orbits.

ROYAL MICROSCOPICAL SOCIETY.

THE second meeting of the session of the above Society was held on the 9th inst. at King's College, Strand, J. W. Stephenson, Esq., F.R.A.S. (Vice-President), in the chair.

The minutes of the previous meeting were read and confirmed, and the thanks of the society were voted for various donations received, including Dr. H. Van Heineck's "Synopsis des Diatomées de la Belgique."

Mr. Crisp exhibited and described Holmgren's apparatus for observing the circulation in the lung of a frog, a French Pocket Microscope, Salt's Pocket Microscope, and Watson's Nose-piece for Analyser, Wenham prism, and the Vertical Illuminator, and described Nachet's new Pocket Microscope (lent by Dr. Klein), and Crossley's Microscope, with special arrangement for illuminating the swinging substage (lent by Mr. Crossley).

The Rev. J. J. Halley, of Melbourne, Vice-President of the Microscopical Society of Victoria, was introduced to the meeting by the Chairman, and thanked the Fellows for the very cordial welcome which they had just given him as a representative of one of the youngest microscopical societies in the world. He had on leaving Australia been asked to thank the Royal Microscopical

Society for the great kindness done to their local Society in affiliating it to the parent body. It was an act which he could assure them had been highly appreciated, and he trusted that they would be able to show that they were worthy of the honour.

Mr. Halley then referred to the microscopical work which was being done in the colony of Victoria, mentioning amongst others a mode of making wax cells for mounting objects. He said that of course there was nothing new in the idea of using wax for this purpose, as it had been done over and over again; but as far as this particular method of making the cells was concerned, he believed it to be new, and it had, at any rate, the advantages of being simple, easy, and done in a very short time. A mixture of wax and spermaceti (about 1-6th part of the latter) was placed hot upon the middle of the slide, and the surface having been made perfectly level by passing over it a gauge made of glass, the slide was placed upon the turn-table, and the cell was turned up out of the solid wax (see *Journal of the R.M.S.*, III., 1380, p. 860). He had with him a number of specimens from which the Fellows could judge for themselves as to the extreme neatness of their appearance, and so far as durability went he thought they would be equal to anything hitherto devised—those which he exhibited had stood the severe test of travelling from Australia, knocking about in his portmanteau; and passing through the Red Sea in the month of August, which, even to an Australian, was no joke. Turning to work done in connection with the fauna and flora of the Colony, it would easily be imagined that they had a wide field open to them, seeing that their shores were so remarkably rich, particularly in *Bryozoa*—a term which they had adopted in preference to *Polysoa*. Their Secretary, Mr. Goldstein, was himself working out this subject. Already they had determined no less than thirty new species and several genera. Work like this was favoured by the advantages they possessed of obtaining specimens in large lumps, sometimes as much as three or four feet through, instead of being dependent on the small and dried specimens which alone could be obtained in England. As in Australia they had prospered commercially, so he hoped they might also prosper in their scientific pursuits. They were very careful in everything connected with matters of education, amongst which those relating to science were by no means forgotten.

Mr. Crisp called attention to a slide of *Sarinea gemma*, mounted in phosphorus by Mr. Stephenson, which illustrated the advantage of mounting in media of high refractive index in a more striking manner than had yet been seen, the diatom being resolved with the most remarkable and exceptional clearness.

Mr. B. W. Richardson's paper on "Multiple Staining of Animal Tissues with Picro-carmin, Iodine, and Malachite-green Dyes, and of Vegetable Tissues with Atlas-scarlet, Soluble-blue, Iodine, and Malachite-green Dyes," was read.

Mr. Stewart said it seemed to him extremely important that with such papers they should have specimens before them upon which they could form a judgment, as when anyone discovered a new process he was very likely to become enamoured of it. He did not, of course, say this in any disparagement of the present paper; but he thought it would be very much better if, in future, papers of that kind could be illustrated by the exhibition of type specimens of what the particular reagents were capable of doing.

Mr. J. C. Sigsworth said he had understood that the new catalogue of the books in the Society's library was nearly ready, but that it was not going to be printed; he should be glad to know if such was the case.

The Chairman said that the announcement was premature, the question of printing not having been decided by the Council. It was, however, under consideration.

Mr. Jno. Mayall, jun., exhibited an Abbe apertometer, which was devised by Prof. Abbe, specially for the measurement of very large apertures. The original one was of crown glass, which had a somewhat low refractive index, and this necessitated the pointers being placed so far apart that it was sometimes a little difficult to see them. The improved form was made of flint glass, with a refractive index of 1.631, and this enabled the pointers to be placed nearer together, so that they could be seen with greater facility. The scale was marked up to 1.40, and, without doubt, apertures could be accurately measured up to 1.50 or higher, if the opticians succeeded in producing any such aperture.

Mr. Mayall also exhibited a specimen (lent by Mr. T. S. Bazley) of a new micrometer plate, ruled in America by Fasoldt, who undertakes to rule lines of any given fineness, up to 1-1,000,000 of an inch; but he was obliged to say, after examining the plate before them, which was from 10,000 to 120,000 lines to the inch, that the lines were so slightly ruled that their practical value was very small. The lines ruled by Nobert were very much more distinct, and, therefore, much better as scales.

Mr. Crisp said that, with regard to the claim to have ruled 1,000,000 lines to the inch, the only suggestion of a proof was that the micrometer screw had been set to that degree of fineness, which, of course, was quite another matter.

Mr. Dreyfus called attention to a slide of *Seyzigites megalocarpus*, by Dr. Zimmermann, of Chemnitz, who had acquired considerable reputation for mounting micro-fungi. This slide showed distinctly both zygospores and azygospores, the existence of which had been denied. He also exhibited *Aspergillus glaucus*, *Pilobolus crystallinus*, and *Mucor racemosus*.

Mr. Crisp said they had to regret the deaths of two gentlemen well known in the microscopical world. Mr. C. S. Nachez, the founder of the French firm of that name, had died on the 23rd October, at the advanced age of 83; and Mr. C. A. Spencer, of Geneva, U.S.A. (one of the early makers of objectives with apertures exceeding those of 180° dry objectives), had died on 23rd September.

The Rev. Dr. L. G. Mills's paper on "Diatoms from Peruvian Guano" was read, and was illustrated by specimens exhibited under the microscope, and also by drawings.

The Chairman said he did not notice that the author had suggested any reason for the changes which he had observed to take place in the species of diatoms now found in this guano.

Mr. Michael said that the term "Peruvian Guano" was a very wide one, and he thought that as the first deposits of this substance were pretty well worked out, what came over here now was from another deposit altogether. He therefore inclined to think that this change in the varieties of the diatoms really indicated that deposits now received were from a new locality; or it might even be that the old deposit was being worked at a much lower level than formerly. Moreover, although various guanoes may correctly be called "Peruvian," still they might come from widely different districts.

Mr. Casaux said that his experience was, that there were no two cargoes of guano alike; but it came from various places, and its uniformity of quality could never be depended upon.

Mr. T. Charters White said he had for many years past felt the need of some apparatus by which the development of the lower forms of animal life could be watched under the microscope, under similar conditions to those in which the objects naturally existed. A large number of growing-alides had been brought before them, but he had never found that they were of very much use; certainly not so useful as one which was given to him a short time ago by a member of the Quakett Club, Mr. Goodwin. It was necessary in any contrivance of this kind to have the objects kept constantly wet, and to afford an opportunity of constantly observing them without the danger of their being crushed, which would be sure to occur if the cover were shifted in the least degree. The contrivance to which he referred consisted of a triangular piece of glass, about 2in. in the base; at a short distance from each angle a small block of vulcanite was cemented upon the glass, and a small piece of thin glass was fitted between them, so that it could not be shifted laterally: in the centre of the thin glass a hole was drilled, and a small metal ring was cemented round the hole; under the thin glass some thin strips of blotting-paper were fixed, and if water was slowly dropped into the hole it was drawn off under the thin glass by means of the blotting-paper. The slide answered its purpose so well, practically, that he thought it was worth bringing before the notice of the meeting.

Mr. Stewart asked if it was not probable that minute organisms might get under the blotting-paper, or get entangled among its fibres?

Mr. Curties said that the thin disc of glass was held down in its place by small vulcanised rings fitting over the vulcanite blocks. He had found that these blocks were liable to get loose, so that it would probably be necessary to make them of glass.

Mr. Watson exhibited and described a simple form of Stephenson's safety stage. The new form was more simple than any which had hitherto been made.

The Chairman announced that the first conversazione of the session would be held on the 7th December, and expressed a hope that there would be a better exhibition of objects than on the previous occasion. He then adjourned the meeting to December 14.

The following were elected Ordinary Fellows:—Messrs. Robert Bygott, Walter T. Christian, F. Howard Collins, George Healey, Charles Newton, Joseph B. Robinson, and Louis A. Sittum.

MICROSCOPICAL SOCIETY OF LIVERPOOL.

THE eighth meeting of the session was held at the Royal Institution, Colquitt-street, on Friday, the 4th of November, 1881.

The following gentlemen were elected ordinary members of the Society:—John Pennock, 11, Marmion-road, Sefton Park; Henry Kendall, 15, Marmion-road, Sefton Park; Harold Swift, 22, Wellesley-road, Prince's Park; Alfred Clay Abraham, 117, Hartington-road; Edward Realing, 35, Devonshire-road, Claughton; Rev. Henry E. Martin, Woodlands, Garston.

The paper of the evening was read, "On the Sea-Lily Pentacrinus," by the Rev. Henry H. Higgins, M.A., of which the following is an abstract:—The meridian of the Sea-Lilies, Pentacrinus, seems to have been reached in the seas of the mountain limestone, where they covered thousands of square miles, and became constituents of sedimentary rocks many hundreds of feet in thickness. Their extreme beauty and complexity of structure, if attained by natural selection, point to a pedigree of immeasurable antiquity, concerning which nothing is known. The Sea-Lilies have been placed near the Polypes; but the latter are radiate in type, the former are annuloid: the latter have a good canal open to, or constituting, the body cavity—the former have a distinct good canal with oral and anal apertures: the latter have no neural regions—the former have a nervous system branching from a ring with pseudo-ganglia: the latter have thread-cells—the former are without thread-cells: the latter generally are composite—the former are always simple. The annuloid structure of the Sea-Lily has nothing whatever to do with the "ringed" appearance of the stem. The segments, which are five in number, are "ringed" in a horizontal plane, like the figures on the dial of a watch laid on a table. This is true of all the Echinodermata. The Star-fish is, therefore, not a rayed animal. From an example of a "mend" in a fragment from the plume of a Sea-Lily, the subject of the restoration of lost parts led to the following remarks:—"How a speck of 'plasma,' having from its position a special function, can take upon itself to change that function, and charge itself with the duties attached to a fertilised ovum, at the same time having its embryological potency modified so as exactly to suit the special requirements of a situation determined by an accident—is an inquiry from the threshold of which he that assumes to be scientifically rich must be sent empty away. It is, however, in the regions of the unknown that the noblest rewards of future observers lie hidden. Whether the highest prize may be the discovery of truth or the habit of mind developed in the search after it, one thing is sure—nature is a field where honest toil never terminates in disappointment." At the conclusion, the meeting resolved itself into a Conversazione, when the following subjects were illustrated:—Anacharis, in decay, with high power, George F. Chantrell; Cabinet slides, recent, Alfred Leicester; Cristatella mucosa, A. T. Smith, jun.; Desmids and diatoms, George F. Healey; Diatoms, T. W. Bruce; Diorite, section, Henry C. Beasley; Diptera, species of, W. H. Weightman; Foraminifera, various, I. C. Thompson; Hairs of various animals, H. R. Boulton; Hydra viridis, Dr. McClelland; Ova of Planorbis, showing rotation, J. T. N. Thomas; Ovum of Hydra, in amoeboid state, George F. Chantrell; Rotatoria—Staphanoceros, Floscularia, and Melicerta, Charles Botterill; Seeds of Digitalis, Thomas C. Ryley; Worms from wine corks, H. M. Bennett.

Tests for Cotton-seed Oil.—Cotton-seed oil at 0 deg. C. has the sp. gr. 0.9406; at 30 deg. it is only 0.9206. With oil of vitriol it takes a violet tint, which increases on stirring. At the end of twenty-four hours the mixture becomes thick and deep brown. With sulphuric acid and potassium bichromate there is a violent reaction; sulphuric acid evolved, and the oil takes a blood-red colour. At the end of twenty-four hours it has become a black solid mass. With caustic alkalies—sp. gr. 1.21—the oil thickens, becomes a straw colour, while the alkaline solution separates, and takes a deeper colour. If the mixture is stirred with a glass rod, the upper layers take a blue colour, which gradually passes into a violet.

Battery Carbon.—A useful method of preparing cheap carbon poles for voltaic batteries has been devised by M. Mauri. It consists in taking finely powdered graphite mixed with an equal weight of sulphur free from carbonate, and heating the mixture in a crucible until all the sulphur is fused. The temperature, however, should not be raised over 200° Cent. When the mass is fluid it is poured into a suitable mould of metal, and a stout copper wire is inserted to serve for an electrode. When the mass is cool and solid it is ready for use. Its conductivity is practically as good as that of the best retort carbon, and as it is more electro-negative than simple carbon, the electromotive force of the cell is higher. By increasing the proportion of sulphur in the mixture a highly-resisting composition may be obtained, which can take the place of copper or platinum silver coils for telegraphic or electric lighting purposes.

SCIENTIFIC NEWS.

THE medals of the Royal Society have been awarded as follows:—The Copley medal to Prof. Karl Adolph Wurtz, of Paris, For. Mem. R.S., for his discovery of the organic ammonias, the glycols, and numerous other investigations which have exercised considerable influence on the progress of chemistry; the Davy Medal to Prof. Adolf Baeyer, of Munich, for his synthesis of indigo; a Royal medal to Mr. Francis Maitland Balfour, F.R.S., of Cambridge, for his numerous and important contributions to animal morphology, and more especially for his investigations respecting the origin of the uro-genital organs and the cerebro-spinal nerves of the vertebrate, and for his work on the development of the elasmobranch fishes; a Royal medal to the Rev. John Hewitt Jellett, of Dublin, for his various mathematical and physical papers, more especially for his researches in chemical optics and his invention of the new and delicate analyser by which they were carried out.

The anniversary meeting of the Royal Society will be held on the 30th inst., when the following list of officers and council will be submitted for election. As president, W. Spottiswoode, M.A., D.C.L.; Treasurer, J. Evans, D.C.L.; secretaries, Prof. G. G. Stokes, Prof. M. Foster; Foreign Secretary, Prof. A. W. Williamson; and to complete the council, Prof. F. M. Balfour, Mr. I. L. Ball, Sir R. Bennett, Prof. T. G. Bonney, Prof. H. Debus, Mr. A. J. Ellis, Sir J. Hawshaw, Mr. T. A. Hirst, Mr. W. Huggins, Prof. T. H. Huxley, Prof. J. Liester, Prof. D. Oliver, Prof. H. E. Roscoe, Mr. W. W. Smyth, Mr. H. T. Stairston, and Mr. E. J. Stone.

Dr. W. A. Herdman has been appointed professor of natural history in University College, Liverpool. Dr. J. Campbell Brown has been appointed professor of chemistry in the same college.

Mr. R. C. Johnson, F.R.A.S., has issued his paper on the dimensions of the Stellar Universe, read before the Literary and Philosophical Society of Liverpool last year. The paper will interest many astronomical students.

We have the annual report of the Postal Microscopical Society, which we are glad to find is steadily progressing, and now numbers 140 members. The "report" contains illustrations and descriptions of a simple section-cutter and a tadpole-slide by Mr. F. C. Cox and Mr. A. W. Stokes respectively. The hon. sec. of this useful society is Mr. Alfred Allen, Cambridge-place, Bath.

At a recent meeting of the Society of Telegraph Engineers, Mr. J. A. Lund read a paper on the system of synchronising clocks adopted in London and elsewhere. The system, it will be remembered, employs electricity for the actuating power in regulating the clock time, and it was stated that the wires used for sending the time current could be employed for telephonic purposes—an advantage which will be appreciated by those who are in doubt whether the electric or the pneumatic system of synchronising is the most useful.

One of Mr. Holmes's siren fog-signals is about to be forwarded to Nicolaief to the order of the Russian Government. It is connected with an engine driven by heated air, the invention of the maker, Mr. Buckett, of Gravel-lane, Southwark. The hot air, heated in a closed furnace, is used to drive a pump feeding air to the fire and also to drive the engine, which is of 12 h.p., and is employed in compressing air for blowing the sirens. Some of these engines are at work around the coast, but it is only recently that they have been submitted to public inspection.

Amongst the awards made by the Royal Scottish Society of Arts we notice a Keith medal, value ten pounds, to Mr. G. J. Wishart, for his paper on the recovery of soda from spent lye of papermakers; a Reid and Auld prize of three pounds to Mr. J. S. Matheson for his contrivance for winding up chronometers without reversing their suspension; and a Hepburn medal, value three pounds, to Mr. H. Booth, for his arrangement for relieving the strain on horses in starting a car.

One of the electric time-lock signals will be ex-

the illumination of the wires, which must be lighted in some way, whether the instrument be furnished with the Barlow lens or not. Its effect is merely to render the converging rays of light from the object-glass more divergent, and so to increase the magnifying power. In the third place, the simplest mode of calculating the angular subtense of the field of view with any given eyepiece is to note accurately, by the aid of a side-rod clock, the time of transit of a star diametrically across it. Then multiplying the observed interval in seconds and tenths (of time) by 16 and the result by the cosine of the Star's declination, we get the diameter of the field in arc. Assuming that my querist knows how to use a table of logarithms, an example of this may assist him. Suppose, then, that he notes that α Arietis takes just 1 min. 42.5s. to cross the field of view of an eyepiece diametrically: we say—

sec.
102.5 log. 2 010724
15 log. 1.176091
Dec. of α Arietis 22° 51' cos. 9.964347
1116.3" log. 3.151162

... the angular diameter of our imaginary eyepiece is 1416.3", or 23' 36.3". Finally, with regard to "An Amateur's" question about books. He will now only get a copy of the B.A.C. for some £4 or £5 from a second-hand bookseller. The same observation applies to Argelander's and Struve's catalogues. (I mean not precisely as to their price, but as to the most probable mode of obtaining them.) Wesley, the scientific bookseller, of Essex-street, Strand, would be as likely a man as any to know of stray copies. I do not know what the price of the Greenwich Star Catalogue is, but Murray, of Albemarle-street, is the Admiralty publisher, and would tell him.

I am not familiar with the arrangement described by "J. F. E." (in query 45278, p. 243), of a loose declination circle on a conical fitting to an equatorial. It seems as though the ordinary construction were reversed in it, and that instead of the circle being fixed and the verniers movable, the reverse is the case. What my querist really must do is to fix the circle (as nearly as he can) so that the verniers read 0°, when the telescope is parallel to the plane of the hour circle. This done, he may proceed as indicated in my reply on p. 206, only shifting the circle instead of the verniers, until readings in Declination are alike on both sides of the polar axis. The remainder of the adjustments I trust he will be able to make from those instructions of mine of which he is good enough to speak approvingly.

It is now some 2,070 years since Hipparchus entered upon the most brilliant part of his long career, by the formation of the first Catalogue of Stars. This, as is well known, laid the foundation of our knowledge of Sideral Astronomy, and has largely contributed to the intellectual civilisation of the world. His unprecedented career of protracted and intelligent labour came to its close about 120 B.C., and there is no doubt that he is buried somewhere or another in Bithynia. The mortal remains of some subsequent astronomers have been, through the appreciation of the countries which gave them birth, consigned to national mausoleums; but, in a less appreciative age, the memory of Hipparchus received little or no public recognition at his death. It is now proposed in some degree to rectify this omission by a tomb-stone (in the Marylebone-road Style of Art). The estimated cost would not exceed £5,000; and it has been suggested that it might also include an inscription to the memory of the noble Ptolemy, who, with rare fidelity and affection, reproduced in his "Almagest" the labours of his great predecessor. As it is anticipated that everybody (and many other people besides), who respects the progress of the Sciences at home and abroad, will desire to co-operate in this project, it is proposed, in general, to limit the amount of each subscription to a sum not exceeding £50. In conclusion, I would express an earnest hope that no ill-natured people will charge me with any notion of mere self-glorification, in my proposition of this scheme; or will assert that it is a cheap way of advertising "F.R.A.S.": or that I am saying one word for Hipparchus and two for myself. But then the world is so uncharitable and envious.

A Fellow of the Royal Astronomical Society.

STAR-GAZING.

[18410.]—The following observations were made by Mr. H. Sadler and myself, at Hoxton, on various occasions during the latter part of September and beginning of October, 1881.

The instrument used was the fine 6 in. Calver belonging to Mr. Sadler. The powers usually employed were 50 and 164. The air was never very good.

γ Cassiopeiæ, beautifully split with 164, and the colours strongly contrasted. A, pale yellow; B,

reddish purple. Σ . gives A, yellow; B, purple (1832).

ψ Cassiop. A, yellow; B and C, blue; well separated with 164. There seems to be considerable variation in the mags. assigned to A by different authorities. A. gives 4, Σ . 4.5, Fl. 4.7, Heis 5. Unfortunately, however, the mag. of A was not rated when the above observation was made.

Σ . 163, Cassiop. This is a most lovely object (almost an exact miniature, as far as colour goes, of γ Andromedæ). A, orange; B, blue. Σ . gives the mags., A, 6.2; B, 8.2; but A seemed more like 7 mag.

γ Arietis. Very little difference was perceptible between A and B; the north star, however, seemed slightly the fainter and dusier of the two. δ Herulis. A, yellow; B, blue. The mag. of B, according to Σ , is 8.1. This object was first observed with a 3 in. refractor, in July, 1881, and the companion rated as 10 + mag. With the 6 in. Calver it seemed decidedly fainter than the *comes* to Polaris, with which it was compared. The following are some of the recorded observations of this star:—

Σ . A, green; B, ashy white (1829-1835).
De. A, pale yellow; B, blue (1854).
Fletcher. A, yellow; B, red (1852).
Webb. A, pale lemon yellow; B, lilac (1865).
Knott. A, pale yellow; B, bluish-green (1871).
These observations seem to show some variation in colour. B would also seem to be variable in mag.

η Herulis. A, pale green; B, pale orange. The colours, as given in Webb, are "light apple-green and cherry-red." The alleged variations are probably illusive.

ϵ Ophiuchi. A, pale yellow; B, pale blue. According to Smyth there are two 8 mag. stars following, the south one of which seemed very much fainter than the other, which was almost equal to the *comes* of ϵ .

δ Oph. A, straw colour; B, blue. Lamont's *comes* seen; but not Bu.'s to H.'s *comes*.

Herschel's orange star, near δ Oph., was seen as a very dull orange hue, not very perceptible. It is B 422, variable in colour, according to Birmingham.

δ Oph., μ star, pale yellow, f star, pale blue; but Webb gives "silvery white" (1833). There seems to have been some variation also in mag. here.

θ Serpentis. Both stars closely similar in mag. and colour—"yellowish white."

There is probably some variation in mag. here.

ζ Lyre. A, yellow; B, pale pink; there was nearly a mag. difference between A and B.

The mags. (assumed from Piazz), were 5, 5.5, in 1834; Σ . 4.2, 5.5 (1835); Da. 4.5, 6 (1843); Plummer 4, 6.5 (1876).

δ Lyre, pale yellow. There seems some variation in the colour of this star.

B. 483 Aquilæ (a red star) seemed of a deep orange, but scarcely "red," even in the 6 in. Calver. (i.e., however, Birmingham's introduction to his red star catalogue); in a 3 in. refractor (power 50) its colour was orange, but not very perceptible. This star is probably variable.

11 M. (in Antinous) was beautifully resolved, and is a very striking object; there are two easy pairs quite close to it. P. xviii., 197. N. of the cluster, yellow and blue, and a fainter pair S. "blush."

γ Aquilæ was well opened (in strong twilight) with 164; it was seen split, at times, with 50; both "pale yellow."

B 545, Capricorni, "pure ruby, H; perhaps his finest" (Webb). Here, again, the red colour was not very marked; rather a deep orange. Gore finds this star variable, and proposes to call it γ Capric. (i.e., R.A.S. *Monthly Notices*, xxxvi, p. 70).

β Pegasi. A, white tinged with blue; B, pale blue. There seems to have been some variation in the colour and mag. of B.

γ Aquarii. A, deep golden; B, blue.

γ Aquar. A, white; B, purple (much fainter than 9.3 mag.).

Oxford. T. Read.

P.S.—Will any other correspondents who may have observations on any of these objects, kindly send them for comparison.—T. R.

JUPITER: DUSKY SOUTHERN BELT.

[18411.]—For some time past a dusky belt on Jupiter has been very conspicuous south of the great red spot, which it follows for nearly three hours. The following end of this belt usually appears very well defined, so as to be fairly easy of observation; and on Sept. 27, when it was first noted, it was so striking as to attract immediate attention. It is situated immediately south of the red spot, so that on indifferent nights it seems in contact with it; but this is not the case, for on fine nights it is separated from the red spot by a narrow, bright, well-defined interval. A portion of this belt was visible last year, but it was then very

faint. The following observations of the following end have been secured here up to the present time:—

	1881.	h.	m.	Long.
Sept. 29	11	54		115.3
Oct. 1	13	32.5		115.9
" 15	14	50		110.2
" 26	8	43		104.4
" 30	11	58.5		104.8

The period of rotation of this belt is 9h. 55m. 23.76s., which is nearly the same as that deduced by Mr. Barnard for his small spot of July 25, 1880—namely, 9h. 55m. 19.07s. (letter 19137, No. 856). Following the f . end of this belt is a group of several dusky spots, one of which is probably identical with the small spot of July 25, 1880.

A. S. Williams.

Brighton, Nov. 12.

ORDER OF BRIGHTNESS OF STARS—FOWLER'S SOLUTION.

[19412.]—I NOTE a couple of misprints in my last communication (19249, p. 88). These are:—The insertion of δ for γ in list taken from Heis; and the putting of 8 for 7 in the first column of my own list (thus altering the date from July to August). Also, I think the printer must be responsible for the bad grammar of the third paragraph from the end.

My thanks are due to "Dubliniensis": his prompt courtesy and clear explanation are alike pleasing. Mr. Proctor stated, some years since, in an essay, that he felt as a great difficulty in Laplace's hypothesis, its requiring that the *outer* planets be enormously older than the *inner*. Can this objection be urged to Mr. G. H. Darwin's theory?

I also thank "F.R.A.S." and entirely forgive him, as requested. I must, however, beg him to forgive me, if I say that it was a slight inaccuracy in the way in which he gave his information, which caused me to employ phraseology which appears to him "conventional." I asked for information respecting the "order of brightness" of certain stars. "F.R.A.S." (whom I again thank for taking the trouble), supplied me with lists which, while they certainly said that five of these stars were of the magnitude "2," did not furnish what was desired. "Stars of the 2nd magnitude," said "Stars of 2.2 magnitude" are talked of. I must say, however, that I remember seeing "Stars of the 2.4 magnitude"; to this extent, then, is the *conventional* retained. I meant the *mag*; "F.R.A.S." means the *degree*; this is the difference. "F.R.A.S." of course, did not mean to indicate in his first communication that these five stars were all of the same "tenth of a magnitude." Speaking of discriminating differences of brightness, Sir J. Herschel, 1837 list, defines hundredths. I am sorry to have been one of those who have, of late, troubled "F.R.A.S.," and I am also sorry that he thinks it necessary inferentially to inform me that "2.1" comes before "2.2," and that before "2.3."

From Flammarion's list I gather two things: that my observations were quite correct, and that my impression that *all* these stars are variable is correct also. I would wish, however, for more recent observations; γ seems more brighter than δ ; if so, δ must be approaching a minimum, or γ is increasing—probably both. Perhaps some of the contributors to your journal can supply lists taken from catalogues other than those I quoted from; and furnish information which shall give definiteness to the epochs to which the magnitudes given in Groombridge and Yennall refer. It is strange, indeed, that the phenomena of stars so widely celebrated should not have been by this time exhaustively investigated. "F.R.A.S." recently wrote in your columns some excellent lines about the value of systematic work; no branch of astronomy seems to me to afford to amateurs so many opportunities for usefulness as the subject of "Variable Stars." The most careful and conscientious observer might have his labours rendered well-nigh useless by the occurrence of a long period of persistent mist; but if the gap in his list could be filled up from the corresponding part of a similar series made elsewhere, no loss would result to the science.

I observe one curious thing. Flammarion and α Ursa Majoris same brightness as α Cassiopeiæ. I had not thought it so. 2.5 is exactly the magnitude I found for α Cassiopeiæ on 15th Sept. upon that evening α Ursa Majoris was the brighter of the two; α Cassiopeiæ is certainly variable. How comes it, then, that Flammarion gives α Cassiopeiæ definite magnitude? Could "F.R.A.S." be right? Also: in Flammarion's list the magnitude of α is practically that found for it by Sir J. Herschel in 1837: will "F.R.A.S." kindly give the accounted variables) rated at 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 4.0 respectively, so that an idea of Flammarion's standard of comparison may be seen. My last request is, will "F.R.A.S." give Flammarion assigns magnitude to Capella, Rigel, Fomalhaut, α Orionis, α Persei, Polaris.

medæ, Cassiopeie, Persei, Cassiopeie (stars in which I am interested), and, if he does, will he kindly state them? I want to check my own method.

In M. Gaudibert's communication (19280, p. 112) respecting the comets, there is one omission—the state of his sketch of Schaeberle's. He might also have stated aperture employed and atmospheric conditions. His letter is interesting; can no other contributor to "ours" supply similar matter? Some among them must, surely, have sketched the recent comets; others must have made physical observations. The complicated character of every question concerning comets renders everything of the nature of fact important. M. Gaudibert's "aigrette" (in his drawing of comet), is the great "jet," which was seen under so many forms; in Mr. Newall's drawing of the nucleus on the 27th, it appears as a miniature comet lying across the nucleus; as it endured till the 29th, it is possible that Mr. Birmingham did not observe it, but probable that its instrumental means did not allow him to distinguish it from the "envelope," as Mr. P. Smith's drawing of the 29th shows it spreading out forward—whence it is likely that M. Gaudibert saw it in transition state. Of course, the atmosphere may have been the cause of the discrepancy. Will Mr. Birmingham give information? M. Gaudibert's drawing of comet *c* differs markedly from the drawing published by Mr. Rand Capron, in *Nature*, or September 8th, of its appearance on August 24 and 28th. When I saw it, with the naked eye, on August 18th, it seemed to me that its tail was pointed (narrower at end than at head); this peculiarity would seem to have been the chief feature of this comet. Can anyone give further information respecting the reported "division" of Tebbut's comet on July 6th?

Some correspondence has recently appeared in the "E.M." respecting fog-signalling. I think the writers have overlooked Prof. Tyndall's important researches on the subject. In them he showed that there is no relation between the acoustic and optic transparency of the air; that sounds were often heard with great clearness in fog, and with much difficulty in clear weather; that the acoustical conditions of the same section of air varied constantly, and in the most extraordinary manner, and that these phenomena were mainly due to the presence of currents. He, also, succeeded in obtaining experimental illustration and proof. Dr. Tyndall published an account of these investigations in one of the magazines, I think the *Contemporary Review*, some time during 1876.

In a recent number Dr. Edmunds gave some off-hand directions for the use of "Fowler's Solution." I think his usual caution—for a moment—forgot him when he omitted to name that it is a preparation of arsenic. I have heard a good deal about it, and can assure the querist that it is not particularly safe, and that Dr. Edmunds' directions must be carried out to the letter.

Since writing the second paragraph above I have re-read the letter from Dr. Ball, which appeared in the "E.M." for Aug. 12. In it I see he says that the earth is destined to have, in future, towards the moon, the relation at present subsisting between Mars and his interior satellite. If, then, this which is to happen to the earth has happened to Mars, Mars must be the oldest. This consideration would appear to invalidate Mr. Proctor's argument. I do not quite understand the letter from "Dublinensis," printed on the same page, for I cannot realise exactly the shape which the earth-moon mass is supposed to have had just before disruption. Nor can I quite make out what forms the earth and moon are supposed to have had immediately after.

S. Maitland Baird Gemmill.
Glasgow, Nov. 12.

DOUBLE OBJECT - GLASSES - TO "QUERY"—OTHER MATTERS - TO "SUNLIGHT" AND "PRISMATIQUE."

[19413.]—I FANCY there is less real difference in the replies of "W. G. P." and myself to this query as your correspondent, "Query," imagines. "W. G. P." says "the blue image will be formed nearer to the o.g. than the red one." My reply is to the same effect: Certainly the second lens may be so emergent coloured pencils to be parallel, action takes place too late to secure a sharp The red and blue rays are considerably separated when they impinge on the second lens, separation is not diminished by passing it. The extent of chromatic error depends distance the dispersed rays travel before a second lens. A concave can be used in with the first, but a convex must be at a considerable distance. No doubt two separated can be used to form a sort of dialyte; but I "W. G. P." does not set much value on such question. Why not use a concave as well, in for the proper arrangement at first? I am glad if "Query" finds it convenient to use an experimental instrument. Very proper practice may, to some extent, upset theory,

for the Huyghenian possesses a self-contained capacity for correction by altering the separation, which cannot be brought under mathematical treatment. According to Coddington, the best lenses to use would be—first lens, equi-convex: second, plano-convex, with plane side towards the eyepiece. If the 1st lens be 4in. aperture, focus 60in. 2nd lens 2½in. aperture, focus 20in., distance apart 40in., the final refracted focus would be 10in. behind the second lens, and the whole combination equivalent to a 30in. lens. I hope "Query" will try either this or some other similar combination, and report to "ours."

Will Mr. Arthur Hinde kindly describe his dialyte—that is, give the curves, foci, and kind of glass used, &c.? After his "immense number of experiments," he should have something good to tell us.

It is very gratifying to see the practical working of specula undergoing such a thorough treatment at the hands of Mr. Wassell. Cannot something of the sort be done for the object-glass? I am satisfied there is a great deal to be learnt in regard to its practical treatment. What have Mr. Wassell, "Prismatique," and "A. J. S.," to say in this matter?

I would respectfully remind "Sunlight" that there is his promise regarding the curves for a portrait-lens not yet carried out. As he made his second reply dependent upon mine, which has now appeared, it is, according to promise, now due from him. May I also call the attention of "Prismatique" to a few remarks I addressed to him in the reply above alluded to, No. 4713, page 119? Orderic Vital.

[19414.]—I SHOULD not have attempted to criticise the letter of your esteemed correspondent, "Orderic Vital," p. 209, had not the query which drew it forth been addressed to myself also. There is then one passage in it which the generality of your mathematical readers will certainly not subscribe to. He says that "for general cases of refraction of parallel rays, the Huyghenian combination has no effect in correcting dispersion, but rather the reverse."

I venture to offer some remarks upon this. The equation of condition for achromatism is

$$d = \frac{f_1 + f_2}{2 + \frac{f_1}{b}}$$

Or, since $f_1 = f_2 - 1$ (Parkinson, Optics),

$$d = \frac{f_1 + f_2}{1 + \frac{f_1}{c}} \dots\dots\dots 1$$

Where *b* and *c* are the distances of the image from the first lens of the pair which has to be achromatised, before and after refraction respectively.

Now here there are two quite distinct cases, according as the pair is to be used as an object-glass, or as an eyepiece. In the former, what is given is the distance of the image from the first lens, and in the latter, the distance of the image from the second lens. When, then, they are used as an o.g., *c* is given, and hence the equation for determining *d* is of the first degree, and always, therefore, gives a real value for *d*, whether *c* is great or small. For example: for parallel rays *c* becomes *f*₁, and we have $d = \frac{1}{2}(f_1 + f_2)$, a result which certainly does not agree with the passage above quoted.

On the other hand, when the lenses are used as an eyepiece, we do not know the distance of the image from the first lens; all that we know is that it is situated in or nearly in the focus of the second lens, so that $d = c + f_2$, or $c = d - f_2$. We must now, in order to get an equation between *d* and known quantities, substitute this value for *c* in Eq. 1, and it gives, after a little reduction $(d - f_2)^2 = -f_1 f_2$; so that, as I endeavoured to show in some former letters, the values of *d* are always impossible, unless *f*₁ and *f*₂ have opposite signs; that is, the pair cannot be achromatic when used as an eyepiece, but is so when used as an o.g. In fact, in this case there are two conditions to be satisfied—those implied in equations 1 and 2; and, when such is the case, the conditions may be incompatible, as they are here.

It may, in like manner, be shown that spherical aberration and distortion may also be greatly reduced when the pair are used as an o.g., so that it would seem that a very passable dialyte might be formed. "O. V." seems to take into account the spherical aberration as affecting the chromatic. Of course, this is lawful; but it is generally thought to be sufficiently exact to treat them separately, and to calculate the one as if the other did not exist.

W. G. P.

[19415.]—In reply to letter 19391, I may say to "Query" that, supposing he uses convex glasses, both of them being crown glass, he had better not use a greater ratio for the focal length of the first to that of the second lens than 3:1, for this is the limit beyond which the second lens will cease to

receive all the rays transmitted by the first. If the ratio is greater, some of the rays will not pass through the second lens, and, consequently, there will be waste of light. With regard to his proposed combination, it will most certainly be, in a sense, achromatic; and hence, perhaps, a word may not be out of place to show it will be inferior to a Wray o.g. In this latter, by properly managing the thickness of the lenses, the rays achromatised may be made to emerge not only parallel, but coincident.

In the other case, however, they can only be made to emerge parallel, and the blue image will lie nearer to the second lens than the red does; and, therefore, they will be more unfavourably placed for observation with an eyepiece than if they coincided, or had their positions reversed.

W. G. P.

P.S.—As to the form of the lenses, I am not as yet able to speak with certainty; but I will endeavour, when I have time, to find out a pair which will considerably reduce the spherical aberration. In the mean time, it might be worth while to try what the usual arrangement in a Huyghenian eyepiece will do, taking, of course, great care that the lenses are properly centred.

SHAPE OF "FLAT" FOR NEWTONIAN.

[19416.]—In the last paragraph of letter 19278, page 112, it is stated that an egg-shaped oval surface is required, instead of the ordinary ellipse. Although this comes from a great authority, I beg to take exception to this very new idea, and should like to be informed how to bisect a cone so that the resulting section shall be an egg-shaped oval.

A. N. H.

STENCIL PLATES.

[19417.]—THE following may be useful to many fellow-subscribers:—

Stencil plates made from paper are made more durable and give better, i.e. finer results, by saturating the paper with paraffin wax.

Having cut the stencil carefully from cardboard, press, or other paper—I mean such as is used for pressing cloth, dress-pieces, or other goods—warm or lay the paper on a warm oven plate, paint it over with paraffin (melted), use a moderately warm flat-iron, same as if ironing a cuff, until the stencil is saturated; if required, it may be trimmed up a bit afterwards. By this means they may be made as good, and nearly as durable, as ordinary metal plates.

S. J. Simpkin.

FORMS OF SPECULA.

[19418.]—I HAVE mislaid the number containing my former letter on this subject, and cannot, therefore, refer to the paragraphs quoted by Mr. Wassell in his letter on page 230, but I find in one or two points he has somewhat mistaken my meaning.

I certainly never suggested, or thought of suggesting, the use of two metals in making the speculum of the form which I described. Speaking from recollection, I think my sketch was intended for a glass speculum, to be cast of this particular pattern, with the projecting ring at the background true to fit an ordinary cell. Whether this ring should have a continuous circular bearing in the cell, or be itself cut away so as to give three points only of support, would be matter for experiment.

If made in metal, there should first of all be the equal thickness disc of the mirror itself, and then the stiffening backing, of the same metal, applied afterwards. If cast in one piece, the face would be spongy, for the reason I then mentioned. I would now add (supplementing my previous letter) that if the speculum is to be supported by its rim only, the section given would be preferably replaced by one with a deep band at back, forming as it were a hoop round the edge, and from this hoop should radiate inwards towards the centre of disc a series of brackets, the same depth as the hoop at starting, but dying out to nothing near the centre of disc.

Obviously, if the brackets increase in number, we may assume them to coalesce into a solid ring, and we then get a speculum thick at the edge and thin in the middle; a sort of very flat dome in fact, which is, I should say, an enormously rigid form. I must not omit, in conclusion, to express my sense of the interest and value of Mr. Wassell's letters.

A. S. L.

MOY'S PATENT STEAM BOILERS.

[19419.]—I SEND you diagram of one of the forms of steam-boiler which I have recently patented. The general principle of construction consists in surrounding the uptake, or the tube or tubes (according to the construction), with annular cups of various forms, so as to provide a large water surface (to prevent priming); large heating surface and large steam space, the amount of water

being reduced as much as possible, in order to raise steam quickly.

The Admiralty conditions as to water surface in steam-boilers are that there shall be from 19'3 to 23'6 square feet of water surface to 100 horse-power; the latter can be far exceeded by my arrangement of water surface.

The feed-water enters at the top, just under the dome, where the deposit (if any) takes place; an inner portion is set apart for receiving the clean water, from whence it overflows by means of the tube seen on the left of the uptake, to the upper

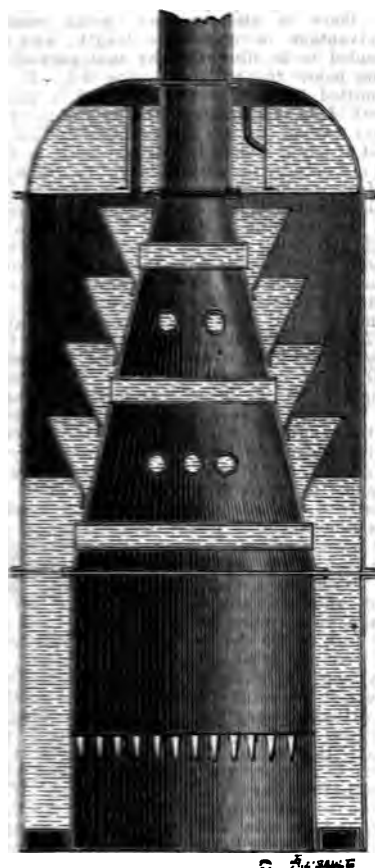


FIG. 1.

vertical dish, and so on through the series to the lower part of the boiler. A greatly increased amount of heating surface may be obtained by means of cross tubes as shown, or by U tubes, or otherwise; and the uptake may be conical, cylindrical or tubular.

An arrangement is also shown in my specification No. 572, 1880, for surrounding horizontal tubes with water in an analogous manner; and another arrangement is shown, whereby the boilers can be made very small and light, of a few inches diameter, and suitable for being worked into the framing of structures that require small weight, such as swift boats, trams, road-carriages, and small steamers, the fuel for such boilers being paraffin oil or methylated spirit. As the engraving is merely intended to show the principle of construction, the ordinary fittings are not shown. For marine purposes, circulating pumps will be used to raise the water from the lower parts of the boiler to the upper, and the receptacles for water will be deeper than those of stationary boilers.

The main object is the construction of a small boiler, which is capable of doing the work of a large one, without priming, and therefore with a great reduction of weight.

The arrangement of annular and other receptacles can be applied with advantage to many of the existing forms of boilers.

Nov. 18.

Thomas Moy.

A CHEAP SUBSTITUTE FOR AN OBSERVATORY.

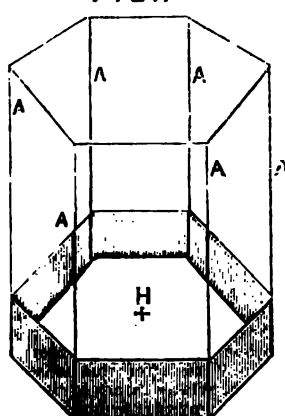
[1881.]—An observatory is necessary for the purpose of securing the telescope from the effects of the wind, dust, &c., and also to furnish a stand for the other instruments. In my case all required was an arrangement for covering the telescope when not in use, so as to be secure from the weather, and a movable screen to be placed on the westward side of instrument to break narrowing ground wind.

In Fig. 1 is represented the position of the instrument when in use, as indicated by the six upright pieces of wood A A A A A A. These are planted in the ground to a depth of 18in., and project

one or two feet above the top of telescope when pointed vertically. The distance from pier should be such that the end of telescope will not approach nearer than perhaps 18in.; this will give ample room for working telescope in any direction.

Now, take six strips of pine board and nail from post to post clear around as represented in the figure; this will serve as a support to the posts.

FIG. 1

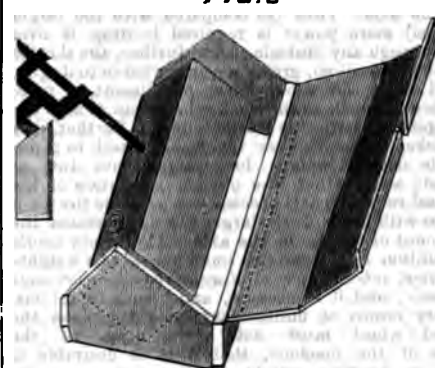


Now around the bottom nail boards to a height of perhaps 18in. from the ground, as represented. Next drive a nail into the middle of each strip, leaving the head projecting half an inch. This will serve as buttons to which the protecting canvas can be buttoned.

To make this, take a strip of heavy canvas long enough to go one-third around, and wide enough to reach from base-boards to top strips. Now make button-holes in this at top and bottom to correspond with the positions of the nails in strips, and you have a perfect protection from wind which can be changed in 30 seconds to any other place on framework if desired.

Now about the cover for telescope when not in use. It will first be necessary to describe my equatorial mounting, as it probably differs somewhat from the usual construction. The polar axis is 15in. between bearing, and nearly 2in. in diameter, and of solid steel. Declination axis is 30in. long and projects about 20in. beyond the bearings, and is of a diameter of 1 1/2in. Just outside of the bearing farthest from the body of the telescope is a circular ring of sheet brass pierced with two holes opposite each other, and in line with one of

FIG. 2



same size through declination axis. A metal pin is passed entirely through this, and thus we have a shoulder which prevents the declination axis from sliding through the bearings when in use.

When through using, I draw out the pin and revolve the telescope around underneath the polar axis, and pointing east and west, and let the declination axis slide through bearings until the telescope rests on two cross supports an inch or two above the surface of the ground. Now fold up the canvas protector and wrap around speculum end of telescope, which will thus serve to protect it from rain leaking through the cover, as well as from temperature changes.

Now for the cover or box for telescope. A few inches north of the supports for telescope two posts are sunk in the ground about 5ft. apart, on the north side of which a pine plank, 2in. in thickness and a foot longer than the body of the telescope, is fastened. This goes below the surface of the ground about an inch or two, the top being 8in. above ground.

On the south side of telescope another plank is fastened in the same way, and projects about 3in.

above ground, so as not to be in the way of telescope when in use.

A hinged cover is fastened with strong hinges to the north plank, and folds over the whole in the manner represented in Fig. 2.

This is covered with oilcloth, preferably white, as it absorbs less heat from a hot sun, and is locked with a padlock to a strong staple in southern plank, and is thus secure from outside interference.

A strip of the cover, 2in. wide and a foot or so in width, will evidently interfere with the declination axis when the cover is folded down, and this must be sawn out, and a block of the same size or a strip of tin arranged to cover this hole when cover is in place, the whole thus forming a very efficient protection from the weather if well made, and at a very reasonable cost.

I hope this simple device may be of as much use to others as it has been to

Harry L. Baldwin, jun.

Princeton, N.J., U.S.A., Oct. 18.

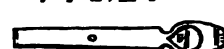
BERLINER'S VIOLIN.

[19421.]—So many of your readers appear to take an interest in violins that I venture to ask you to insert a brief description of the invention patented by M. Emile Berliner, of Boston, Mass. The sketches accompanying are almost sufficient in themselves, Fig. 1 being a section through the

FIG. 1.



FIG. 2.



instrument, and Fig. 2 is a plan view of the metal or wooden bar T to which the strings are fastened as if to an ordinary tail-piece. The sketches really show the modified form; in the original, the fingerboard is itself continued far enough to receive the ends of the strings, the bridge passing through the aperture shown in Fig. 2, which is then cut in the finger-board. The inventor says:—"By disposing with the tail-piece and extending the fingerboard downward below the bridge sufficiently to receive the ends of the strings, which rest on the bridge and extend to the keys or pegs, I make use of only two points through which to communicate the vibrations of the strings to the resonant body of the instrument, one of these points being in the bridge, the other in the neck, and by disposing with the truss form in stringing the instrument, I eliminate or prevent entirely the strains which, in ordinary instruments, are exerted upon the resonant body, and are enabled to transmit the string vibrations unimpaired to the body of my improved instrument. My invention affords very important results. For example, the violin body being in a state of equilibrium and free from internal and external strains, the player is enabled to give great expression to his performance. This result is apparent not only in the superior kinds of stringed instruments, but is particularly noticeable in what are called inferior instruments, as the latter, with my invention applied to them, will have the clearness of tone and resonance hitherto observed only in superior instruments." In the original form the finger-board is rigidly screwed or fastened to the neck of the instrument to make the board and neck practically one piece, so that there will not be any dissipation of vibration by their separation. By this construction the violin-body is in equilibrium—that is to say, not being trussed from end to end, it is not bent or buckled while the strings are under tension, and any strains arising from the pressure of the bridge upon the sounding-post have such a slight purchase or leverage that any tendency to interfere with the transmission of the string vibrations is reduced to a minimum. In the modification illustrated in Fig. 1 the strings are fastened to a second board, or metal or wooden bar T, which is secured to the neck or the upper block under or at the side of the ordinary fingerboards, and extends beyond the bridge.

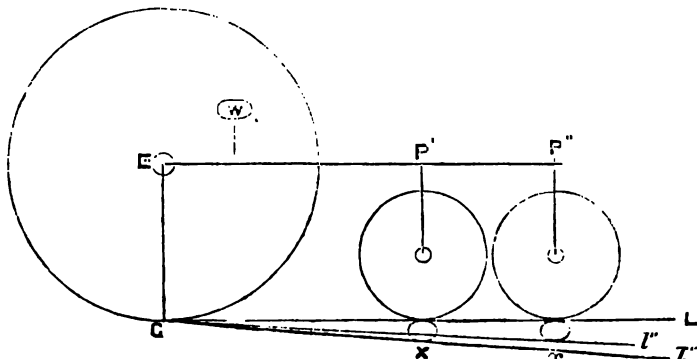
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TRICYCLES.

[19422.]—Now that this subject is burning briskly on the hearth of the *ENGLISH MECHANIC*, I do not like to miss the opportunity of laying on the anvil of "our journal" a point relating to the construction of the hayfork type of tricycle, which I do not think has received the attention it deserves. We seem disposed to accept the general outline of the machine just as the makers choose to give it to us, and to devote our whole attention to the improvement of detail, without taking the trouble to

ask whether the frame-work which is to carry these details is as correct as possible in its proportions. I have long been convinced that the best development of the hayfork class of machine is being hampered and crippled by the reluctance of makers to add a few inches to the tails of these steel ponies. When I have remonstrated on this point (as I have often ventured to do), the answer has been sometimes that this must be done for the sake of "appearance," sometimes for that of "quick turning," and sometimes I have been told "the machine would run heavier if the draught were lengthened." Now, the special object of this letter is to show the fallacy of the last idea. I will first deal with the first two objections. The rider who is willing to sacrifice running qualities for mere look, will have his reward, and must be content with it. But the second objection is undoubtedly more practical in its character: for it is obvious that the shorter machine may always be made to turn within shorter compass than the longer one. Here the question would seem to resolve itself into the comparative value of such running advantages as lengthening the machine can be proved to secure, and the convenience of being able to turn corners a little more sharply, together with that of turning right round within shorter compass. I must confess that, for my part, the balance of these advantages could not admit a moment's doubt. For running qualities are constant in their labour-saving value at every turn of the wheel; while the value of quick turning is only felt occasionally. As to the rare necessity of turning right round, a good rider will as often do this by manoeuvring his machine as by sweeping it round; and the sooner the rider who cannot manoeuvre in this way

machine it must be somewhere there whatever the disposition of the wheels may be, it follows that every ounce P loses must go on to F; and thus, more weight may be thrown on the drivers by moving P backwards, long after the necessity of keeping the centre of gravity a certain distance behind F has placed a limit to any further adjustment of weight by moving W towards F. And there is this advantage in effecting this by moving P backwards. For, although the weight of the hind wheel on the ground will remain the same wherever it is placed (except, of course, the slight increase caused by a few more inches in the back-bone), yet its action as a counterpoise to any tendency of the machine to tip over forwards will increase exactly in proportion as it is put further back—just as the value of the same weight increases as it is put further down the arm of the steel-yard. And further, as the rudder depends for its action not only on the weight put on it, but also on the leverage given to that weight, and as increasing the length of the tail gives more leverage, it follows that the weight necessary for steering purposes may be decreased in proportion to the increase of leverage. In other words, the long-tailed machine will not require so much weight to be thrown on its hind-wheel as the shorter machine, and therefore more of the weight may be thrown on the drivers. It is, of course, clear enough that the drivers must have a certain amount of weight thrown on them, in order to secure traction-hold; but as, after this is secured, the question of weight relates rather to the hind-wheel than to the drivers, my case would be incompletely stated without referring to this most important point. There are many practical reasons for keeping the hind-wheel smaller than the others,



learns how to do so, the better it will be for him. As to turning corners, I do not think any really good rider would advocate the butcher-boy style of cutting round them. It may astonish admiring spectators innocent of any kind of wheel practice. But granting that any running advantage can be secured at the slight cost of having to take corners a little more cautiously, no real wheelman would hesitate a moment as to the choice. I will therefore try to show on paper what I have proved to my own satisfaction in practice—viz., that a fair length between the axles of front and hind-wheels in a hayfork machine, will make it run more lightly, more safely, and more smoothly; while unduly shortening the tail is putting so much unnecessary drag on the run, wasting power by causing jolting, and detracting from the safety of the machine in shooting hills.

These points will certainly be more easily explained, and possibly more readily understood by aid of the accompanying diagram. But in order to have some premise from which to start, I will assume: 1st, That it is desirable to throw as much weight as possible on the driving-wheels; but, 2ndly, That the weight must be disposed over the three wheels so as to avoid all tendency to make the machine tip up forwards, either in mounting or running; and, 3rdly, that the hind-wheel must have a sufficient share of the weight to make it do its duty as rudder properly.

Now, although the mass of the weight may be distributed on both sides of the axles of the drivers, yet it is a necessary condition of this proposition that the centre of gravity should fall behind these axles. Therefore, we may at once resolve the tricycle into a lever of the second order; and, in the drawing, the axles F will be the fulcrum, P or P' (as the case may be) will be the supporting power, and W, the weight, will lie between the fulcrum and the power. It is, therefore, no new theory, but simply the statement of a fundamental mechanical axiom to assert that there are two ways of throwing weight on the drivers. The first and most obvious is to put W nearer to F. But the same thing may be accomplished without moving W at all, by simply putting P further away from W. It is certain, from the law of leverage, that the further P is put from W the less weight will it have. And as, if 12 stone has been put on the top of the

although I am convinced its size might be most advantageously increased over the usual 18 or 20 inches. Now the smaller wheel has less leverage of spoke for utilising any power communicated to the axle. Thus (as compared with the larger wheel) more power is required to drag it over or through any obstacle. And further, the shorter spoke (or radius), giving a quicker curve to its rim, will make the same given impediment a more serious obstacle to the small wheel than it is to the larger one with the easier curve. Further, the quicker curve disposes the small wheel to penetrate deeper (weight for weight) into dust or mud; and further, the quicker revolution of the wheel round its axis necessary to make its tire keep pace with those of the larger wheels, increases the amount of friction on the axle. Thus every single condition is against the small wheel as a weight-carrier, when driven or dragged by other driving-wheels; and it is because, under such conditions, every ounce of unnecessary weight put on the hind wheel must act as a drag on the run of the machine, that it is so desirable to go on heaping weight on the larger wheels, even after they may have plenty for their own traction needs. The dragging effect of a short back-bone will not be very apparent on the floor of a show-room or a smooth and hard road. Here all the adverse conditions, except that of axle friction, are in abeyance. But a rough road, a little mud, or even a thick summer dust, will soon make the rider conscious that his machine has lost its life and go in a wonderful way.

I have lately been making a good many experiments by means of putting a temporary lengthening tail to one of my machines, to ascertain what is the minimum weight required for steering purposes. As has been shown above, this must vary with the length of the tail, and will also vary with the weight of the rider. But taking 46in. length between axles as the minimum length required for a thoroughly comfortable disposition of 11st. 10lb. (added to that of the machine), I find that a weight of about 30lb. (i.e., for machine, say, 16lb., and 16lb. of the rider's weight) is ample for all steering purposes; and I think this might be safely reduced still more. This reading is taken when sitting quite upright. Leaning backwards or forwards will throw some 15 or 20lb. on or off as the case may be. Many of

the machines I have tested in this way, i.e., by carefully hanging the tail in a Suter's balance, have pulled down 50lb.; and one or two still more. According to my experiments, this would mean an unnecessary and constant drag of 20lb. Few folk would think of sticking a 20lb weight on the head of their steering-wheel. Yet that is exactly what many of the very short back-bones mean!

The greater safety of the long machine in shooting hills requires no comment while arrows, moderate shot, boats, carriages, and railway-cars—in fact, everything that is destined to travel at high speed through the air or water, or on road or rails—is always made long in proportion to its width.

But there is also another great comfort and advantage in reasonable length, and this is intended to be illustrated by that part of the diagram below the horizontal line G.L. It will be admitted that all power expended in raising any part of the machine from the level of the road is power wasted. It will also be admitted that the amount of power wasted in this way must be estimated not only by the vertical height to which any part of the machine may be raised in passing over obstacles; but also, and chiefly, by the angle at which the machine will have to rise from the ground. Granting this, let X and x be obstacles of exactly equal heights from the ground. Now if the hind-wheel be at P, then the new ground-line on which the obstacle is lying, will be G, P'; and the hind-wheel P' will have to rise at the angle L, G, P'. But if the hind-wheel be at P'', then G, P'' will be the new ground-line; and the hind-wheel P'' will rise at the angle L, G, P''. Thus, just as the angle L, G, P', being contained in the angle L, G, P'', must be less than it, so it is evident that the angular disturbance of the machine and its rider by any given inequality in the ground, will be less in proportion as a machine is lengthened, and greater as its tail is shortened. Consequently, the short machine causes more waste of power than the longer one. There is yet one more advantage to claim for length. It has been shown that the shorter tail must have more weight on it than the longer one. More weight, and especially when the rudder has less leverage, means more strain on the head and axle of the fork of the steering-wheel; and this means faster wear and greater tendency to shakiness, and as anything that lessens strain will lessen this wear and tear, it follows that lengthening the machine does virtually strengthen it. If so, the diameter of the hind wheel might safely be increased; and, although this would add a little weight to the machine as a whole, yet weight at this end would enable the rider to get a little more forward. Thus, no more weight would be thrown on the hind-wheel, and its own additional weight would, I think, be far more than compensated for by the relief which increase of diameter would afford to the several adverse conditions named above.

This letter about "length" has grown so long that I must not now lengthen it. But I am sure the point is worth very careful attention. I am convinced it is of far more practical importance to the ordinary rider than the point on which I ventured to try to modify the force of "Guido's" theorem. I venture to doubt, from little straws in his letters, whether his actual experience of tricycle riding is very varied. But it is quite clear he is a writer who knows what he is writing about; and I should be much obliged to him if he would criticise what I have now written. I observe in "Sunlight's" last letter some remarks on the best position of the rider. This is a question involving a good deal of consideration, and one that must be left open enough to suit a great many different tastes. "Sunlight" certainly does not touch the real key to the solution of this most important point. It is one on which I happen to have made some experiments, which (as is my practice in all such cases) I have recorded in drawings to scale, so as to arrive at exact angular measurements. Of course I do not mean that every rider should set himself on his seat or saddle by a goniometer; but I have always found that the most dependable "rules-of-thumb" are those which are formulated on accurate knowledge of the principles on which they depend. Should any brother tricyclist and subscriber to "our journal" care to have some lucubrations on the "seat-and-handle" question, I shall be happy to send them for publication.

I cannot conclude without congratulating tricyclists that this subject is now so well afoot in the ENGLISH MECHANIC. It is here, rather than in the more special journals, that the mechanical principles of the machine are likely to be well opened up; and it is only by the spread of such knowledge among practical readers that we can hope for the gradual perfection of our steeds.

D. H. G.

[19423].—I would suggest a simple test which shows comparatively the power required to drive different machines; it is this:—Raise the machine until the driving-wheels are clear of the ground, then, with a vigorous sweep of the arm, set the driving-wheel spinning, and count the number of

revolutions it will make before coming to a stop. This test, coupled with a knowledge of the weight of the machine, will give you a good insight into its hill-climbing capabilities. The following are some of the results I have obtained:—

	Revolutions.
Excelsior, ball-bearings everywhere..	35
Coventry, do., side-wheels only.....	12
Do. do., all wheels and crank-shaft	45
Cheylessmore, do.	6

I have timed the side-wheels of my Coventry up to 200 revolutions, when I became tired of counting. The foreman of a large engineering works was examining my machine the other day, and on my spinning one of my small wheels he said, "Why, friction seems to be absolutely annihilated." The two enemies we have to contend against are friction and weight. Surely "Sunlight" will not pretend to tell us that ball bearings will not lessen the former enormously—the amount of gain is shown in the case of the two Coventrys quoted above. By this test I have been confirmed in my opinion that double drivers are a mistake. In theory they are correct enough, in practice we get increased weight and increased friction without anything in the way of compensation, particularly as they are only double-drivers when they are running absolutely in a straight line—in other words, but a small portion of the time. Most of the double-drivers I have tried have come to a stand almost as soon as the hand is removed from the wheel. Will some of your correspondents try their machines and give us the results?

What I believe we want is a simple, light, easy-running machine, free from all complications, and if the makers would only turn their attention to these points instead of taxing their ingenuity to invent needless schemes for hill-climbing it would be better for all parties, and we shall get up our hills fast enough.

I should certainly recommend "C. J. H." to get rid of his old Coventry and get a modern one: he would be delighted with the change. I had one built lately, and nothing can surpass it for steadiness, easy running, and safety. Mine is only 79lb., or 36lb. lighter than his—a great gain in itself. By all means have the rotatory action. He need not fear having it of the ordinary width: mine is stable enough for anything. I am 6ft. 1in., and weigh above 15 stone, so that I am a pretty good test for any machine.

If "C. J. H." would like to know who made my machine, or any further particulars about it, I shall be happy to correspond with him if he will advertise his address. **Fal.**

TRICYCLES.

[19424.]—As a tricycle rider, and therefore a practical as well as theoretical reader, I am much interested in this discussion, and am very pleased that there is so much agreement between the "facts" of different writers; the points now in dispute mainly consist of questions based on matters of opinion, which must ever be variable, and on which we must for ever differ. For instance, the question of the size of wheels. "Sunlight" and myself have consistently advocated drivers of about 40in., geared to whatever the state of the country may require. Others prefer a larger wheel geared down. Now, it is true, as "Sunlight" says, that a large wheel runs more easily than a small one if geared to the same size, but there is such a great loss of strength in a large wheel that many may, as I do, prefer a little more jar with much more strength. If you always ride slowly and carefully, large drivers may be best, but if you ride for exercise, and drive your machine at full speed over all sorts of ground, then I believe that 40in. drivers will combine strength and comfort as well as may be.

There is an erratum in letter 19378, par 3. The sentence in which it occurs should read: There would, of course, be an increased strain on the bearings of the pedal-shaft with the smaller wheel; but there would, on the other hand, be less friction, indeed, there might be ... on the bearings of the driver-shaft."

I trust our indulgent Editor will permit me to say a word about personalities. If "Sunlight" thinks I have ever intended a gratuitous personal insult by any remark, I would apologise to him for having written anything which can be so construed: nothing could be further from my wishes. Whether my language has been ungentlemanly and discourteous I, naturally, am unfitted to judge, but I certainly followed the example set me in par. 1, letter 19333, p. 184, and assuredly I did not import personalities into the discussion.

The difficulty is this: "Sunlight" says "see letter 19333, and elsewhere," that in a machine running at a certain speed, say, 19 miles per hour, a small wheel makes more turns per mile than a large one, which is quite right: but he further states that a given point in the periphery of the small wheel revolves with a greater velocity than a similar spot in a large wheel which

is not correct, although it would have been so had he spoken of angular velocity, which is a totally different matter. Precisely what I intended to write three weeks ago I, of course, cannot now recollect, but nothing short of insanity could have prompted the words "if he can," in letter 19378, par 1, they are altogether meaningless as far as I can see, so I suppose I must have meant "if he will." "Sunlight" has made the pages of the "E. M." more instructive reading for me; I owe him no grudge, as he seems to think, and I have very considerable respect for his opinions. Only a repeated misstatement of fact with which I chance to be acquainted, coupled with jealousy for the "E. M." itself, can draw from me language such as "Sunlight" rightly deprecates.

Paugul.

[19425.]—I CONGRATULATE Mr. Westropp on the possession of so ingenious a seat. Its motion is always exactly that of a vessel riding at anchor. Would it be improved by a horizontal joint at X, as well as the vertical, so as to provide against side motion? I see he agrees with me about left-hand steering, another advantage of which would be that the driving-wheel (of a single-driver) would be on the right side, thus making it easier to turn sharp to the left at slow speed.

I think the real advantage of slow-gearing is somewhat overlooked. The object is not to gain leverage, which, as Mr. Westropp, in 19328, shows, it does not do, but to enable the rider to maintain the rate of stroke most convenient to him, although his rate of progress is limited by the steepness of the hill. Thus, in a lathe, back gear may, to some extent, be dispensed with by placing the band on the slowest speed of the flywheel and treading slowly and steadily. This, however, is not only fatiguing, but a very slight check at the dead points will stop the mandril altogether, or at least throw the worker out of his stride, so to speak. The back gear corrects this, by permitting rapid motion of the feet, while the mandril revolves steadily at the required slow speed. In other words, the difference of form of effort required, is very similar to that needed to drive a tricycle over a series of, say, 3in. blocks, or over three times the number only an inch high. The work done in each case is the same, but in the former the machine is staggered, if not stopped, at each obstacle, to say nothing of the heavy jolt after passing it, while in the latter case the effort and succeeding jolt at each block will be, in comparison, insignificant. The tendency of open-front machines to tip up is the result of the apparent inability of some makers to arrange in their due relation to each other. The proper sequence would appear to be, first to place the pedals beneath the rider, and then the carriage, i.e., the whole three wheels beneath both. Instead of this, they have in many instances placed the crank-shaft in a comfortable-looking position with regard to the big wheels, and the rider on the top of the axle of these only, the object of this last being to enable a small and light hindwheel to be used. A capacious seat (which is a delusion, as only a narrow strip of the front can be utilised, and thus the weight of the rider is thrown still more forward), and a long backbone, removing the hind wheel still more from beneath the weight, add to the typical effects, and to the consequent vague steering.

I have often wondered why a screw-down brake, *a la* locomotive, is not used. It would have the merits of preventing a too-sudden application of the brake, which must strain the machine terribly (especially if it be a band brake), even if it produces no worse effects; of relieving the hand from a continuous strain; of dispensing with an extra purchase-handle; and especially of preventing the sudden hard application of the brake when in gentle use, often caused by a jolt—a fruitful source of mishaps to single-drivers.

I have lately purchased an "Otto," and, though I have not been able to use it much, owing to bad weather and other causes, yet I think I may venture an answer to A. H. Dicksee (19398).

His first suggestion I do not think at all likely to happen, for the band cannot stretch as chains do, though, of course, I cannot speak authoritatively, since the mishap, if it could occur, would only be experienced by an older rider than myself. In any case, there is ample means of tightening up. The "Otto," on first use, does seem to tend to the gutter when steering is attempted, owing, I suppose, to the slope of the road; but very little practice gets over that. To the other two queries I can confidently say no; in the case of a spurt the pull of one foot counteracts the thrust of the other, and even without straps I find no difficulty. I see "56 Inch" (19443) has answered the second question. I should like to know the reason of his great dislike to the "Otto." The chief fault I find with it is in going down-hill, which is rather ticklish work: but, perhaps I should rather use the word "difficulty" than "fault," for I think more practice is all I want, and the machine has many good points, not the least being its making only two tracks.

This letter, however, has, I am afraid, exceeded

its just limits, so I will say no more on that point at present. **Faber.**

FAURE BATTERY

[19426.]—Mr. J. S. HUMPHREY should proceed as follows:—Take lead-foil, such as used in putting on damp walls; cut the plates, leaving a long tongue at one corner. I made the plates 4in. by 2in., with a tongue 2in. long and about 1/4 in. wide; next take some flannel. I used common, at 10d. a yard; cut it in strips, 1in. more in length than twice the length of the lead plates, and wider than those plates; then take some blotting-paper and cut it into pieces 1in. each way larger than the lead plates; mix one part of sulphuric acid by measure with 10 parts of water by measure, and with this and some red-lead make a paste; now paint over one strip of flannel, on one side only, with this paste, leaving a 1in. margin of clean flannel all round; paint over one of the lead plates on both sides, keeping the tongue clean; lay it on the painted flannel, and double the flannel over it; lay this covered plate down on any convenient board or piece of glass; on this covered plate lay one of the pieces of blotting-paper, and the blotting-paper is not thick and good, no pieces; prepare another plate of lead with the flannel and red-lead as before; place this on the top of the blotting-paper, taking care that its tongue is on the opposite side; lay another piece of blotting-paper, and so go on until you have a pile of as many plates as will go easily in the jar or cell you intend to use; then tie the plates round loosely in a couple of places with paraffined twine; pinch the tongues on one side together, and those on the other side together, and attach terminal wires; put the bundle of plates into the cell, and fill up with the acid and water, and keep it full. I have tried this and found it answer. **H. B. T. S.**

LANTERN POLARISCOPE, &c.

[19427.]—My method of making unsanded glasses is as follows:—I first get a piece of flint about 1/4 in. thick, and drill a hole into it about 1/4 in. diameter; I then take a piece of ordinary glass, such as is used for looking-glasses, and cut it into squares about 1 1/2 in. across. These unsanded ones only require grinding upon the edges, and make them perpendicular to surface. Round ovals are chipped to shape with pincers, pliers, or other suitable tools, and then ground smooth on the edge. This may be done upon a softish glassstone. Have ready a good fire, with a sized opening in the centre, and as little dust as possible or loose particles of coal about as possible. Throw the grate and into the middle of the opening lay a piece of smooth slate, so that the fire may be equidistant from it top and bottom. Place the glasses upon the slate one at a time, and keep them turned round during the time they are getting hot, so that the heat may be equally distributed over the surface. I find long pipe stumps are best for turning them round; metals stick to the sides and spoil them. Just as the glass is about to become pasty through the heat, turn it out of the fire upon the slate, and with pipe-stem slide them upon the iron, so that they may be with centre of glass over the hole. If they are not placed centrally over the hole, the instant they touch the iron the figure will not be a good one. Unequally heated the figure will be bad, and any kind of dirt falls upon the slate or glass, as to touch the soft surfaces they will be made scabby. Many of the glasses fly to pieces while cooling or some time afterwards. My most beautiful ones have only been a joy for a few weeks or months; but three—a square, round, and oval—I have had now fifteen years. They have been shown by myself and others at I don't know how many different places, undergoing a considerable amount of ill-usage, and are still in quite equal to any I have seen. I have had many calcites. These are quite easy to grind, and are not to amateurs so easy to polish. I, therefore, when ground sufficiently thin and of good factory, give them to an optician in town, who polishes them for me at 1s. 6d. each. I have cut and polished quartz, and thrown away an immense amount of labour for little result. The optician referred to above cuts and polishes them for me at from 2s. and upwards according to size. One with inch aperture costing 2s. 6d., and "L. R." will see that, if he goes the right way about it, there are better ways of getting such things than making them oneself. Of course, in the case of quartz, I find my own crystal and send it for the workman just where I want it.

THE DESFORD JUNCTION ACCIDENT

[19428.]—THE Desford accident has been the principal topic of interest and conversation in the railway world, and I am able to state, without hesitation, that all engineers who considered the facts of the case agree that, under the circumstances,

beg to say, since I gave the above process in the "E. M." a friend of mine down north has made some very nice soap by the above process. I have not yet made any myself.—*IRON HORSE.*

[44701].—**Tempering of Circular Saws.**—You want special plant, for I understand by your query that you want to make your own. The cheapest way would be to get some German plate, such as the butchers' meat-saws are made from, and cut them out; that is what I used to do years ago, and purchase the plate at 2s. 6d. per pound. You would want two cast-iron discs, 6in. in diameter and 3in. thick, nicely faced, to chill them upon; two cast-iron tiles, to form a muffle to heat them upon; and a cast-iron pan, 1in. thick, 2in. deep, and 6in. in diameter, for tempering; and after you have gone to all the trouble and expense, it is doubtful whether you would get five per cent. fit for use. But if a sketch of the appliances would be of any service, I will forward it to you, if you like to advertise your address, as it would take too much space, and cost too much to engrave.—*JACK OF ALL TRADES.*

[44820].—**Patent Wrought Nails (Sharp Points).**—I was in hopes that some one of your readers more conversant with the subject than myself would have replied to this question, as I have thought about it for a long time, and have made a machine for the purpose, which performs tolerably well, but am at a loss to know how it can be made to pay. The nails are evidently made out of flat-pointed nails by being cut from each side of the point, and some have undergone pressure as well. I can conceive no other than placing them each by hand; it must be a much slower process than making the nails. I have no doubt that many of your readers are acquainted with the process, for to my knowledge it has been done for this last twenty years. There can be no patent-right existing in the matter. I hope that some of your readers will be good enough to describe it.—*DONCASTER.*

[44855].—**Induction Coil Peculiarity (U. Q.)**—The shock is greater the greater the quantity of electricity passing through the body, and as the body offers considerable resistance, a pretty high tension is necessary to drive any considerable quantity through it; but in the coil described, though the tension is high enough, the resistance of the long thin wire is, I should say, so great that no great quantity can be made to pass it with the E.M.F. at disposal. A long spark does not necessarily mean a strong shock; witness the difference of the shock of the 4in. or 5in. spark of a friction machine, and 1in. or 1in. spark of a jar.—*J. BROWN, Belfast.*

[44888].—**L. and N. W. Engines.**—In reply to "W. B. P." I beg to say that 1158 is a six-coupled coal-engine, and has, I think, 5ft. wheels. It is stationed at Doncaster (?) shed. The others I know nothing about.—*IRON HORSE.*

[44853].—**Balance - Weights of Loco. Wheels.**—As "Essar's" reply to the above, in our last issue, is not satisfactory, I venture to supply the following formulae, remarking that they are the logical outcome of perfectly definite mechanical principles, neglecting the effect of the obliquity of the connecting-rod on the alternating forces. In practice, this effect is appreciable; the formulae can only be used "to find a first approximation to the required position and weight of the counterpoise, but the final adjustment is always performed by trial, the engines being hung up by chains attached to the four corners of its frame, and the machinery set in motion; a pencil attached to the frame near one angle marks, on a horizontal card, the form of the oscillations, being usually an oval, and the counterpoises are adjusted until the orbit described by the pencil is reduced to the least possible magnitude. When the adjustment is successful, the diameter of the orbit is reduced to about 1-16th of an inch" (Rankine's "Steam-Engine," page 531). "Essar's" reply might lead some of our readers into the error of supposing that the counterpoises were to balance the weight of crank and reciprocating parts. Their true purpose is, I think, to counteract the alternating forces caused by the difference between the pressures on the piston and crank-pin, the former being alternately in excess and defect, this effect being due to the fact that, whilst the motion of piston is being accelerated, a part of the steam-pressure is used up in producing motion of the piston, &c., and whilst the piston is being retarded, its energy is used up in producing a pressure on the crank-pin, in addition to that due to the steam-pressure. As these are in opposite directions on the two cranks during parts of the stroke, we have couples alternating in direction, which, if not compensated for, would cause the loco. to wriggle about, and probably be thrown off the line. As the compensating effect of the weights follows the same law with relation to speed as the effect of inertia of piston, &c., in producing alternating forces, I think that an engine adjusted for one speed would also be adjusted for another. As the position of the cylinders must be taken into account

in performing the adjustment, the principle stated in "Essar's" remark respecting inside and outside cylinders, is involved in the calculation.

W = weight of piston, piston-rods, connecting-rods, and a weight having the same statical moment as the crank.

" = radius of circle which centre of crank-pin traverses.

b = radius of centre of gravity of counterpoise.

2' = distance between centres of wheels measured parallel to the axle.

2" = distance between centres of crank-pins, measured parallel to the axle.

θ = angle which line drawn from centre of gravity of counterpoise to centre of axle, makes with the plane through the axle, bisecting the angle between the cranks.

π = weight of each counterpoise.

$$\tan. \theta = \frac{c}{d}$$

$$\pi = \frac{W}{\sqrt{2}} \frac{a}{b} \sqrt{1 + \frac{c^2}{d^2}}$$

The angle which "J. F. C." asks for is $135^\circ + \theta$.—*J.*

[44935].—**Galena-Plating.**—I have heard that the process is practically a failure, but why, I cannot ascertain; and I have never met with anyone who had seen the plated articles.—*J. T. M.*

[44938].—**Indian Dialects.**—The proper Afghan dialect is "Pushtu," or "Puktu"; but Persian is much used. In Beloochistan there are two dialects, "Belooche," similar in idiom to modern Persian, but differently pronounced, and Brahovehes.—*DONORRY.*

[44942].—**Calculating Weight of Rivets.**—I do not know of any rules such as "F. D." appears to want, but I think he will be able to gather some information on the subject from Nelson Foley's "Mechanical Engineer's Office-book," published by Lockwood and Co.; "Jordan's Tables," published by Spon, will give the weights and spacing for shipbuilding, and there are some notes in Molesworth's "Pocket-book." For boiler-work, there are good rules in Nicholls's "Theoretical and Practical Boiler Maker," published by the author, Bell-lane, Bramley, Leeds.—*S. M.*

[44944].—**Heating Gas-Bath.**—I think "Gas-bath" would find a remedy in some of the appliances devised by Mr. T. Fletcher, of Warrington. At all events, he might get his catalogue, and see whether he cannot get an idea from it. If the burner works all right when the exit pipe is not attached, it seems rather strange that it will not work when, by adding a pipe and practically a long column of heated air, the draught ought to be increased. I should say try a solid-flame burner.—*ESSAR.*

[44951].—**Ship-Stove.**—A coal-stove is best, and the heat can be controlled by regulating the draught, by means of valve in flue, and also by close-fitting plate to slide under grate.—*T. J. M.*

[44962].—**Dissolving Gold, Silver, Platinum, and Copper.**—The plan made use of in this experiment was not the one I had made up my mind to follow beforehand, but circumstances alter cases, and the "modus operandi" had this time to be altered to meet unforeseen difficulties which made their unwelcome appearances. I may say that the assertion made by "Would-be Piper," that nitric acid dissolves silver from an alloy, leaving the gold undissolved as a black powder, is true only in a limited sense; if the quantity of gold is small in proportion to the silver, it is a fact; but when the gold reaches a certain amount it protects the silver, and nitric acid is without action on such an alloy. Dr. Ure, a good authority, says "it is indispensable that the weight of the silver be at least double that of gold," to permit of a successful parting or separation by means of nitric acid; and alloys containing more gold than this proportion must be brought to it by addition of fine silver, and fusion before being refined. In fact, a more advantageous proportion is that in which the gold only constitutes one quarter of the whole alloy, and the making of alloys to this standard, by addition of fine silver, is termed "quartation." I object to the method of reducing silver chloride by means of fire and carbonate of soda, as, if one has a tolerably large quantity to operate on, a furnace is required, with crucibles, coke, heat, glare, dust, dirt, discomfort, and all other et ceteras. If the chloride of silver is impure, containing paper, dirt, &c. (photographers' waste), then this plan is, perhaps, the best to follow; but with pure chloride a much easier method may be used. The reduction by means of zinc and acidulated water is also defective, as proving a means of contaminating the resulting silver, with lead, carbon, cadmium, and the various metals associated with commercial zinc; and here I may say, though I have paid a very high price at first-class houses for so-called pure zinc, I never got any which did not leave a considerable residue on solution in acid. In fact, I never saw any pure

zinc. Certainly, the contamination spoken of may be partly avoided by inclosing the cake of zinc in use in a bag of calico, or filter paper, which will retain the undissolved portion. Having made these preliminary remarks, I will give an account of an actual experiment carried out successfully lately, which will show a few difficulties encountered and overcome, and give roughly the composition of the substance which dentists call gold, and charge for as such. Received from a friend, an old gold dental plate for conversion into chloride of gold for photographic use. It was weighed (112.4 grains), beaten up so as to enter a glass flask, put in the flask, and a mixture of three parts pure hydrochloric acid to one part of nitric poured on, heated on a sand-bath to hasten the action, and left to itself. After several hours' digestion and energetic action, there was apparently no alteration in the bulk of the plate, so I used a glass rod to ascertain the reason. The plate had become dull and lustreless, and, by means of the rod, portions of a thin crust (chloride of silver) could be detached, showing the bright metal underneath. Proving difficult of removal, this skin was dissolved by means of strong ammonia, after pouring off the acid solution, and washing the plate. After washing, I started action again with new acid, continuing digestion until the crust of chloride formed required removal, which was effected as before. By means of these alternate applications of acid and ammonia, I effected solution, though only after the expenditure of a considerable amount of time and trouble. The two solutions, acid and alkaline, were, of course, kept separate, so I had the plate in the form of a green solution, and the silver an ammoniacal chloride in liquid form. They were treated as follows:—(1) Gold Solution. Evaporated in water-bath to drive off excess of acid, diluted, and added oxalic acid solution. Instead of the expected gold powder, a greenish precipitate fell, which was set down as oxalate of copper. Removed by filtration, and to avoid further trouble from this complication, a proto-sulphate of iron to separate the gold from the filtrate, which it did readily in the usual form of a brown powder. This was filtered and washed aside for a time. (2) Silver Solution.—The ammoniacal solution, which, in the interval (after several days) had let fall a small quantity of dark-coloured sandy crystals, was mixed with hydrochloric acid, the crystals being treated with ammonia, in which process they, too, gave a deal of trouble by proving extremely insoluble. Consequently, I mixed the white chloride and the crystals together, added strong potash solution, a little sugar, and attempted to boil the mixture so as to reduce the silver. On applying heat, an explosion took place, throwing out a small quantity of the contents of the dish. When a second attempt was made, a similar result followed, likewise after a third trial. It appeared that fumes of silver had been formed by the action of potash on the dark-coloured crystalline compound of chloride of silver and ammonia; so I filtered the mixture after dilution, washed and burnt in filter-paper, and, to the ashes and bulk of precipitate, added strong nitric acid. After acid had stopped, muriatic acid was put in, and gold chloride of silver which was easily and safely reduced by boiling with sugar and potash solution. The resulting silver powder was filtered and washed aside. In my estimation, this is the process for working up waste chloride of silver, introducing no impurities, as zinc does, requiring no furnace, crucible, and leaving the silver as a grey powder, extremely easy to wash, and easily soluble in nitric acid; but the chloride must be insoluble (not fused), and reasonably pure, must be well stirred while reduction is being effected, or it will jump and splash about. When operating on large quantities, a lot of steam may be used for boiling, and away with the jumping. The potash (or soda) must be in strong solution; very little sugar is wanted. (3) Precipitate of Oxalate of Copper.—This proved on trial, very insoluble in acid, but dissolved readily in ammonia, giving a deep blue solution. After washing and burning the little filter which contained the above precipitate, the ashes were dissolved in aqua regia, and gave up a little gold; proto-sulphate of iron: this was, after washing, added to the bulk of the gold thrown down before. The deep blue fluid containing the copper chloride boiled, gave up its metal as sulphide to a current of sulphuretted hydrogen; and the filtrate from the precipitated gold was also treated with the gas. The mixed sulphides filtered, washed, partly dried, were roasted until all sulphur escaped. The roasted residue was partially dissolved in sulphuric acid containing a little nitric filtering and adding hydrochloric acid a chloride of silver fell, and, being reduced with potash and sugar as before, its metal was of the larger bulk already obtained. The filtrate the chloride of silver containing the copper, digested at a gentle heat for a few hours on a clean iron wire, gave up its metal, which collected on a filter, and the filtrate, on boiling showing no copper, was thrown away. The

residue from the roasted sulphides, together with filter-paper I calcined, during which on its power of maintaining incandescence in cold coal-gas, was noticed. The incinerated dissolved in aqua regia, and filtered, gave, on 1 of sal-ammoniac, the characteristic yellow fine double chloride of platinum, and ammonia the quantity was too small to be worth treatment. I don't think the platinum was with the other metals; there had, probably, bit of platinum wire used as a rivet. The powder was now fused on charcoal with a blowpipe, and gave a splendid little button gr. weight. The silver, similarly treated, a beautiful bead of 22.5gr., and the copper dull bead weighing 11.2gr. Results tabulated below.

Gold (button)	69.3gr.
" used as powder	2.5 "
Silver button	22.5 "
Copper "	11.2 "
Platinum	1.0 " (about)
	106.5

g a loss of 5.9gr., not very satisfactory ly, but probably accounted for by the ex- while reducing the silver. The item- used as powder" was a small quantity dis- used by my friend before the completion riments, for his toning bath. The button of s next dissolved in nitro-muriatic acid, and are completely in one hour, though the l plate had required a day or two's time, being much thinner than the button. The s, being evaporated nearly to dryness, was up with a little hydrochloric acid, again ted on water-bath until, on cooling, it be- mass of crystals, and finely diluted to the ion degree.—J. W. B.

8.]—**Permanent Ink Photographs.**—No practical acquaintance with the process I to, I do not care to answer the questions; but if John Halé could get hold of the *Journal of Photography* for 1878-9 (the ear more particularly) he would find an g series of articles on the photo-mechanical g processes by Mr. Bolas.—PHOTOS. [See No. 774.—Ed.]

10.]—**Dissolving Paper.**—This can be done ther sulphuric or nitric acid, or a mixture wo, heat being applied if necessary to assist ation; but of course not without altering the aents of the paper.—PHOTOS.

4.]—**Oxyhydrogen Microscope.**—I am to "Antares" for his letter correcting an of mine, and I am really sorry to have to n more decided terms than I did in my former Instead of merely saying: "Answer 45044, lth—You cannot use your micro-objectives OH microscope," I will go still further y that there never has been a good quality objective that could be used with any degree ess with the OH microscope. I believe I am, ways have been, desirous to tell an amateur et truth, founded upon absolute experiment, the present case I may merely add that objectives have been used by me in every able and inconceivable way for lantern es, but they bear no comparison—no, not as ocheese—to the ordinary achromatic powers. ave made hundreds during the last 20 I have no doubt that an amateur may fied with a small disc with fair illumination v powers, but when it comes to exhibiting m—e.g., a Triceratium 6ft. in diameter—I like to put one of our powers by the side of ero-objective, and I have not the slightest if the result. Micro-objectives are not the things to use for OH microscopes, and any r who attempts to use them, unless he is l with a makeshift, will soon find this true. Of course, in speaking of the cro-powers, I do not include the trash sold by people who ought to know

There is one thing in "Antares" letter ould have had a little addition. In g of the use of the alum cell, he is evidently ainted with the best kind of cell. Now dy knows that any transparent body is either s, diathermic, or intermediate, nearer to s the other, and it is also known that a sickness of such a body will stop nearly all at that can be stopped by itself, conse- a second piece of same material will be warmed by the filtered heat passing through w in the microscopic slide the fear in using ot the breaking of the glass, but in the f of the balsam. Now then, this is how I ny troughs: first, a space for alum, say, ap, then on one side of the trough I have nd piece of plate-glass cemented with e balsam, the balsam being about 1-16in.

With this trough slides are much safer ith the old-fashioned alum trough. One ll the whole of the MECHANIC with little &c., that every now and then come up as hings; but then if one did so, someone else

would jump up and say that he remembered Adam doing the same thing ages ago.—W. J. LANCASTER.

[45053.]—**Panoramic Eyepiece.**—Your eye- piece should give a clear disc quite free from colour, both when closed and when opened out within 14in. of the end of tube. If it has a blue haze, then the lenses are not in the right places, or the diaphragm in the eyepiece is out of position. Try first altering diaphragm in eyepiece, then if that is right and the blue ring is still seen, make the hole in brass cap over eyepiece larger. This is very often too small and causes a blue haze round the field; if it still gives the colour, then the lenses are wrongly placed.—W. J. LANCASTER.

[45060.]—**Fossil Birds in Delabole Slate.**—I have seen the fossils referred to by Mr. Barrett in the ENGLISH MECHANIC of Oct. 21. The so-called butterfly is, in my opinion, a good specimen of a broad-winged spiropter, and the so-called birds are parts (halves) of similar brachiopods, with legs, beak, &c., added, to give them the appearance of birds. Of the manufacture of the birds I have not the least doubt.—JAS. BRYANT, Truro.

[45067.]—**To Mr. Lancaster.**—You should have an electro-magnet with cores about 1/2in. diameter, and wire on bobbins 1/2in. deep; then have a long armature with metal striker on the end; get one of the strikers used on large bells, something strong, and of an oblong form; this should be so hung as to strike the gong slowly. The 4 Leclanchés will work the magnet well if the armature hangs downwards; that is, the gong should be under the electro-magnet, and should be so hung that gravity will keep it a little distance in front of gong. The spring can then be a weak one, consequently less battery power will do all you want.—W. J. LANCASTER.

[45080.]—**Barometer by Henry Andrews.**—I can answer the latter part of "J. H. W.'s" query, as I possess a portrait of Andrews, in which he is represented wearing a wig and large neckcloth. It has the following inscription:—"Henry Andrews, Astronomical Calculator to the Board of Longitude, and the celebrated author of 'Moore's Almanack.'" The engraving is signed "J. Watson, pinx"; T. Blood, sculp." My uncle recollects the rather curious request of Rogerson, an astronomer, from Pocklington, in Yorkshire, who held Andrews in great esteem, for his wig, which he (Rogerson) promised to wear when studying till the day of his death. Rogerson had the wig, but whether he kept this singular promise, made about the year 1824, when only twenty-five years of age, I am not able to state. I may mention it as a curious fact, that the portraits of these astrologers, in a good state, are of great rarity.—ARTHUR COURTENAY.

[45081.]—**Photographic.**—The proto-sulphate of iron used probably contained a little free acid, which would naturally attack the print. The reactions which take place in the ferrous oxalate developer are not, I believe, very well understood. The clear solution would doubtless be principally potassic oxalate, and the precipitate ferrous oxalate, or the same converted into some form of persalt.—PHOTOS.

[45090.]—**Telephones.**—All that you want is the primary and secondary coils of a small induction coil. Any of the cheap induction coils will do, or you can make one up with two layers of 18 silk covered for primary, and—6oz. of 32 for secondary; couple primary to transmitter, and secondary to line and earth.—W. J. LANCASTER.

[45091.]—**Rendering Cotton Wadding Absorbent.**—Boil in water made slightly alkaline with either potash or soda, followed by well wash- in plain water.—PHOTOS.

[45092.]—**Silvering Goods by the Electro Process.**—Should there be anything in the construction of the battery which is not understood, I will endeavour to make it plainer; but it is necessary that querists should state what they have done, and what they fail to accomplish. No plating can be efficiently executed without a proper scratch-brush, and although small hand-brushes may be useful at times, they are, when compared with a machine, miserable makeshifts. Circular brushes are sold which can be fitted to a lathe; and here I must say that an ordinary lathe is not the best contrivance, as the operator requires to stand facing the brush. You require a flywheel (almost any sort or size, provided it is sufficiently heavy) with a crank-shaft 12in. or 18in. long. This can be mounted in a frame, so that the treadle is parallel with and beneath the crank-shaft. The workman, therefore, stands at the end of the shaft, and not at the circumference of the wheel, as in an ordinary lathe. Any old lathe-head or contrivance will do to carry the scratch-brush. On the top of the frame will be placed a box with the open side towards the workman; a hole at the back of this box will admit the spindle to carry the brush. The length of spindle will depend on length of crank-shaft, and it (the spindle)

should be higher than centre of box; in fact the position of the brush and the size of box depend on the size of the work, but it is as well to make it full large. The box itself must be lined with zinc, with a slight edge at the bottom to prevent any liquid from escaping. The best liquid for using with the scratch-brush is common porter. This must run in a continual stream on to the brush. Any old tin canister can be utilised for this purpose with a piece of fine tube soldered into the bottom. This tube comes through the top of the box, so that the stream of porter falls just where the brush touches the work, or as near to it as possible. It can't fall exactly in that spot, as the work is held beneath the brush; but it can fall so that the brush carries the liquid on to the work. In what will now be the bottom of the box solder a piece of brass gas-pipe to carry off the porter into a jug or vessel placed on a small shelf beneath, in order that the porter can be returned to the top as often as necessary. Some workmen have a drawer lined with zinc to catch the liquid, but I prefer a jug, as it takes less time, and can be emptied while the lathe is turning. With the exercise of a little ingenuity a small pump might be fixed; this, geared with the lathe, would always keep up a supply. I would send a figure of the lathe, but as I have not the slightest knowledge of perspective I am quite sure it would not be worth engraving. All I can say is that if the above is not plain, I will send to anyone a model from which they can construct one, and for which I should have to charge a nominal sum, just sufficient to prevent those sending for it who don't absolutely want it. There are certain classes of work which require great care in brushing, such as earrings, chains, &c. Watch-chains must be held firmly in both hands, exposing only a small portion at once, just enough for the brush to cover, taking care that the ends hang down well away from the brush. If it is not held securely, or the eye is taken from it for a moment, it will be taken up with the brush, and probably break into three or four pieces. If the brush should catch it don't attempt to hold it, but let it go at once, and direct your attention to stopping the lathe, when you can carefully unwind it. Long earrings can be held by the wire on top end in the left hand, the remainder of the article being supported by the fingers of the other hand.—OS.

[45100.]—**Cube Numbers.**—What I meant by this query was—Do cube numbers possess any properties which distinguish them from other numbers, or is there any mathematical way in which I can ascertain whether any number is a cube number, without extracting the cube-root, or decomposing the number into its prime factors? I know that no number which leaves 2 for a remainder when divided by 4 or 7 can be a perfect cube, or the sum of whose digits is six. Would "M.I.C.E." answer this query and oblige—THE VILLAGE PHILOSOPHER.

[45107.]—**Screw-Cutting.**—Rule for finding change-wheels:—As the number of threads per inch on leading-screw: the number of threads to be cut: the number of teeth of wheel on mandril: the number of teeth of wheel on leading-screw. Example: leading-screw four threads per inch, required wheels to cut eleven threads per inch. As 4 : 11 :: 20 : 55, or as 4 : 11 :: 40 : 110; any wheel may be used to connect the two wheels; in cutting finer threads it will be necessary to use four wheels, and I will now call, for the sake of clearness, the wheel on mandril and the outside intermediate wheel, driving-wheels, and the other two, driven-wheels, and the rule then is, As the number of threads per inch on leading-screw: to the number to be cut: the number of teeth in driving-wheels multiplied together: the number of teeth in driven-wheels multiplied together. Example: required to cut 20 threads with the same leading-screw as before; then, as 4 : 20 :: 40 : 200, but lathes are not usually fitted with a wheel of 200 teeth, and it, therefore, is necessary to use four wheels; find, then, two wheels, which, multiplied together, will give 40, and two that will give 200, but you will not have wheels small enough to do this, so the proportion must be increased 4 : 20 :: 400 : 2,000; now 20 x 20 will give 400, and they will be the driving-wheels, and 40 x 50 will give 2,000, and will be the driven-wheels, or, to get larger wheels, as 4 : 20 :: 800 : 4,000, which will give 20 x 40 = 800, and 50 x 80 = 4,000, thus by altering the proportion various sets of wheels may be got to cut the same thread. To find by calculation if the wheels are correct, multiply the drivers together, and also by the number of threads per inch to be cut, and also multiply the driven wheels together, and by the threads per inch on leading-screw, and if correct, the two results will be similar, thus taking the last example 20 x 40 x 20 = 16,000, and 50 x 80 x 4 = 16,000. Should you not understand the above, I shall be happy to write if you will publish your address. To grind tools to the proper angle 55° buy a screw-cutter's gauge, price 1s. 6d., from Churchill and Co., or any good tool-shop.—C. E.

[45109.]—**Electric Lighting.**—Your queries

are not answerable in anything less than a page of the "E. M.," but if you refer to back numbers, you will find much of the information you ask for. You will find there are a great many difficulties to get over in conveying the current requisite for lighting 50 incandescent lamps over a distance of one mile. To get anything like a steady light, you would require from 30 to 40 horse-power at the water-wheel. Incandescent lamps are very beautiful with a steady current; but when the current fluctuates, then the light becomes absolutely painful.—W. J. LANCASTER.

[45110].—Indigestion, or What?—I have had a good deal of experience with persons who describe symptoms similar to those which "Lighen" complains of. I can assure him that medicine will do him very little good. It is pretty clear that the food which he takes is too heavy for his stomach, and that he must either eat less in quantity and of a different quality, or else he must get some hard labour, and do it nearly every day. If he has not time to attend to this he must live upon fish, milk, and fruit. During the night he suffers from the after-effects of bread and tea, both of which are injurious to a sedentary man.—H. BARNABY.

[45111].—Secondary Batteries.—You can use the red-lead almost in any form, but it is best when spread as a powder on to the plates; still, I cannot see any objection to your method, and it would be worth a trial.—W. J. LANCASTER.

[45122].—Contact - Breaker.—Remove the pieces of platinum-sheet from contact-breaker, and drill a small hole in, then rivet a piece of platinum wire into this; you will then have a connection that will be good for years, and will not annoy you as your present one does.—W. J. LANCASTER.

[45123].—Gas Fires.—It is very erroneous to suppose that a very dry atmosphere is invariably irritating to asthmatics: what benefits one is death to another. I know of one who was ordered by a doctor in London, whom he had been advised to see, to inhale steam. He did not do so, having been already nearly killed by that very remedy. No climate suited this asthmatic better than, nor, perhaps, as well, as that of Egypt, where the atmosphere is so intensely dry as to give some people headaches.—PAUL.

[45132].—Change in Pitch of Railway Whistle.—A very simple experiment can be made illustrating the cause of the difference in pitch of railway whistle, by striking a tuning-fork and holding it to your ear quite still, then suddenly move it away, the pitch will fall; bring it up quickly, and the pitch rises; then at rest it will fall slightly. After you have done this, draw the waves going from fork in these three different ways. One series, say C, 256 per second, fork at rest, then fork going away, consequently, longer vibrations, say 250 per second; and, again coming up to ear, being shortened, and, perhaps, 260 vibrations per second. By drawing these waves, you will at once find that the number of waves entering your ear in one second will be respectively 256, 250, and 260, thus giving considerable differences in pitch.—W. J. LANCASTER.

[45135].—Mathematical.—"Felix's" equations are thus easily solved:—No. 1. Multiply the second by $-a$, the third by ab , the fourth by $-abc$, the fifth by $abcd$, and then add the equations so multiplied to the first; y, z, t, v will disappear, and there results:—

$(1 + abcd)x = P - aQ + abR - abcS + abcdW$, whence x . We then get in succession y from the first equation, z from the second, &c. I have assumed that de in the fourth equation is a misprint for de ; if not, the first four equations give by the above method

$$(1 - abcd)x = P - aQ + abR - abcS.$$

No. 2. Writing X, Y, Z , for the reciprocals of x, y, z , respectively, we obtain the equations in the form

$$aX + bY + cZ = d,$$

and then, eliminating Y and Z by the usual methods, we get the value of X , whence

$$[d(b'c'' - b''c') + d'(b''c - b'c'') + d''(b'c' - b''c)]x = a(b'c'' - b''c') + a'(b'c - b''c'') + a''(b'c' - b''c)$$

with similar values for y and z .—R. E. B.

[45142].—Braashear's Silvering Process.—Mr. G. H. Farrow, in his explanation of this process, describes several chemical reactions unknown to the majority of chemists, and mentions some interesting bodies which would be highly prized by the Museum of the school to which I have the honour to belong. Especially we should be glad of a specimen of nitrate of ammonia which has been thrown down as an insoluble compound of nitrate of potash and silver, and if Mr. Farrow would favour us with a sample of the combination of grape sugar and nitrate of potash, which he describes, we should be very grateful to him.—L. R. L. SQUIRE, E. M. OAKLEY, Clifton Cottage, Clifton.

[45150].—Leclanche's Battery.—My own experience is, that when the binoxide is crushed, it is not nearly so good as when in pieces about the size of peas, quite free from dust; then the battery works at its best. The gas-coke is also best when about the same size, and be careful in having a good mixture; don't have all binoxide in one place, but as much intermixed as you can possibly get it.—W. J. LANCASTER.

[45155].—Electrical.—You cannot determine resistances unless you have a series of coils and a bridge. There are many kinds of makeshifts, but they are all to a degree quite worthless. Better use the right thing, and have results worth the trouble of getting them.—W. J. LANCASTER.

[45161].—Economy of Electric Light.—From an economical point of view the arc is cheapest. That is, you get greatest candle-power for your outlay: but the arc is too brilliant for ordinary purposes, and then the more expensive incandescent lamp comes in useful. At present it is impossible to give an absolute cost for the carbon incandescent lamp; they do use up an immense amount of current, and where power is no object they are useful.—W. J. LANCASTER.

[45190].—Damp Piano.—The very title of this query is suggestive of the only real remedy; as, indeed, is plainly enough exemplified by the fact that when it is dried by the fire it is all right for the rest of the day. To say that the "next day it is as bad as ever," only proves how very ill-adapted the room is for an article so sensitive to damp as a piano. I might recommend "Bucks" to take the hammers off the wire and broach the centres, but I am afraid that—for one who, with twenty dumb notes to weary his patience, had yet enough on hand to await the arrival of a tuner to take out the action—the chances are he would never get them on again. And even if he succeeded in doing so, a removal to drier premises would render the centres so loose, that whenever a lively tune was played it would be to such a castanet-accompaniment that even dumb notes would be preferable. It is also possible that the binding is between the forks of the hammer-rail metal; if so, directions to remedy were given in No. 818.—W. H. DAVIES.

[45196].—Paper.—All paper changes more or less by the action of light and air, but a good deal depends upon the nature of the materials used in the manufacture, paper made from wood pulp and other similar materials being much more easily affected, I believe, than that which has been made from linen or cotton rags.—PHOTOS.

[45197].—M. S. and L. Engines.—Smith's vacuum brake is in use on the above railway. I don't know dimensions of the above engines (bogies) and should also be glad if some one could give them.—IRON HORSE.

[45198].—L. & N. W. Engines.—In reply to "Diomed," No. 24 shed is at St. Helen's, according to the list published in the "E. M." Ruby (194), I see, in a back number, is a 6ft. 6in. single, with outside cylinders. Kestrel (the old one) was 344, 7ft. single outside cylinders, 16in. by 22in. I see in a recent number of the "E. M." (43643, May 20), the new Kestrel is 852. [45201].—Velocipede (187) is same class as Kestrel: see above. [45215].—In answer to "W. B. P.," Peel (127) is one of the "Lady of the Lake" class—i.e., 7ft. 6in. single drivers, 17in. by 24in., outside cylinders. Prospero is, or was, No. 414. Patterdale, 381. Latona is same as Ruby (194), see above; number of Latona is 927. [45218].—In reply to "E. W. J.," I give the following:—Mabel (619) and Bredalbano (789), I see, by late "E. M.," are both "Precedents," and built last year, see "E. M." 45085, No. 866, Vol. XXXIV. I give dimensions of Mabel as taken from the list of the engines shown at the Newcastle Exhibition, at which was Mabel:—6ft. 6in. drivers, four coupled inside cylinders, 17in. by 24in. The Auditor (1173) is a Webb's four coupled, and I think is at Crewe (15). Prosperpine (871) is also a Webb's four coupled, date 1878, and was at Northampton (6). I forgot to say, for "Fortuna's" [45201] information, the number given above of Velocipede is taken from a several years' old "E. M." I see "Fortuna" gives the number as 1932; perhaps 187 has been scrapped, and 1932 is the new one; if so, I know nothing about 1932. Engines not named I know nothing about.—IRON HORSE.

[45199].—Regilding Picture-Frames.—They are first dusted, then washed off with a sitch and all repairs done, mouldings glued up, and ornaments made good with pine or composition (consisting of glue, whiting, and linseed-oil worked into the consistence of stiff putty). The dressing consists of finely-washed whiting and crystal size or clear parchment size. For matt—i.e., dead gold, oil gold size; for burnish, clayed, and parchment size; the clay is good fat pipe-clay, well washed, and a small portion of plumbago mixed.—JACK OF ALL TRADES.

[45202].—Electric-Bells.—If platinum is too

expensive, then you had better tin pieces. Or, if you boil them white, it good for a long time. Nickel has been fairly successful, but not a b when the parts have been boiled w LANCASTER.

[45204].—Bichromate Batteries.—reduce the current down to about one bichromate is sufficiently unsatisf coupled in series in the ordinary way them all in one vessel would be to m more unsatisfactory.—W. J. LANCASTER.

[45205].—Small Circular Saw.—1½in. deal is quite enough to cut with bench, and "J. W. R." will find inch for him to cut if he has much long l up. The best and handiest treadle s I ever knew or used is one of M raising and falling spindle (4½in. or 5 the best). If "J. R. W." will send I H. Brooker, Sidecup, Kent (or thro through will make him a drawing and full I H. B.

[45206].—To "Sunlight."—My abandon the present engine and mak new one. I am not much given to so I thought about 3½in. by 6in. stroke: pressure would be better. What is yo that? Or if you could advise me more and the size of a low-pressure in r same; also, at the point of cut-off I thought of having for the reversing and collar, with spiral slot. I think is very shaky. I don't understand manage for the condensed water to air-pump by gravity, as you state are outside of the boat; of course t are the lowest. I might be able to i pipe from the air-pump down to the denser-pipes, and in reference to p worked up to 80lb. I have a fair dra of the loco. type. An early answer gestion to the above will be thankfu —AMATEUR.

[45207].—Re-wiring Pianoforte M. W. G., of steel wire for a 5 would be—top octave of 12 notes, N each octave below, Nos. 9, 10, and 11 for the lowest octave, 6 notes of N notes of No. 13 brass music-wire. I would be 1oz. each of the two finer si of the remainder, the price from 4d. t Mr. W. Hughes, 37, Drury-lane, V wholesale dealer, but, probably, couk such small quantities; if not, they c cured from the nearest music-sh DAVIES.

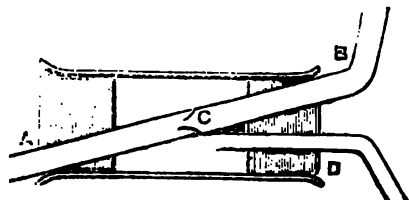
[45208].—Harmonium Queries does not say in what the "swell" c properly-constituted harmonium it sh of box with venetian shutters inclosi of the pallet-holes—that is, the hole the wind (and sound) issues; but I this cannot be the case with the i question. By lowering the whole putting in little stickers to connect t the pallet-stems, it will be possibl swell-box over the top of the pan: but if there is, say, an inch clear space is depressed, a toning-leather, or a b with swansdown, may be placed betw and the pallets. Pedals are easily at harmonium when it is built to suit either independent, which is simple e connected to the manual. In the l usual plan is to take long stickers up the instrument and connect them to k ing the keys. If in "M. D.'s" case t has long balanced keys, it would easier to make the sticker lift the bac instead of depressing the front. Seven been given in back volumes: a fan necessity at some part of the actio pedals actuate the manuals; whan board is provided the channels are s the pedals. The Clavier Mobile is c means of a pipe (rubber, compo., or attaches to a nozzle in the wall by union screw-joint. It is usually a s wind-chest, about 4in. high altogethe keys.—SAUL RYMEA.

[45213].—Electric - Motor for : You could apply either a motor or magnet vibrator to the punkah; but if it would be not only cheaper, but m to have a train of wheels made to giv a pendulum motion, and then you c coolie wind up the weights before g and the coolie could also enjoy th to him would be as great an essentia Any large clock-maker would do the we and I can assure you this would be f ticable than using an electro-motor of a W. J. LANCASTER.

[45214].—Manufacture of Bourdon —They are manufactured of latu

ed with silver solder. The joints are generally la.—JACK OF ALL TRADES.

5217.]—Aspirator.—The following simple will answer as well as anything. Get a glass 3in. long and 1in. bore, and fit a good cork in end, then make three glass tubes and fix them same as shown in the drawing. The tube A is



is diam., the tube B 1in., and drawn to a fine C. It is adjusted so as to blow through the s of the tube A; the tube D is 3-16in. diam., s connected with the apparatus you want to the gas through by an indiarubber tube, and ube B has another indiarubber tube wrapped le with string (to prevent bursting), by which atened to the steam-pipe of the boiler. The must have a safety-valve and a steam- are of 2lb. to 10lb. per inch. The flow of gas uted by pushing in or withdrawing the tube the tube A, altering the jet C and using a r or less pressure of steam.—J. SUTCLIFFE.

219.]—Clark-Webb Brake on the W.R.—In a note in the "Return" recently l, the L. and N. W. say:—"In close coupled mbus trains, such as those running over the and M. D. railways, half the brake-power is for ordinary stops, the other half and the ulic brake on the engine being used as an emency, or when quick stops require to be made. arrangement is now being modified so that river may be able to control all the brakes ghout the train." I don't understand how an be effected as one continuous brake in long s; nor yet how the brake can be made to be ed from either end of a section, which I think e said is not done, for then we should see a t each end of a section. The brake is tacitly nened, and will no doubt be removed in the e of a few years to make way for a continuous s that can be used every stop.—ESGAR.

220.]—Annuity.—If R = amount of £1 for r the P. value of £a due a year hence = $\frac{a}{R}$
Ditto £2a due two years hence = $\frac{2a}{R^2}$

so on.

ie P. V. required = $\frac{a}{R} + \frac{2a}{R^2} + \frac{3a}{R^3} + \&c.$

Let $S = \frac{a}{R} + \frac{2a}{R^2} + \frac{3a}{R^3} + \&c.$

Then $\frac{S}{R} = \frac{a}{R^2} + \frac{2a}{R^3} + \&c.$

$(1 - \frac{1}{R})S = \frac{a}{R} + \frac{a}{R^2} + \frac{a}{R^3} + \&c. = \frac{a}{R-1}$

$\therefore S = \frac{aR}{(R-1)^2}$ = present value required.

Here $a = 10$, $R = 1.05$

$\therefore P. V. = \frac{10}{(1.05)^2} = \frac{10.5}{1.1025} = £4200.$

M. F. N.

221.]—Hanging Tubes in Firebox of a.—There would only be two classes that I had any experience with—viz., the Field and Paxman. The former are pretty good if the fire boiler is kept fairly clean, and as long as keep clean they do good work. The great of failure is, that if fitted to the crown of a boiler firebox, owing to the stays, the cur-lare so obstructed that the proper circulation not so fully take place, as the tubes both draw and discharge into practically the same water, & the same temperature. Add to this, that all of the tube, being in the hottest part of the incrustation is sure to form there, which failure in a limited period of time. When tubes are fitted to the crown of a firebox, as vertical boiler, owing to the absence of stays, a current of water always flowing down next the shell-plates, which is deflected de at the level of the firebox crown, or about, and this upward current, by carrying surface the bubbles of steam freely, greatly the action of the tubes. When we consider ther class of tube, the Davy-Paxman, we a perfectly different action. There the action is different: the water passes in from the side of box, and passes upwards to the crown, the being so strong, that in the boiler of a portable engine, which, when new, was fitted these tubes, around each tube-end on the a-plate all deposit is wanting, owing to the ut thrown down by the deflector washing

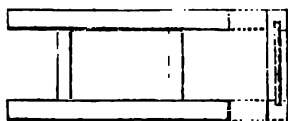
away the deposit quicker than it could form. The tubes themselves, a month or two ago, were perfectly clean inside. One or two new tubes were then put in, but the fact was actually in their favour, as it was caused by the rapid current at the lower end wearing and grooving away the metal longitudinally, due to the speed and friction of the water-current. If you ask my opinion, I should advise this class of tube. But in a loco. I do not care to have tubes at all in the firebox, except a large cross-water tube or hanging bridge; still, where the boiler is short of steam, it is one mode of increasing the power.—SUNLIGHT.

[45223.]—Piston of Fast-Running Engine.—In my opinion, there is nothing better than a pair of Ramsbottom steel rings, as they are light, and will keep tight for a long time. With a fast-running engine, the piston should be as light as possible, consistent with strength. And steel rings are much lighter than cast-iron ones.—SUNLIGHT.

[45225.]—Portable Oxygen Gas-Holder.—The great difficulty is the size of the apparatus. You would want an outer case, say 2ft. 2in. by 2ft. 2in., and 4ft. 6in. high; inside this a gas-bell, 2ft. by 2ft., and 4ft. 6in. inside. A displacement chamber would also be wanted, about 22in. by 22in., and 4ft. high. This holder, when full, would hold 8ft. of gas or so, and, in fact, you might easily compress into it even 9ft. of gas. You would then want four rods at the corner to act as guides to the gas-bell. With such you would require but a moderate quantity of water to fill up the space between the displacement chamber and the outside case. When closed down, it would mean a case 2ft. by 2ft., and 4ft. 6in. high, and this, although it looks small on paper, appears very large when made. I should myself make it of patent tin-plate, well painted or japanned inside and out, and well examined every now and then, to see that no rust is forming on any spot that may have rubbed bare in the gas-bell. If the whole were fitted in a light wood case it would be an improvement, as tending to shield the outer case of metal from being bruised in transit. How would Mr. Chadwick's gas generator and holder suit you?—SUNLIGHT.

[45226.]—Electric Fire-fly Lighting-up Lamp.—This machine (Clark's patent) is not a storage battery, but a manganese battery, working a small intensity coil. The battery is fixed up in a wooden box with platinum connection to the carbon; the coil is on a vulcanite base, and is wrapped up in paraffin-paper; they are both inclosed in the tin case, with the base of the coil next to the side of the battery-box. On pressing the brass key connection is made to the battery, and the coil produces a spark which lights the gas. The coil sold has iron wire for its secondary; if you know how to make an intensity-coil, you can make a better gas-lighting apparatus with 24oz. No. 24 and 2oz. No. 40 silk-covered copper wire, and an iron-wire core about 5-16in. diam. and 4 1/2in. or 5in. long. Use gutta-percha tissue for insulating the secondary wire, and inclose the battery (any kind) in a tin canister. By fixing the coil on the lid, you can look at both battery and coil whenever it is requisite.—J. SUTCLIFFE.

[45228.]—Magic-lantern Slides.—I saw a slide which I think would suit "Josiah." It consisted of a frame, as illustrated, with a groove to



fit slides, and when the slide has been put in position, the frame can be slipped into the lantern. Of course all slides must be of the same breadth.—J. A. H.

[45228.]—Magic-Lantern Slides.—The plan I prefer is to use a panorama holder, which is simply a piece of flat wood the length of three slides, or 9 1/2in. long, with a grooved strip top and bottom, along which the slides slide along. A 3in. circular hole being cut in the centre-place in a slide and behind it a second one—the pushing in of the second one sends the first one forward, so that it exactly comes opposite the circular aperture, and is, therefore, just right to show. When the slide in one lantern is shown; dissolve, and then, by pushing in a third slide in the one holder, the second one is brought into the correct position to show, whilst the one just shown is removed or slid out of the carriage. The advantage is that the slides always come so that they superimpose properly, and if you make it a rule to always change and remove the used slide, there is no fear of the slide being pushed out and falling from the lantern. Unfortunately, hand-painted slides are generally on 3 1/2in. circles, when the plan cannot be followed. I would also mention that the plan I have men-

tioned is only suitable if all 3 1/2in. square slides are used. Persons frequently have to add slides—such as York's, Ferrier's, or Woodbury—occurring in a lecture, and in such case a Chadwick holder is best. In it there are a series of stops out so that you push in the slide to a certain stop, according to its class. For odd slides, this is the best plan I know. But if all 3 1/2in. square are used, I much prefer the first plan. If you cannot quite understand, I should be pleased to either send you a sketch, or lend you a holder to get copied.—SUNLIGHT.

[45232.]—Speed of Boat-Engine.—Your engine is too long in the stroke to do you much good; and the draught of water is certainly extraordinary. Have you correctly stated the dimensions? I fancy not; for a boat 2ft. beam, surely you would not have a draft of water aft even of 24in. But if the dimensions are correct, it is a question of boiler-power. You do not say if it is a vertical one or not. But the size would point to that form. With 30lb. pressure and 24in. draught, if the boiler will make the steam, you might get perhaps four or five miles per hour. But I should not expect to in any way exceed this, if it was attained even; the small size of cylinder in the bore is such that you cannot possibly get much speed. If you are incorrect in the figures, in re-stating the query, let me know all details of the boiler, so that I can calculate approximately the volume of steam that would be available. I am at all times most pleased to help readers, but the data are far too meagre.—SUNLIGHT.

[45233.]—Bleaching Oats.—Is a species of fraud on the inexperienced buyer, and is done by means of the fumes of burning sulphur, sulphurous acid. "One Wishing to Learn" ought not to wish to learn it. If his customers will have bleached oats, he should instruct their taste by showing them how oats are really judged by those who know anything at all of the corn trade, viz., by the smell, feel, and weight of a handful, as well as by the general appearance. Bleached oats may be beautiful to look at, but their fresh smell is gone. The practice is akin to facing tea and oiling beans.—KENTX.

[45235.]—African Languages.—Stanley, in his "Across the Dark Continent," gives rules for the pronunciation. The "m" should be pronounced as if there were a "U" before it, as "Umwafowa," "Umtesa," but the "U" must not be emphasised.—J. A. H.

[45238.]—Raising Boiler-Pressure.—To go properly into this question would take more time than, unfortunately, I can possibly spare from the few hours available to reply to queries in this journal; therefore you must please accept the will for the deed. Approximately, the matter would stand thus: If you increased the steam-pressure and altered the cut-off, so that the same final pressure at the end of the stroke be got, your engine, being a compound, you would only net the gain of power due to the high-pressure cylinder. If I were going to make such an alteration, I should settle on the increase I proposed to make in final pressure of the high-pressure, and hence the actual steam-pressure at the beginning of the stroke of the low-pressure cylinder. I should, therefore, if the parts be all of ample strength, fix on a pressure for the low-pressure engine of, say, 15lb. over the atmosphere. This is easily found by taking the area and finding the volume of steam that would be required at the end of the stroke of the high-pressure engine to give this pressure. Then, by Mariotte's law, find the point of cut-off in the high-pressure with steam at 90lb., which would give a pressure to correspond with the required volume at end of the stroke. Now, approximately, if you were to raise the pressure, and then take a diagram with the cut-off as it now is, the loss of pressure due to condensation, &c., would not need to be calculated, as the diagram would show just where you were in the matter. If the low-pressure diagram showed too much pressure at the commencement of the stroke, it would simply mean shifting the cut-off back, say, in proportion. If the reverse, which is, of course, not likely the other way, Mariotte's law is that, say, a cylinder full of steam at 15lb., if compressed by the piston to half the cylinder capacity, would have 30lb. pressure. If to a third of the space, three times the original pressure, and so on. If not fully clear, let me see a pair of diagrams, and I would help you.—SUNLIGHT.

[45240.]—Beams and Girders.—The pyramid of beams represented in the diagram, presents a curious mechanical problem. Suppose the pyramid to be completed to the apex, and the weight placed on the top, draw two diagonal lines from the weight to each point of support, these lines will represent the lines of pressure or resistance, the vertical element of which will be one half the weight at any point; we may, therefore, suspend half the weight at any points where these lines cross the beams, removing all the beams (with the weight) above these points of suspension, without altering the strains. We can, therefore, suspend W/2 on the lower beam, at each end where the diagonal crosses a

it, which is one foot from the points of support. We can then remove all the beams above the lowest, and we then have a beam 15ft. between the points of support, 12in. square, with a weight $W/2$ suspended 1ft. from each point of support; and we require to find what W will be, in order to (safely) strain the beam to its utmost. If the pyramid is not completed to the apex (as in the diagram) and the diagonals drawn as before, the lower beam will be cut by the diagonal at a point a little further from the point of support, say, 1ft. 3in.; if we call this distance D , the bending moment at any point between the points of suspension will be $WD/2$, and the moment of resistance for a beam is $Ch^2/6$, b and d being length and breadth in inches, C is about 10,000lb. for oak, say, 5 tons; therefore the equation $WD/2 = Ch^2/6$, or $W = Ch^2/3D$ will give us the weight necessary to break the beam by bending. It will be found that $W = 196$ tons, or one quarter of this for a safe strain, say, 50 tons, which is the weight that can safely be placed on the centre of the top beam shown in the diagram. Now as regards the "sandwich" beam: referring to the original diagram, we have two beams which if placed one on the other will make a beam 3ft. 11in. by 15in., this is to be placed between the two iron girders and the whole bolted together, required what weight it will safely bear. Taking the beam first, the bending moment is $Wl/4$, and the resistance moment $Ch^2/6$, or $W = 2Ch^2/3l$, where $b = 15$ in., $d = 17$ in., $l = 180$ in., $C = 5$ tons. $W = 614$ tons. Then we must take the girders into consideration. At page 457 of the number of this journal for July 15th, I replied very fully to a query regarding strains on girders; taking the formula $S = Wl/4d$, S will be the strain on either the top or bottom girder of the sandwich arrangement; the top girder in compression, the lower in tension, the resistance will be the sectional area of one of the girders in square inches, multiplied by the breaking strain of the material. Call this area A , and the breaking strain for wrought iron C , we then get $AC = Wl/4d$, or $W = 4dAC/l$, d may be taken as the distance between centres of gravity of top and bottom girders, or 64in. A for the girder of smallest section is 85 square inches; l is 180in., C is say, 400 tons (the smaller section girder is to be on the top) $W = 1,210$ tons, to which is to be added the 614 tons for the beam, making 1,824 tons, say, 450 tons safe strain; for the other questions, see my former article above referred to.—M.I.C.E. [The sign / is a mark of division.—Ed.]

[45244.]—Vertical Sawing Machine.—By this I take it you mean a fret-saw. I consider to give a querist directions how to make an inferior machine, that would, perhaps, be all to pieces in a month or so, is doing him but little real good. I could give "Romeo" sketches of three or four machines that profess to be easily made, and so forth. If you have, as you state, no appliance for melting metals, it would be far better in the long-run to get proper castings of a really serviceable machine at the outset, than make a cheap-dear one that would be always wanting repairs. I am at all times pleased to help, but I would prefer to do so in a really substantial way. Therefore, if he will construct a good one of metal, I would gladly help by sending him sketch of a simple form that he surely would not find difficult to make as he has a lathe, or if he would prefer it, he could have a casting of the pattern of my own lathe attachment if his lathe be sufficiently high in the centre.—SUNLIGHT.

[45250.]—Ice Yacht.—If you are thinking of constructing, you will save very much time and cost by obtaining Scribner's *Monthly Magazine* for Sept. and Oct. last, I think, in which the very best American yachting practice is very fully detailed, together with dimensions and uses of each part, together with copious illustrations. In fact, it is the best and most reliable authority I have met with on the subject, and gives far more information than could be imparted by a reply.—SUNLIGHT.

[45254.]—Boiler, Loco. Type.—If you look-up the back numbers of this journal, you will find I fully answered this question. The proportions would be in accordance with the required heating-surface. A grate about 4in. by 4in. is quite small enough. The best way to deal with the question is to say size of engine, and I would then tell you size of boiler, length and diam. of tubes, and thickness of plate. But you will find, on referring back, that sizes and all particulars have been given before.—SUNLIGHT.

[45259.]—Surface-Condenser.—Is the engine a stationary or marine one? If the latter, a condenser having two-thirds the area of the heating-surface of the boiler would be found to work well. If stationary, then a difference of dimensions would be allowable. You had better state the class of engine and boiler, steam-pressure, and speed per minute; also how the air and circulating pumps are proposed to be driven, and space available for the condenser. I would then give you dimensions.—SUNLIGHT.

[45260.]—Australian Loco. Driver.—The railway system in the Australian colonies is largely extended every year, and, of course, an increase in the number of men is necessary. A good steady man is safe to get on; but he must be prepared to begin at the bottom.—H. B. T. S.

[45261.]—L. and N. W. Engines.—Soul, Nov., '62; Swan, June, '54; Tiger, Nov., '60; Alchemist, July, '55; Chillington, April, '75; Cygnet, Nov., '61; Hotspur, Oct., '74; General, Sep., '78; Greyhound, Nov., '53; Ilion, March, '68; Nightingale, June, '55; Diomed, May, '63; Napoleon, May, '61; Locke, Nov., '62; Hero, Jan., '64; Waverly, Feb., '63; Caradoc, April, '75; Goldfinch, Aug., 1857.—DIOMED.

[45262.]—L. and N. W. Engines.—Hampden, 1532, The Duke of Edinburgh, 1481, are 6ft. Gin. coupled Ramsbottoms; Victoria, 827, a 7ft. Gin. single, "Lady of the Lake" class. Di Vernon and Merlin I do not know the numbers of. Telegraph used to be an engine on the Great Eastern; the rest, I believe, belong to other companies. I have never heard of them on the North Western.—DIOMED.

[45267.]—Power.—No. The larger the wheels the easier it is to move.—G. F. C.

[45267.]—Power.—The car with the larger wheels would be the easier of the two to push. The frictional resistance would be the same at centre of wheel, supposing the diameter of axle to be alike in each case; but, in the case of the large wheel, there is more leverage to overcome this resistance. A simple experiment, which I will describe if you like, will demonstrate this.—GLATTON.

[45273.]—Cutting-Hoops.—Make them a bright-red heat and lower them steadily and evenly into oil, the cutting edge first.—G. F. C.

[45275.]—Thermopile.—FROM MR. J. MARPLES. —A thermopile of about twenty couples, similar in size to the one described in my former letter, would do admirably for class demonstration. Owing to the comparatively low temperature at which bismuth and its alloy with tin melt, considerable care is necessary in soldering the couples, but a little practice will soon overcome the difficulty. The metal may be readily fused in a common iron tablespoon, and poured into the mould. To make this mould I used half a dozen "type," from which the letters had been filed away; they were then laid side by side, groove upwards, on a piece of glass and plaster of Paris, mixed to the consistency of cream carefully poured over them. When "set" the type may be removed with a pin and the mould baked, then cut a groove in the smooth surface of the plaster for the metal to run in, and having placed a piece of stone or slate on the top of the mould, pour the fused metal into it. Owing to the expansion of the metal on cooling, the bars, when removed from the mould, are sharp at the angles and are ready for soldering. As the bismuth and its alloy with 1-12th part of tin are almost identical in appearance, care must be taken to insure the alternation of the bars in making up the "pile." If "East Anglian" needs further information he will find my address in this number.—JOSEPH MARPLES.

[45277.]—Steam Canoe.—I should have to thoroughly go through the matter before I could tell you the price likely to cost; but I may say that the general price is about £80. I have little doubt that, if properly handled, it need not cost more than perhaps £45 to £50. Very much depends on the fact that if I were to go to a man who would, say, build the hull cheaply, and ask him to quote a price without being able to say that a positive order would be had by the cheapest man, he would most probably quote a figure that would need no consideration on his part except that it would be ample. But if he knew there was an order in the market he would then carefully go through the cost, with the idea of seeing the lowest price he could quote. If you think that the figure I have named would approximately suit you, I would then ask one or two builders a positive price, and could then tell you to a pound or two the cost of carrying out a given specification. For a boat the size I mentioned I should consider three persons a full complement. Speed must in great part depend on the engine-power, but I really think that you must not expect more than six miles unless you so modify the craft that it would be reduced to a wager-boat only, and not a safe pleasure steamer. But my advice is, Do not sacrifice comfort and safety to speed. Six miles in so small a boat would feel going quite fast enough, you would find. On hearing from you on this, I would with pleasure ascertain the exact cost.—SUNLIGHT.

[45281.]—Brush Dynamo-Electric Machine.—If "Galvani" will say for what purpose he intends to use the machine I will do what I can to help him. Is it for plating or lighting? If for lighting, what lamp does he intend to use—arc, or incandescent? If he will advertise his address, I can show him a small machine and explain connections.—G. F. C., Clapham, S.W.

[45282.]—Gelatine Dry Plates.—To "FIXER RESPIRE."—I have tried a great many experiments in the direction indicated, but have not succeeded in getting a "grain" fine enough for my purpose, (i.e., enlarging 15 or 20 diameters) by any such process, worked of course as an ordinary dark-room operation. It can be done by using very dilute solutions of silver and bromide, but it takes several days to precipitate thoroughly, and as the mixing must be very carefully performed it is exceedingly tedious. The handiest means (and the most rapid) of making an extremely sensitive emulsion is that of Dr. Eder, in which he first dissolves the silver nitrate in water, and then precipitates it as oxide by the addition of ammonia solution, and by the continued cautious addition redissolves it, and then adds it to the gelatine and bromide, digests it for half an hour at 93° F., precipitates or cools it, washes, redissolves, strains, and coats—the whole preparation can be completed in 1½ to 2 hours ready for coating. This is fully described in an article, "Gelatine in a Nutshell," in the "Photo. News Almanac for 1881," published by Piper and Carter, London.—FIREM BARNES.

[45309.]—Gas-Stove.—I see "Sunlight" adduces, as proof of his statement that all deleterious gases are condensed in a pan of water by the stove he recommends, the fact that plants thrive in greenhouses heated by it. Surely, if it proves anything, which I doubt, this would show that carbonic acid gas is given off, as plants consume this gas as part of their food.—GLATTON.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, J. Brown, Belfast, has replied to 44855; Iron Horse, 44748.
44681. Honey Slinger, p. 24.
44683. Moulding Glass, 24.
44689. Paper Trade, 24.
44706. Plumbing, 24.
44708. Analysis of Ores by Electric Method, 24.
44710. Violin Making, 24.

44905. Legatees Abroad, p. 122.
44906. Steam Launch, 122.
44914. Fine Surface on Cold Rolls, 123.
44934. Chamber Planes, 123.
44947. Bicycle Route. Preston to York, 124.
44948. Larhe Chucks, 124.
44956. Diamantine, 124.
44964. Kendal Brown Snuff, 124.
44965. Steam Press, 124.
44972. Compact Battery, 124.
44975. Carpenter Brake, 124.
44977. Hydrogen, 124.

QUERIES.

[45283.]—Fossils.—To "F.R.A.S."—With thanks to "F.R.A.S." for his reply, I would say that I do not think what I have taken for barnacles are encrinurans; these I have been very familiar with for years, and saw great numbers of, from the Carboniferous and Oolitic strata. The supposed barnacles are not round or long like encrinurans, and I do not know what part of the fossil they could be. I have many oysters from Kilmurridge clay coated with them, as well as separate specimens from various rocks.—M. A.

[45284.]—Palinurus Compass Corrector.—Can anyone give me a description of this?—H. J. A.

[45285.]—To "Sunlight."—I am in charge of a three-plunger pump; plunger is 4in. in diameter and 8in. stroke, suction-pipe 2½in. in diameter and has about 60 fathoms in length between pump and bottom of suction, but does not exceed 18 perpendicular feet. When I get the pump in working order they all pump for a stroke or two, and then either of the outside ones stops pumping. The delivery-pipes are 2½in. in diameter and forcing water 9ft. above delivery-valve; air-valve on connection next to the pump. I get air in the vessel any time I go to it. I pack the plungers with white rope, neither oil nor tallow on ft. Information on this will oblige.—EUGENE KEEFER.

[45286.]—Amateur Silversmith's Work.—How can I bend silver wire to form rings? When I use pliers they tear the metal. Also, what solder should I use for small articles of silver jewellery? The solder which I have melts at such a high temperature that it is difficult to avoid spoiling the work.—DANIEL THOMAS.

[45287.]—L. and N. W. Goods and Coal Engines.—I should be glad if some kind reader would give description of the above. How many different classes of the above are there?—JESSE HOBBS.

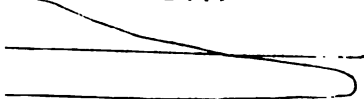
[45288.]—Isle of Man.—I have a small fixed income, a family of three—i.e., self, wife, and one daughter. I want to know what I could live comfortably for at the Isle of Man, to have a nice house with, say, two acres of ground, and to keep a pony, cow, &c. Would two acres support the cow and pony through the year? I don't want to live extravagantly. If any of your readers can give me a few particulars in detail I should feel much obliged.—E. WILLIAMSON.

Gas-Stoves.—Will "Sunlight" be kind enough to give a sketch of the arrangement inside stove, as he has (45089, No. 686, "E.M.")? I have this shape, [3 ft. 6 in. high, one end to an Argand gas-burner, the other over water, that sometimes it will light with slight explosion, and then it gives out a splendid heat, is no smell whatever; at other times when it is very much. Can the arrangement be made to radiate?—F. T. N. B.

Photography.—My thanks are due to "ht" for his kind offer of assistance. I wished a whole-plate size camera with the latest improvements. The price asked by the dealers was quite a means, so I thought I would try and make began by making the parts I thought most important, and what I should be most likely to fail in, so I began first, then the dark slide, afterwards I made frames for the back and horizontal swing, then the focusing-frame, and the dark slide. This I could not do at all, and I am sorry to say I do not quite understand "Sunlight's" description. I will try to get the focusing-frame to the back of the camera, and the dark slide to the front. Now, I do not see how the camera is given so as not to interfere with the rack, and my real difficulty lies in the base-board; the various parts so that each one will work properly. The reversing-frame I mentioned, advertised by a well-known London dealer in the use of it seems to be that it enables the camera to put the focusing-frame and dark slide in without having to put the camera on its side. As I am making it square, and the dark slide take the plates either way, I shall not trouble with it. The focusing-frame, as you describe it, very much, and shall try and fit one. Will you make for wet plates do for dry? And, will you describe the way the plates are put in a double and kept in their places, as I have never had the opportunity of seeing the interior of one? I should like to ask "Sunlight" if he has any objection to my privately with the maker's address of the camera, as I see by an answer to a query in the "Ours," he recommends them for the camera. I have been making my own apparatus, economy." The principal use I should want them for is photograph designs and manufactured goods; I should like to be able to take a group or portrait, so, if not quite so rapid as those made by the camera mentioned would not, I should think, much to be desired.

Horse—Power of Engine.—Will "ht," or some other kind friend, please tell me the power the engine is driving which the diagram has been taken from? Boiler pressure,

F. END N° 40 SPRING.
FIG. 1.



ameter of cylinder, 35 in.; stroke, 5 ft. 9 in.; 25, 35 per minute. Also, be kind enough to tell me the diagram up as plain as possible, as I am a moderate scholar. Fig. 1, F. end, No. 40

B. END N° 40 SPRING
FIG. 2.

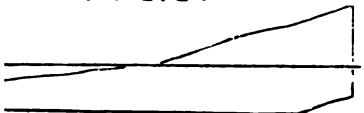


Fig. 2, B. end, No. 40 spring.—A CONSTANT

Breadmaking.—At the head of an engine which will grow much, I should be glad to hear means of breadmaking. I applied once to the Bread Company for information, and found it very obliging. Could anyone give me any on which would enable me to get the speed of their patent? I should study it, and, if I shall get their apparatus.—P. ROBIN, de l'Orphelinat, Prévoist à Compuis, Oise.

Oatmeal.—I have plenty of good should like to have them ground coarse in the Irish way, as the oatmeal is unknown in my where I live. What directions shall I give to the miller?—P. R., à Compuis, Oise.

Texas.—Can any reader inform me about the soil of Texas, and if it would be a likely one to get on in? And, what trade would be likely to pay: farming, cotton or wheat growing, or stock raising? And, if there is any duty to pay that would be brought out exclusively for my?—AN INQUIRER.

Chemical Calculation.—Would N. Cheltenham, who kindly gives a solution of chemical problem proposed by me, do me the favour to explain whence the elements 47 + 104 and equation arise?—PHOTOGRAPHY.

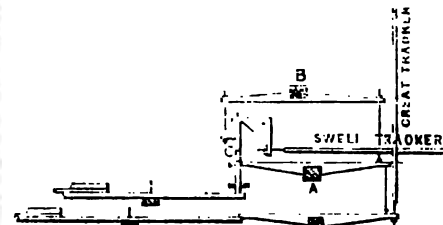
Link Motion.—Will "Sunlight," or P., kindly give me the following information: setting out the above?—Should the radius of the crank be the centre of the crank-axle, or the middle point in a line joining the centres of the cranks, having allowed for lap and lead? may the cranks be set on the shaft, in their

proper places, in a small model horizontal engine?—GUDS YUKS.

Sulphate of Lime in Boiler Feed-Water.—What is the best antidote for sulphate of lime in boiler feed-water, either before or after it gets into the boiler?—GEORGE WILSON.

Medical.—Will Dr. Edmunds advise me—a sufferer for two years from what my medical at first called ingrowing large toe-nails! He said I must have them removed. I patiently underwent the painful operation of having them removed. New nails took their place, and, for four months, all went on well; however, they again commenced to show an unhealthy appearance. The doctor said unhealthy nails had taken the place of those removed, and that I must undergo the operation once more. Remembering the excruciating agony attending the last operation, I decided upon trying some other remedy. By this time a continuous discharge of matter was exuding from the roots of the nails. I was advised to cauterise them with caustic. This had little or no effect beyond causing pain. Afterwards, I treated them with applications of carbolic lotion on lint. I may say this is the only thing I have received relief from; still there is no abatement of the disease. After an ordinary day's walking and standing, there are considerable inflammation and swelling. I have been told that after the nails have been once removed, they have to be done periodically. My general health is good, and much better than two years ago. My age is 20, a baker by trade (which I was recommended to give up 18 months since, and am now doing light work in a woollen factory). Any advice from Dr. Edmunds or other authority will be most acceptable.—DEXTER.

Organ Coupler.—To a small church-organ of about eighteen speaking stops it is proposed to add a coupler to couple the Great to the Swell Sub-Octave—that is, tenor C on the lower manual is required to be connected to bottom C on the upper manual. Although not in "the trade," I have been asked to undertake the work, and shall, therefore, be glad if some correspondents will up in organ matters will give their opinion of the plan here sketched. A is a set of backfalls forming a



manual coupler when the bridge A is raised by the stop. I propose to add another set of backfalls, B, set askew, and connected as shown, so that when a key on the Great is depressed, the swell sticker C, an octave below, is pulled up; the bridge B will, of course, be made movable by the stop action. This is the simplest and most efficient plan I can think of. It can also be carried out without removing any of the existing mechanism, which is a rather important consideration. Perhaps Mr. Dresser will oblige with his assistance and recommendations. The organ is fitted with the usual couplers:—Swell to Great, Swell to Pedals, and Great to Pedals.—J. E. F.

Shoeing Young Horses.—Would some of our kind readers inform me of some efficient plan to keep young horses quiet while being shod? A rough sketch would oblige.—AF IFAN.

Floate of Water-Wheel.—What is the best form of floate for an underbut water-wheel? The diameter of wheel is 10 ft., and the height of water about 5 ft. Which is the best way to apply the water to it?—AF IFAN.

Loco. Injector.—I am about placing a new injector and piping on one of our locos. Would some of our readers kindly inform me as to the best method of bending copper piping from injector to boiler and tank? Also, how to fasten flanges to pipes, and oblige!—W. E. POWELL.

Numismatic.—I have a 6d. of Victoria, 1840, which, on the obverse, is countermarked upon the neck of the bust with a circular stamp: Lion walking, showing left cheek. Legend encircling it, "LITADE. POR. EL GOBIERNO." Wanted, an explanation of this stamp.—W. STAYENHAGEN JONES.

Oil in Watches.—Three years ago I bought from a respectable maker at a high price a watch which he declared to be perfect in every respect. When the weather got cold this perfect instrument lost some four minutes a month, but when I gently suggested to him that the compensation was at fault, he would not admit it. It was due principally, if not entirely, said he, to the thickening of the oil. The next year the variation was less—between two and three minutes a month. Last Christmas I had it cleaned, hoping by that means to improve its going still further, but with this result: its rate was four and a half minutes a month faster in June than in October. Will any of the experienced watchmakers who contribute to your columns tell me whether this exceeds the maximum variation in a good watch from this cause? And, whether a well-adjusted watch should vary 8 or 9 seconds in 24 hours from change of position as mine does?—W. W.

Keyless Geneva Watch.—I have received above, in white metal, works very rough. The train consists of—

Going barrel	80
Centre-wheel	90
" Pinion	10
Third wheel	96
" Pinion	6
'Scape-wheel	30
" Pinion	8

and goes once round in 15 seconds. Would "S. P. W." or "A. F. W." kindly explain, and say who the manufacturer is?—GUYOR.

Iceland Spar.—I should be very much obliged to anyone who would give me directions for completely polishing sections of above. I can get a dull polish, but not a bright transparent one.—MAY.

Strength of Alcohol.—Can any of your readers tell me the strength over-proof of absolute alcohol?—DUAL.

Fusel Oil.—By what means can I find the percentage of fusel oil in samples of new spirit?—DUAL.

Chemistry of Alcohol.—Which is the best book on the subject of "The Chemistry of Alcohol"?—DUAL.

Half-Round Boring Bits.—Are the half-round boring bits used for model cylinder work like the wood-turner's gauge, but solid?—STAXX.

Distance of Moon from Sun.—At what apparent distance from the Sun will the Moon be at Greenwich on the afternoon of the 21st prox.?—AJAX.

Mars.—In what month this winter will Mars subtend the greatest apparent diameter?—AJAX.

Air-Gun.—Will someone give sketches of the parts of an air-gun, showing the action as much as possible?—NIMSON.

Fossils of Ireland.—Can anyone tell me where I can find engravings of the fossils found in the Tertiary and Quaternary formations of Ireland, such as would enable a tyro to recognise them and label them for a collection?—E. C. R., Co. MEATH.

Grinding Outlets.—Will someone explain how razors and pocket-knives are ground hollow, or diamond-edged, as it is commonly called? Will a diamond-wheel grind hollow?—J. S. S.

Cleaning and Frosting Gold and Silver.—Would someone kindly say the proportion of sulphuric acid and water?—GUYOR.

Timing Old Verge Watch.—I have an old verge watch in good going order, which gains three or four minutes after winding for the first twelve hours, then, when nearly run down, loses as much during the last twelve hours. Would "A Fellow Working Man," or "Seconds' Practical Watchmaker," kindly answer?—GUYOR.

Copper Wire.—Having a large quantity on hand uncovered, and wishing to utilise it, am thinking about making a dynamo. The machine for covering I have made from directions given in "Ours," but am at a loss how to get the silk and cotton, and the name by which the particular articles are known in the market. Would any subscriber kindly give me that information?—BETA.

Average Pressure on Piston.—To MR. WOOD OR MR. BROADLEY.—Would you be so kind as to tell me the average pressure on a piston having a 6 ft. stroke, initial pressure 4 lb., cutting steam off three-fourths of the stroke? And, also, the number of expansions? Please show it in hyperbolic log., and oblige.—A FIRE.

Rough-and-Ready Surgery.—Being connected with some large engineering works situated some ten miles from the nearest doctor, I should be glad to know if there is any handbook published which would enable me to acquire such surgical knowledge as would enable me to give temporary assistance to men hurt in any of the numerous ways to which quarrymen and navvies are exposed? Or, better still, would Dr. Edmunds give us a few practical hints?—LANCET.

Removing Chemical Stains.—I have accidentally stained a white linen tablecloth with some aqua regia, in which I had been dissolving some gold. Will any of "Ours" kindly inform me the best way to take these stains out without injuring the cloth?—N. N.

Imitation Flowers made with Liquid Films.—What is the strength of the weak nitric acid described on p. 244 of last issue? Is the acid washed off the wire before plunging it into the glycerine fluid? And, what is Marseilles soap?—AN M.D.

Sulphate of Zinc Battery.—Would Mr. Lancaster give me the necessary information for the construction of the above? And, will it do work of a small pocket coil? Also, will he kindly say how I am to charge anew a "Gaiße Battery" (silver chloride)?—AN M.D.

Faulty Electric Bell.—I have an electric bell and battery contained in a box with about 10 yards of silk-bound wire, and push at the end. When I press the button the hammer strikes against the bell, and remains so as long as I keep my thumb to the button, but when I release the button the hammer is also released. Will some of your correspondents kindly tell me the cause? I have cleaned out and fresh charged it, and it rang for a short time, but it is now the same as before I cleaned it out. I put 8 oz. of sal-ammoniac in the battery, and filled it two-thirds full of water.—ONE IN TROUBLE.

Staining Sections of Wheat, &c.—Information would be acceptable as to best means of staining sections of wheat, barley, &c., for the microscope, so as to colour the starch, skins, albumen, germ, &c., different colours. Also, best medium for mounting same as transparent objects?—MICROSCOPIC.

Hosiery Finishing.—Wanted to know class of machinery for washing and finishing stockings. State machinery and hands required for 200 doz. per week.—BROCKWICK.

Carbon in Steel.—How can I find the percent of carbon in steel while the charge is in a Siemens-Martin furnace?—CARR DE.

[45328].—**Morgan's Process.**—Will someone give particulars of Morgan's paper process for photographic enlargements, mentioned by Mr. Palmer in the paper on that subject in the last issue?—H. B. T. S.

[45329].—**Salicylic Acid.**—To Dr. EDMUNDS.—It is stated that the French Government have prohibited the use of salicylic acid as a preservative for articles of food, as it has been found to be highly injurious. Will Dr. EDMUNDS be good enough to say what is the nature of the injurious effect which is produced by the acid?—H. B. T. S.

[45330].—**Galvanometer.**—I have one of Dr. Dixon Mann's medical galvanometers, showing current in 10,000ths of a B. A. Weber. Will this be of any use to a student in electricity? If so, how are the readings of the instrument treated to show E.M.F., resistance, and current? On coupling up a Daniell's cell, the needle goes beyond the limits of the scale, and against the stops with a bang. How is this?—J. H. B.

[45331].—**Waste Pieces of Oak, Ash, Elm, &c., in Sawmill.**—Can any of our readers inform me what is the best way to turn the above to account? I use a great lot of this wood for fire, and find it does not pay. Are there not machines for making bobbins or reels for thread, &c.? Would there be a possibility of using these woods for that purpose? Do these machines require much power? Are they complicated?—SAWMILLER.

[45332].—**Coil to give Quarter-Inch Spark.**—Would Mr. J. LANCELOT, or any of "ours," say the diameter and length of core, weight, and gauge of primary and secondary wires, if condenser is required, the size and number of sheets, cost of a contact-breaker, and battery power required for an induction coil to give $\frac{1}{4}$ in. spark?—ONE PERPLEXED.

[45333].—**Gilding Japanned Goods.**—How are the gold patterns put on the japanned metal plates and arms of sewing-machines, iron bedsteads, &c.? What kind of gilt, powder, leaf, or liquid is best for this purpose? A practical reply, with particulars as to how to set about it, will be esteemed a favour.—PEARSON.

[45334].—**Reducing Leather Waste.**—I want to reduce to powder leather-cuttings, shoddy waste, &c. Could any of "ours" assist me with practical advice? I am told it is done with hot air or superheated steam. If with hot air, would there be any danger of burning or charring the article? Also, is superheated steam dangerous to use?—CHILD.

[45335].—**Wheaten Flour, &c.**—Would any contributor to the ENGLISH MECHANIC kindly give information as to the prices, properties, and preparation of "wheaten flour" or meal, and "Indian meal" or maize? I can command back volumes, so references will do.—HOUSEKEEPER.

[45336].—**Condenser.**—Will someone inform me in what way does the condenser add to the power of an engine—viz., that a boiler can be worked at a much lower pressure and still produce the same power? And, what are the principal things to be attended to in making a condensing engine as efficient as possible—I mean both in fuel and power?—NOVICE.

[45337].—**Indiarubber not to Stick.**—Please mention how to prevent rubber sticking when poured in a brass mould after being dissolved. Also, how to put on the something to prevent the sticking?—ROS.

[45338].—**Preservative for Iron Ships.**—If some of your scientific and practical correspondents would give us their ideas and experience with regard to preservative covering for iron, it would be, I think, of value to numbers of your readers, particularly in relation to the preservation of iron ships. In London a very general method of coating ship bottoms is: Two coats of zinc white and one coat of tallow; and, to commence a correspondence on the subject, I will put a question. Instead of the first coat of zinc white, could a composition be made up which would adhere firmly to a damp iron surface, be as elastic as oil paint, dry in a few hours, be cheap in preparation, and easily applied. If so, how?—C. W. CLIFFORD, Painter.

[45339].—**Salicylic Acid.** I observe that Mr. Allen, in this week's number, says that "he is not aware" that salicylic acid has any dangerous effects when used in the "very small proportion necessary for preservative purposes." I read, however, in the *Athenæum* for October 16th, the following note in "Science Gossip": "The French Government, it cannot be too generally known, has forbidden the preservation of any articles of food with salicylic acid. This substance has been proved to be dangerous to health when used in sufficient quantity to preserve the substance treated with it." Will Mr. Allen, or someone else, explain? The matter is important.—HOUSEKEEPER.

[45340].—**Disinfectants.**—Would some of the writers in the ENGLISH MECHANIC be kind enough to say what is the proper method of using permanganate of potash as a disinfectant? Also, if chloride of lime is useful for purposes similar?—HOUSEKEEPER.

[45341].—**Motor for Blowing Chamber-Organ.**—I am wanting some small economical motor to blow my chamber-organ, and should be glad if any reader of "ours" would give me some idea from the following particulars:—The organ has five stops (through), Open Diapason, Stopped Ditto, and three solo stops, comprising two in the Swell and three in Great Organ, with Pedals coupled on to the keyboard. The bellows have weights placed upon them amounting to 68 lb., when full organ is on the blowing-lever requires 30 strokes per minute. Bellows are single acting, that is, only supply wind to the reservoir one way of the stroke. I may also mention that there is no water-pressure to be had, and gas is not convenient. Any further particulars shall be glad to give.—NIDDERDALE.

[45342].—**Swelling on Hip Bone.**—If Dr. EDMUNDS should see this, perhaps he would favour me with an answer. I have swelling on hip bone (right leg) caused by carrying weights. The pain is something terrible, runs down to small of knee; most pain is in the groin. It has been like this for about six years. The leg is a shade less in circumference than left. I thought of

trying remedies recommended to "Working Lad" for pain in toe last week. Possibly Dr. EDMUNDS can give something more beneficial.—E. H.

[45343].—**Balance-Spring.**—Many thanks to "Second's" Practical Watchmaker, and "A Fellow Workman" (45296), for their excellent articles on the Balance-Spring Fitting. "Second's" Practical Watchmaker leaves off at the very part I am most anxious to understand, viz., making old springs round and flat when the old spring is out of order. I dare say the cheapest and easiest way is to fit a new spring; but people are not always willing to pay for a new spring, and I am unwilling to give them a new one; therefore, to understand the most easy way to make old springs flat and circular would be of great advantage. If "A Fellow Workman" would kindly explain a little more clearly the fractions, he would greatly oblige—viz., 5 1-5th, 10 2-5th, 5 2-5th, &c. I have read with pleasure his article on Turning in Cylinder in answer to another correspondent, and I would suggest "A Fellow Workman" should write a whole series of articles on Watch-Making and Repairing, and then publish them in book form—omitting algebra and fractions as much as possible.—GUYOR.

[45344].—**Enlarging Photographs.**—Can any brother-reader help me? I am a good amateur artist, and have made myself a good family portrait-gallery by enlarging in oils the photographs of my friends—that is, painting over. I have, however, during the last month, tried six separate times to copy a small vignette of my mother without being able to produce a good likeness, the photo, being excessively small. For the same reason the pantograph is useless. I have thought some means might be devised to render the photo, transparent, and throwing it on a screen (enlarged, of course) so that I might obtain a correct outline. Can this be done? As I have several copies of the photo, I don't mind sacrificing one; and I may mention I am a good carpenter, &c., in fact, clever with my hands. Any advice will be thankfully received by—ONE WHO WISHERS TO BE IT SOMEHOW.

[45345].—**Enlargements from Quarter-Plate Negatives.**—I have read with interest the article in the "E. M." of Nov. 11, on "Enlarging with a Home-Made Apparatus," and would be glad to avail myself of the experience of an amateur like myself, who, wishing to reduce his "kit," has adopted small negatives and has printed enlargements from them. I am at present working with 6 in. by 4 in. plates, and a Hunter and Sands' single lens. I have also a 10 in. by 12 in. combination lens by Lerebour and Secretan. Would it be worth my while to dispose of these and procure a pocket-camera, such as "Le Merveilleux," and enlarge from the negatives on Morgan's paper? And, could my present lenses be adopted to make a suitable lantern? I should be glad if someone would give me a sketch to scale of a suitable enlarging lantern for enlarging from $\frac{1}{4}$ plates up to, say, 10 in. by 12 in. prints, and would also say if such prints would be worth having.—D'ELAC.

[45346].—**Knight's Razor Sharpener.**—Just fifty years ago there appeared in the *Journal of the Royal Institution* an account by Mr. T. Andrew Knight, F.R.S., of a little implement he had devised for giving a keen edge to razors and surgical instruments. This implement was a simple smooth cylindrical bar of hard steel about 3 in. long, and about $\frac{1}{4}$ in. in diameter, and was to be smeared with a mixture of oil and the charcoal of wheat straw. The razor or other blade was to be drawn lightly across the bar from heel to point, varying the angle made by its side with the axis of the bar according to the fineness or strength of the edge it was desired to give. Can any of your readers say what has been the result of experience as to the value of Mr. Knight's invention, which seems simply to be a more delicate variety of the common butcher's "steel"?—J. POWERS HICKS.

[45347].—**Boiler Construction.**—To "J. F. B., York."—I am unable, through want of scholarship, to follow you in the way you have replied to my previous question. If you will kindly show it in plain figures instead, I think I shall be able to understand it. Boilers I allude to are in length 40 ft., in diameter 5 ft., in thickness $\frac{1}{4}$ in., pressure 40 lb. per square inch. My experience during the last seventeen or eighteen years leads me to think (however much it may be in opposition to theory) that the transverse seams are more in need of double riveting than are the longitudinal. During the time I mention I have seen something like nine or ten rents along the line of rivet-holes in transverse seams varying in length from a few inches to four feet, whilst, on the other hand, I do not remember of seeing one such split in the longitudinal. As I happen to be in some degree responsible for the safe working of upwards of twenty boilers, I shall take it as a favour to have the question fully and clearly explained.—VULCAN.

[45348].—**Launch Machinery.**—For a 3 ft. cylinder, 6 in. stroke, in a launch, should a copper boiler suit, 3 ft. 6 in. long, 20 in. dia., with a flue 9 in. dia., which returns into tubes 8 in. dia. to furnace end? There is one cross tube in flue 1 ft. dia. Please say length of fire-bars, width and space, height of bridge, diameter and length of chimney. Copper is $\frac{1}{4}$ in. thick, all joints riveted and brazed, and well stayed. Is 40 lb. safe to work at, or will it bear more? Again, what is proper size, dia., and pitch of propeller? Boat is 4 ft. 6 in. beam by 22 ft. long, goes very slow; present propeller 18 in. dia., 2 ft. 3 in. pitch, 2 blades. Boiler is very hard to raise steam, taking one hour and a half from cold water, and does not keep enough for engine to allow of feeding with water. Could any one suggest any means of more quickly getting steam, as I always want boat in a hurry. Boiler holds about 25 to 30 gallons; exhaust orifice is $\frac{1}{4}$ in. dia. in the chimney, which is 6 in. dia. now. Opening over bridge is 3 in. down from crown of furnace. Bars are 11 in. long, $\frac{1}{4}$ in. wide, $\frac{1}{4}$ in. spaces.—STEAM GUY.

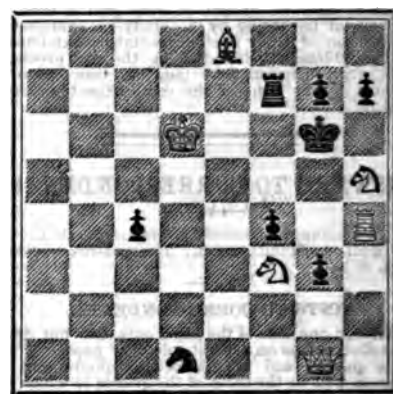
To tin small castings, clean and boil them with scraps of block-tin in a strong solution of cream of tartar.

CHESS.

All Communications for this department must be addressed Chess Editor, 22, Chancery-lane, W.C.

PROBLEM DCCXIV.—By B. G. LAWS.

Black.



White.

White to play and mate in two moves.

PROBLEM DCCXV.

(A competition problem in the Berlin Tourney, 1881)

(From the Turf, Field, and Farm.)

Black.



White.

White to play and mate in two moves.

SOLUTION TO 709.

White.

1. Q to Q 3.
2. Mate acc.

Black.

1. Anything.

SOLUTION TO 710.

White.

1. R to Q B 6.
2. Mate acc.

Black.

1. Anything.

NOTICES TO CORRESPONDENTS.

CORRECT SOLUTIONS TO 709 by W. W., J. W. P., W. J. Jubb, H. Planck, and S. L.; to 710 by W. W., J. W. P., W. J. Jubb, H. Planck, and S. L.; to 707 by H. Planck, and "Tri"; to 708 by H. Planck.

J. W. P. (Greenwich).—Thanks for contribution. We believe it to be unsound, but will write you on the subject.

CHESS ITEMS.

The *Brighton Guardian* has started a very liberal Two-move Tourney. The final award will be given by the collective reports of five judges, not in consultation Messrs. Bland, Crake, Geary, Laws, and Thursby are to act as adjudicators. First prize, £2 2s.; second, £1 11s. 6d.; third, "English Chess Problems"; fourth, *Forty "History of Chess";* fifth, volume of the "Chess Monthly"; sixth, "Wormald's "Chess Openings" and seventh, Klett's "Chess Problems." There are several special prizes and attractions which promise to render the tourney a success. Competing problems—each author being permitted to enter one, two, or three compositions—to be posted by residents in the United Kingdom on or before the 1st February, 1882, by composers resident abroad within the Postal Union 1st March, and those resident outside the Postal Union 1st April.

In order to dispose expeditiously of the surplus copy of "English Chess Problems," they are offered at 6s. copy; Pierce's "Chess Problems" at 5s., and the supplement at 1s. 6d. Orders must be made through Messrs. Longman and Co.

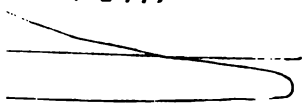
A CORRESPONDENCE TOURNEY has been announced by the Editor of the *Hornsey Express*, the first prize being £2 (presented by Col. Thursby), second prize £1, with

-Stoves.—Will "Sunlight" be kind enough to let the arrangement inside stove, in (45039, No. 868, "E. M.") I have in shape, [?] 3 ft. 6 in. high, one end to be a gas-burner, the other over water, so that it will light with slight explosion and then it gives out a splendid heat, well whatever; at other times when lit up. Can the arrangement be made to be F. T. N. B.

tography.—My thanks are due to his kind offer of assistance. I wished plate size camera with the latest improvement asked by the dealers was quite so I thought I would try and make by making the parts I thought most likely to be most likely to fail in, so I first, then the dark slide, afterwards I for the back and horizontal swing, then with the vertical swing. This I could all, and I am sorry to say I do not quite "night's" description. I will try to find to fix the pinion to the back of the to the base-board. Now, I do not see even so as not to interfere with the rack, real difficulty lies in the base-board; rious parts so that each one will work properly. The reversing-frame I mentioned by a well-known London dealer in use of it seems to be that it enables ut the focusing-frame and dark slide in ut having to put the camera on its side. I am making is square, and the dark e plates either way, I shall not trouble. The focusing-frame, as you describe it, and shall try and get one. Will a wet plates do for dry? And, will the way the plates are put in doubling in their places, as I have never had of seeing the interior of one? I should, "Sunlight" if he has any objection to vally with the maker's address of the I see by an answer to a query in the "ours," he recommends them for the ive been making my own apparatus. The principal use I should want them graph designs and manufactured goods; to be able to take a group or portrait if not quite so rapid as those made by ous would not, I should think, much it.

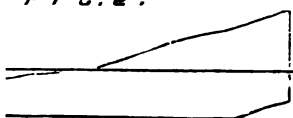
orse - Power of Engine.—Will some other kind friend, please tell me the engine is driving which the inas been taken from? Boil r-pressure,

END N° 40 SPRING.
F. I. G. 1.



of cylinder, 35 in.; stroke, 5 ft. 9 in.; r minute. Also, be kind enough to tell diagram up as plain as possible, as I ate scholar. Fig. 1, F. end, No. 40

D N° 40 SPRING
F. I. G. 2.



B. end, No. 40 spring.—A CONSTANT

admaking.—At the head of an will grow much, I should be glad to ns of breadmaking. I applied once to l Company for information, and found bliging. Could anyone give me any h would enable me to get the speed- patent? I should study it, and, if get their apparatus.—P. RUBIN, rphelinet, Prévoist à Cempuis, Oise.

meal.—I have plenty of good like to have them ground coarse in the way, as the oatmeal is unknown in ve I live. What directions shall I the miller?—P. R., à Cempuis, Oise.

us.—Can any reader inform me about il of Texas, and if it would be a likely get on in? And, what trade would be pay; farming, cotton or wheat grow- ing? And, if there is any duty to pay id be brought out exclusively for my sqetars.

chemical Calculation.—Would stenhams" who kindly gives a solution problem proposed by me, do me the explain whence the elements 47 + 104 ion arise?—PHOTOGRAPHER.

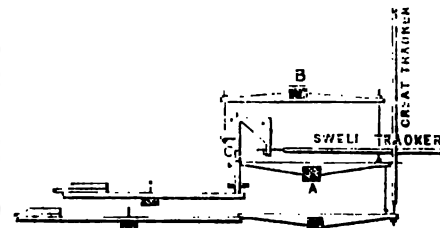
Motion.—Will "Sunlight" or dly give me the following information out the above?—Should the radius of from the centre of the crank-axis, or joint in a line joining the centres of the, having allowed for lap and lead? sheaves be set on the shaft, in their

proper places, in a small model horizontal engine?—GORDON YORK.

[45297.]—**Sulphate of Lime in Boiler Feed-Water.**—What is the best antidote for sulphate of lime in boiler feed-water, either before or after it gets into the boiler?—GEORGE WILSON.

[45298.]—**Medical.**—Will Dr. Edmunds advise me—a sufferer for two years from what my medical at first called ingrowing large toe-nails? He said I must have them removed. I patiently underwent the painful operation of having them removed. New nails took their place, and, for four months, all went on well; however, they again commenced to show an unhealthy appearance. The doctor said unhealthy nails had taken the place of those removed, and that I must undergo the operation once more. Remembering the excruciating agony attending the last operation, I decided upon trying some other remedy. By this time a continuous discharge of matter was exuding from the roots of the nails. I was advised to cauterise them with caustic. This had little or no effect beyond causing pain. Afterwards, I treated them with applications of carbolic lotion on lint. I may say this is the only thing I have received relief from; still there is no abatement of the disease. After an ordinary day's walking and standing, there are considerable inflammation and swelling. I have been told that after the nails have been once removed, they have to be done periodically. My general health is good, and much better than two years ago. My age is 20, a baker by trade (which I was recommended to give up 18 months since, and am now doing light work in a woollen factory). Any advice from Dr. Edmunds or other authority will be most acceptable.—DRESSER.

[45299.]—**Organ Coupler.**—To a small church-organ of about eighteen speaking stops it is proposed to add a coupler to couple the Great to the Swell Sub-Octave—that is, tenor C on the lower manual is required to be connected to bottom C on the upper manual. Although not in "the trade," I have been asked to undertake the work, and shall, therefore, beglad if some correspondents well up in organ matters will give their opinion of the plan here sketched. A is a set of backfalls forming a



manual coupler when the bridge A is raised by the stop. I propose to add another set of backfalls, B, set askew, and connected as shown, so that when a key on the Great is depressed, the swell sticker C, an octave below, is pulled up; the bridge B will, of course, be made movable by the stop action. This is the simplest and most efficient plan I can think of. It can also be carried out without removing any of the existing mechanism, which is a rather important consideration. Perhaps Mr. Dresser will oblige with his assistance and recommendations. The organ is fitted with the usual couplers:—Swell to Great, Swell to Pedals, and Great to Pedals.—J. E. F.

[45300.]—**Shoeing Young Horses.**—Would some of our kind readers inform me of some efficient plan to keep young horses quiet while being shod? A rough sketch would oblige.—AF IFAN.

[45301.]—**Floats of Water-Wheel.**—What is the best form of floats for an undershot water-wheel? The diameter of wheel is 10 ft., and the height of water about 3 ft. Which is the best way to apply the water to it?—AF IFAN.

[45302.]—**Loco. Injector.**—I am about placing a new injector and piping on one of our locos. Would some of our readers kindly inform me as to the best method of bending copper piping from injector to boiler and tank? Also, how to fasten flanges to pipes, and oblige!—W. E. POWELL.

[45303.]—**Numismatic.**—I have a 6d. of Victoria, 1840, which, on the obv., is countermarked upon the neck of the bust with a circular stamp: Lion walking showing left cheek. Legend encircling it, "... LITATA - FOR - EL - GIBERNO." Wanted, an explanation of this stamp.—W. STAVENHAGEN JONES.

[45304.]—**Oil in Watches.**—Three years ago I bought from a respectable maker at a high price a watch which he declared to be perfect in every respect. When the weather got cold this perfect instrument lost some four minutes a month, but when I gently suggested to him that the compensation was at fault, he would not admit it. It was due principally, if not entirely, said he, to the thickening of the oil. The next year the variation was less—between two and three minutes a month. Last Christmas I had it cleaned, hoping by that means to improve its going still further, but with this result: its rate was four and a half minutes a month faster in June than in October. Will any of the experienced watch-makers who contribute to your columns tell me whether this exceeds the maximum variation in a good watch from this cause? And, whether a well-adjusted watch should vary 8 or 9 seconds in 24 hours from change of position as mine does?—W. W.

[45305.]—**Keyless Geneva Watch.**—I have received above, in white metal, works very rough. The train consists of—

Going barrel	80
Centre-wheel	90
" Pinion	10
Third wheel	96
" Pinion	8
'Scape-wheel	30
" Pinion	8

and goes once round in 15 seconds. Would "S. P. W." or "A. F. W." kindly explain, and say who the manufacturer is?—GUYOR.

[45306.]—**Iceland Spar.**—I should be very much obliged to anyone who would give me directions for completely polishing sections of above. I can get a dull polish, but not a bright transparent one.—MAY.

[45307.]—**Strength of Alcohol.**—Can any of your readers tell me the strength over-proof of absolute alcohol?—DUAL.

[45308.]—**Fusel Oil.**—By what means can I find the percentage of fusel oil in samples of new spirit?—DUAL.

[45309.]—**Chemistry of Alcohol.**—Which is the best book on the subject of "The Chemistry of Alcohol"?—DUAL.

[45310.]—**Half-Round Boring Bits.**—Are the half-round boring bits used for model cylin work like the wood-turners' gauge, but solid?—STRAEM.

[45311.]—**Distance of Moon from Sun.**—At what apparent distance from the Sun will the Moon be at Greenwich on the afternoon of the 21st prox.?—AJAX.

[45312.]—**Mars.**—In what month this winter will Mars subtend the greatest apparent diameter?—AJAX.

[45313.]—**Air-Gun.**—Will someone give sketches of the parts of an air-gun, showing the action as much as possible?—NIMROD.

[45314.]—**Fossils of Ireland.**—Can anyone tell me where I can find engravings of the fossils found in the Tertiary and Quaternary formations of Ireland, such as would enable a tyro to recognise them and label them for a collection?—E. C. R., Co. MEATH.

[45315.]—**Grinding Outlets.**—Will someone explain how razors and pocket-knives are ground hollow, or diamond-edged, as it is commonly called? Will a diamond-wheel grind hollow?—J. S. S.

[45316.]—**Cleaning and Frosting Gold and Silver.**—Would someone kindly say the proportion of sulphuric acid and water?—GUYOR.

[45317.]—**Timing Old Verge Watch.**—I have an old verge watch in good going order, which gains three or four minutes after winding for the first twelve hours, then, when nearly run down, loses as much during the last twelve hours. Would "A Fellow Working Man," or "Seconds' Practical Watchmaker," kindly answer?—GUYOR.

[45318.]—**Copper Wire.**—Having a large quantity on hand uncovered, and wishing to utilise it, am thinking about making a dynamo. The machine for covering I have made from directions given in "ours," but am at a loss how to get the silk and cotton, and the same by which the particular articles are known in the market. Would any subscriber kindly give me that information?—BETA.

[45319.]—**Average Pressure on Piston.**—To Mr. WOOD on Mr. BROADLEY.—Would you be so kind as to tell me the average pressure on a piston having a 6 ft. stroke, initial pressure 40 lb., cutting steam off three-fourths of the stroke? And, also, the number of expansions? Please show it in hyperbolic logs., and oblige.—A FINE.

[45320.]—**Rough-and-Ready Surgery.**—Being connected with some large engineering works situated some ten miles from the nearest doctor, I should be glad to know if there is any handbook published which would enable me to acquire such surgical knowledge as would enable me to give temporary assistance to men hurt in any of the numerous ways to which quarrymen and navvies are exposed? Or, better still, would Dr. Edmunds give us a few practical hints?—LANCET.

[45321.]—**Removing Chemical Stains.**—I have accidentally stained a white linen tablecloth with some aqua regia, in which I had been dissolving some gold. Will any of "ours" kindly inform me the best way to take these stains out without injuring the cloth?—N. N.

[45322.]—**Imitation Flowers made with Liquid Films.**—What is the strength of the weak nitric acid described on p. 244 of last issue? Is the acid washed off the wire before plunging it into the glycerine fluid? And, what is Marseilles soap?—AM M.D.

[45323.]—**Sulphate of Zinc Battery.**—Would Mr. Lancaster give me the necessary information for the construction of the above? And, will it do work of a small pocket coil? Also, will he kindly say how I am to charge anew a "Gaisie Battery" (silver chloride)?—AM M.D.

[45324.]—**Faulty Electric Bell.**—I have an electric bell and battery contained in a box with about 10 yards of silk-bound wire, and push at the end. When I press the button the hammer strikes against the bell, and remains so as long as I keep my thumb to the button, but when I release the button the hammer is also released. Will some of your correspondents kindly tell me the cause? I have cleaned out and fresh charged it, and it rang for a short time, but it is now the same as before I cleaned it out. I put 8 oz. of sal-ammoniac in the battery, and filled it two-thirds full of water.—OZZIX TROUBLE.

[45325.]—**Staining Sections of Wheat &c.**—Information would be acceptable as to best means of staining sections of wheat, barley, &c., for the microscope, so as to colour the starch, skins, albumen, germ, &c., different colours. Also, best medium for mounting same as transparent objects?—MICROSCOPES.

[45326.]—**Hosiery Finishing.**—Wanted to know class of machinery for washing and finishing stockings. State machinery and hands required for 200 doz. per week.—STOCKING.

[45327.]—**Carbon in Steel.**—How can I find the percent of carbon in steel while the charge is in a Siemens-Martin furnace?—CARRON.

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 stamps. Stamps, however (preferably halfpenny stamps), may
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OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words,
 and 3d. for every succeeding 8 words.

Bicycle, 50in. Exchange anything useful. New;
 perfect.—MARRIS, Cupola, Sheffield.

Parrot Cage, new. What offers cash or exchange?
 —MARRIS, Cupola, Sheffield.

Wanted, Photographic Apparatus, or Anglo-
 German Camera, in exchange for 5in. Compound Slide-rest,
 Printing Press, and Type.—A. WILSON, 6, Palm-street, Glasgow.

Small Shaping Machine, parallel vice, price
 £5 10s.; 4 1/2in. Lathe, bed, crank, wheel, complete. Exchange—
 ROBINSON, 23, Market-hill, Cambridge.

Copper Boiler, suitable for lathe or organ, with
 patent steam engine, exchange for something useful.—MA
 WOOD, 38, St. John-street-road, Clerkenwell, London.

Mahogany Tripod, well made; do for telescope;
 Lantern, Level, &c., given for left-off Clothing, &c.—J. P. SARGOL,
 65, Digby-road, Homerton.

Box of Unmounted Objects, various. Lot of
 Geological, Botanical, Conchological, Lichen, Mineral, &c., for
 Left-off Clothing.—HERRAGE, 33, Digby-
 road, Homerton.

Drawing-room Microscopic Table, for parties,
 entertainments, &c., with 1/2in. complete. Amusing and in-
 structive for bazaar, &c. Take Clothing.—HERRAGE, 33, Digby-
 road, Homerton.

To Entomologists, Microscopic Object Mounters,
 and others.—Nice specimen of the Brazilian Diamond Beetle
 Take Clothing, &c.—HERRAGE, 33, Digby-road, Homerton.

Wanted, Bargain.—Powerful Achromatic Telescope, three
 lenses, draws out three feet, mahogany body, 2 1/2in. object
 glass; cost £2 10s.; what offers—mutual approval?—JAMES
 SOUTHEY, Wellington, Somerset.

Wanted, recent copies of "London University
 Calendar;" ink and dirty ones not received. Will exchange
 Scientific Manuals, &c.—F. W. OLIVER, Kew, Surfey.

Large Family Bible, cost 58s. Exchange for any-
 thing useful in Photography.—AMATEUR, Wickwar, Cheshire.

Tortoiseshell Guinea Pig, in good condition;
 exchange for Book on Electricity, or offers.—HARRY GEORGE
 HENSLY, Chapel-hill, Cleveland, Somerset.

Splendid Guitar, cost 25 shillings, and "Cassell's
 Popular Educator" (new issue), cost 21 shillings; will exchange
 for induction coil of same value; out of repair no object.—
 GEORGE FERRALL, 21, Victoria-terrace, Bolton-road, Bradford,
 Yorks.

Bargain.—Gas Tube Table Lamp, bronzed, on
 solid brass, height 21 inches; cost £2; what offers—mutual ap-
 proval?—JAMES SOUTHEY, Wellington, Somerset.

Grand powerful-tone Melodeon, double bellows, in
 green and gold, vermilion-silver, unpainted sides, not soiled, and
 perfect; cost £2; what offers—mutual approval?—JAMES SOUTHEY,
 Wellington, Somerset.

Tungy's No. 4 Donkey Engine, with feed pump,
 complete. Exchange for small Treadle Lathe, or what offers?—
 E. FRANCIS, 15, Fabian-street, Swansea.

52in. Duplex Excelsior Bicycle, in splendid con-
 dition, for a half-plate Rapid Rectilinear Lens with camera and
 a double backs.—F. W. DARLOW, Redcliffe House, Flabett,
 Essex.

"English Mechanic" wanted, first 10 volumes.
 Send stamp for list and particulars of articles offered in exchange.
 —W. F. JAMES, 230, Marylebone-road, London, N.W.

Wanted, exchange, will give lady's Watch (good), or
 48 or 50in. Bicycle for 4ft. or 4ft. 6in. Iron Lathe, with slide rest
 preferred.—J. HUNT, Malmesbury Park, Bournemouth.

Concertina, first-class, 30-keyed, chromatic, Anglo,
 new, very powerful tone, in concert pitch, contains all latest
 improvements in lockcase; perfect; cost £5; what offers—mutual
 approval?—JAMES SOUTHEY, Wellington, Somerset.

Leading Screw and full set of change-wheels for
 5 or 6in. centre lathe, 5 foot gap lathe bed, planned up, cheap, or
 exchange anything useful.—R. D. SMITH, 12, Fazzakerley-street,
 Chorley, Lancs.

Aquarium (plate-glass), a really good one;
 polished mahogany frame; exchange for Lathe Heads or Chucks
 or Turning Tools.—F. UNDERWOOD, Beverley.

Hot-Water Valves, seven 4in. throttle (new);
 "Excelsior" stove about 70lb. paraffin wax. What offers?—
 S. MAWBEY, Old Kent-road, London.

Wanted, a good pair 5in. centre back-gear Head-
 stocks to fit planned iron bed 4in. wide. Good exchange offered.
 —Apply, LOCKYER, Merstham Mill, Redhill, Surrey.

Pair of large, handsome Single-Needle Instru-
 ments by best makers; valued at £7.—BET, Melbroughton,
 Stourbridge.

Hughes' Triplexicon, equal to new, pair of Lan-
 caster's combination fronts, 14 distances.—BETA, Melbroughton,
 Stourbridge.

An excellent old Violin, good tone, in thorough re-
 pair. Also good 1/2-plate Camera, walnut wood, with two dark
 slides, hardly soiled. Will exchange one, or both, for good por-
 trait lens, any maker, of not less than 5 inches focus.—HUNT,
 Photographer, 26, Caroline-street, Cardiff.

Lovely Evergreen Ferns, covered with seed, worth
 6s. per 100. In exchange for anything useful in large family.—J. S. O.
 BROWN, Photographer, Blaenavon.

Telescope—Highly finished Brass Telescope, with
 flags of all nations, 3ft. 10in. long, £3 10s. Exchange for ship's
 Chronometer, or small Screw-cutting Lathe.—WHEELER, Preston.

Grubb's Landscape Lens, 15in. focus, for pictures,
 12 by 10, complete order, and few Printing Frames, for an Orga-
 nized Harmonium.—Address, A. B., 14, Athol-road, Hendon,
 Sunderland.

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 Part of Vol. XXIX. missing, the other eleven I think complete,
 in moderate condition, unbound; exchange Mechanic's Tools or
 other useful articles to value of £1 10s. or cash offers. Also
 "Design and Work" or "Mechanical World," all the numbers
 (weekly) since June, 1876. Exchange as above to value of £1, or
 cash offers. May be inspected.—J. AUBREY VILLAS, Pembroke-
 road, South Tottenham.

Splendid model water-tube Steam Boiler. Cost
 £25 recently. Recently on view at Royal Polytechnic. For
 Lathe, Sewing Machine, or offers.—ALFRED, 50, Quay-lane, Exeter.

"Scientific American" and "Supplement," 69
 consecutive numbers, for Ganot's or Deschanel's "Physics," and
 Sprague's or Jenkin's "Electricity."—ALFRED, 50, Quay-lane,
 Exeter.

"English Mechanic," first-class condition, I. to
 XXXIII., several volumes bound. Want-d gold keyless watch
 or other exchange or offers. Also Violin, complete in case, with
 music.—JAMES FRANKS, 69, Whitefriargate, Hull.

All sorts of Instruments and Apparatus exchanged
 for others. Good value allowed.—DR. CAPLAGE, Science Depot,
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 8 words.

For Sale.

Electrical Wires; silk, cotton, indiarubber, and
 gutta-percha covered. Bell and handle cords.—W. RICKARD,
 Derby.

"The Night-light Clock." Illustrated and
 described on page 370, No. 848. Price, carriage free, 5s. 6d.—F
 ROBERTSON, 13, Greek street, Soho, W.

Photographic Apparatus. Cheap complete sets
 for amateurs. Instructions free.—HUNTER and SANDS, 20, Cran-
 bourn-street, London.

Astronomical Telescopes.—The Complete Equa-
 torial, 4 1/2in. apertures, 4ft. focus, first quality divided 1/2" doublets,
 iron stand, finder, 3 powers, screw motion, £13 13s. Send 6d. for
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 F. E. FABRIC and Co., Opticians and Electricians, Southampton.

Screw-cutting Lathe, perfectly new, weight
 300lb., 36-inch bed, back-gear, reversing motion; all latest
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Sets of Engine Castings, from 3in. cylinders up-
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Fretwork Designs for new miniatures and Illus-
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Harmonium, £5; 7 stops, walnut case, full com-
 pany, ivory keyboard; bargain.—S. COLLIER, street, King's-cross.

Mealli: "E" Violin Strings; infinitely superior to
 gut; 3, post-free, 1s.—PARKER, and SMITH, Plymouth.

Reed Organs, genuine American; first quality;
 without cases. Any ingenious mechanic can cheaply case them.

135 Reeds, 13 stops, Couplers up and down, sub-bass,
 £12 10s.—PARKER and SMITH, Plymouth.

For Sale, six-horse Horizontal Engine and Boiler.
 May be seen at Lister Works, Holway road.

Lantern Photographs, 10,000, with readings,
 from 5d. plain, 1s. coloured.—A. FUMPHART, Emily-street, Bir-
 mingham.

Lantern Photographs for Hire. List and
 sample picture for 5d. in stamps.—A. FUMPHART, Emily-street,
 Birmingham.

Triplex Lantern, Achromatic Lenses, full size,
 best light, limelight excepted, 42s.—FUMPHART, Emily-street,
 Birmingham.

Complete Limelight Apparatus, equal to 200
 candles, 90s. List of Apparatus 3d.—A. FUMPHART, Birmingham.

Chromatope, with 5 designs and Eidiotrope, com-
 plete from the manufacturer, 10s.—A. FUMPHART, Emily-street,
 Birmingham.

Electric Bells, Batteries, &c.—The handiest
 shop is MILLER'S, 129, Chapel-street, Salford, Manchester. Instru-
 ments repaired.

Ironmongery, Clocks, Timepieces, Jewellery,
 Furniture, &c. Agents wanted. Wholesale catalogues, 300
 illustrations, free.—Apply, HENRY MAY (524), Birmingham.

Mechanical Drawings made, Copied, Enlarged,
 Reduced, Camera, and Automatic or Self-acting Machinery designed.
 &c.—J. J. DOLBY, 6, Albion-hill, Leicester.

Harmoniums, second-hand; returned from hire.
 All prices.—VENABLES and Co., 187 and 189, Essex-road, Islington.

Pianos, second-hand; returned from hire. Exten-
 sive showrooms.—VENABLES and Co., 187 and 189, Essex-road,
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Hunter's Piston Lubricant, and for heavy
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 gow.

Silver Cream rubbed on will renovate perfectly old
 electro. Genuine silver; 12 stamps.—Assay Office, Liverpool.

Mellicerta Ringens, with other interesting Micro-
 scopic Life; tube, 9d., post-free.—S., Fifth View, Ayr, Scotland.

Excellent Magneto-Electric Machine, in
 mahogany lock-up box, complete, 17s. 6d.—WILLIAM WRIGHT,
 Electrician, Fairfield-road, Chertsey.

Magnesium Ribbon, burns like the electric light,
 4d. per foot, forwarded free.—L. ROWLAND, South John-street,
 Liverpool.

Elastic Stockings. No makers in London. Made
 in Liverpool only by SMITH and SONS, Greek-road.

Invisible or Lovers' Inks. plain instructions for
 making same, free 5 stamps.—A. RUMF, Aylesham, Norfolk.

Stylographic Pens.—Vulcanite, complete, with
 pneumatic filler, warranted; free, 12 stamps.—JOHN FULLER, 127,
 Sussex-road, N.

"Dental Wonder," a Marvellous Cure for Tooth-
 ache, post-free, 14 stamps. Testimonials free.—SOUTHWELL,
 Pharmacist, Boston.

Small Gramme Machine, for hand or power; 5in.
 bobbin; £10.—J. H. WRIGHT, Weybourne, Farnham.

5in. Reflecting Telescope, by Browning. Can be
 mounted equatorially; £20.—J. H. KNIGHT, Weybourne, Farn-
 ham.

Ferns! Lovely (named) Ferns!! 12 species in
 beautiful moss, 1s. 6d., free.—BROWN, Woodland House, Gorton,
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Grassless Tracing Paper—how to make it, 6
 stamps, post-free.—W. WELCH, 22, Alendale-road, Denmark-
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Munroe Reeds, 8s. per set, to clear out.—RAY, 86,
 Poplar Walk road, Herne-hill, S.E.

Weak Digestion, Inactive Liver, Constipation.—
 Try Charles's Pure Dandelion Coffee, 1/2in. 6d., 1s., 2s. 6d.—
 CHAMBERLIN CO., 1, Denman-street, London, S.E.

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 will be sent on receipt of stamp for postage. Thousands of
 Photographs at 1s. dozen.—F. MITCHELL, Sydenham, S.E.

Circular Saw.—Cabinet-maker wishes to dispose of
 his Circular Saw to make room for larger machine. To be seen
 at work daily.—47, Greek-street, Soho, W. C.

Portable Forge, new, 18in. hearth, 16in. bellows,
 38s., carriage paid. P.O. payable ROBERT GALLONS, West
 Billows Works, Sunderland.

Lathe, 4in. centre, 3ft. 6in. cast iron bed, 5-speeded
 turned flywheel, slide-rest, face-plate, chucks, tool, &c.; price
 £3 10s.—L. LOWNDEN, St. George's, Wellington, Salop.

Driving Bands, best leather; machine-stretched;
 cheapest in the trade. Price lists free.—HATTON BROS., Hereford.

Machine-stretched leather Driving Bands, hand-
 sewn joints. Price lists post-free.—HATTON BROS., Manufac-
 turers, Hereford.

Double Belting, wire screwed, more durable than
 any other make; best leather stretched.—HATTON BROS., Here-
 ford.

Hancock's Patent Potato Peeler; will peel 14lb.
 potatoes in 5 minutes. Price 35s.—CHILDS, Blandford.

Brass 3in. Force Pump, with motion work, com-
 plete on oak plank, £3.—E. FRANCIS, 15, Fabian-street, Swan-
 sea.

Massive Silver Chronometer, by Arnold; perfect as
 new; £10; cost £40.—F. DINE, 10, North-street, Peterboro.

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 Sewing Machine and Bicycle Works, 170, Ebury-street, Essex-
 square.

All kinds of Turning, Fitting, and Forging,
 etc., for Amateurs.—BRAMLEY and Co., London. Above address.

Model Engine, all brass, with oscillating double-
 action cylinder (covers 1 1/2in. dia.), heavy flywheel and pulley,
 large copper boiler, with fittings complete; cash £2; or what
 offers in exchange.—Address, J. H. B., 69, Manchester-road,
 Southport.

Microscopic Objects for Polariscopes. Embryo
 Oysters and Mussels, two slides, 1s. 6d.—W. WHITE, Waver-
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Set of Lee's Locomotive Castings, and therefore
 clean. Will make model 1 1/2 inches long; cylinders 1 1/2 by 1 1/2
 bored, slide surface planed, wheels turned; all complete; 38s.—
 S. BISCOE, Holton, Oxford.

Microscopic Objects, animal and vegetable,
 mounted on glass, 5s. per doz., carriage paid.—Address below.

Le Merveilleux Pocket Camera, with lens, 2 dark
 slides, tripod stand, and focusing screen, 18s. 6d., carriage paid.

Handsome pair Opera Glasses in leather case;
 excellent definition; in good order; 8s. 6d., carriage paid.

Bichromate Cell, movable zinc, 2 carbons, very
 powerful, 1s. 6d.—FORSHAW, Hutton Pharmacy, Hutton, Liver-
 pool.

Photographs, Scottish Scenery, extraordinary
 value, 7in. by 4in., 4d. each.—FISLIE, 135, Renfrew-street,
 Glasgow.

Splendid set Engine Castings, cylinder 3 1/2 stroke,
 1 1/2 bore (flywheel), 6s.—CLARK, 20, Healey-street, Nottingham.

Prize Medal Cement, for jointing glass, china,
 wood, or leather; equal to Key's Coalglue. Bottle, with in-
 structions how to make it, sent free 7 stamps.—FARR, CAL-
 WELL, Great Harwood, Lancashire.

1/2-plate Folding Camera, 3 slides, swing back, new,
 £6 6s.—BROOKHEAD, 15, Old Market-street, Bristol.

Engine Castings, 4-horse horizontal, complete
 set, part brass, 21 pieces, including wrought iron connecting-rod
 and bed-plate 20in. long, only 12s. No useless toy; genuine
 testimonials. Phot. and particulars on approval.—E. TOWNS,
 Belmont street, Oldham.

Pair of Steps, folding, polished; suit library or
 house, price 5s.—5, Dumfries-street, Leamport, Hants.

Bailey's Patent Injector, No. 1, price £2. Take
 back if not approved of.—S. BISCOE, Holton, Oxford.

Splendid 10-air Musical Clock, plays a tune every
 hour. Further particulars on application. Price £2, cost 40s.
 in perfect condition.—S. BISCOE, Holton, Oxford.

Oil or Limelight Dissolving View Apparatus,
 &c.—D. W. NOAKES, Ernest Cottage, Royal Hill, Greenwich.

A. W. Dennis's Patent Pneumatic Fire Ex-
 tinguisher, nearly new; cost £3 10s. Price £2 10s.—JOHN DRY-
 JUNIOR, Piper's-row, Wolverhampton.

One pair each 7in., 9in., 9 1/2in., and 11in. Pimp-
 ton's Roller Skates, nearly new; price per pair, 4s. 6d.—JOHN
 DRY, JUNIOR, Piper's-row, Wolverhampton.

Lathe.—Very strong Bench Lathe, back gear, with
 gap bed, best make (Britannia Co.), 2ft. 6in.; price £4.—GAB,
 Sloane-square, London.

Lathe.—Several Lathe, suit gasfitters or ama-
 teurs, nearly new; Sanders, Little Britain. Price from
 £2 5s.

Fret Saws.—A new and very effective Fret Saw,
 to fasten on any table, and turn by hand; price 1s.—MARRIS,
 BRITANNIA COMPANY, Colchester.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, NOVEMBER 25, 1881.

IVORY PHOTOGRAPH OR MIRROR-STAND.

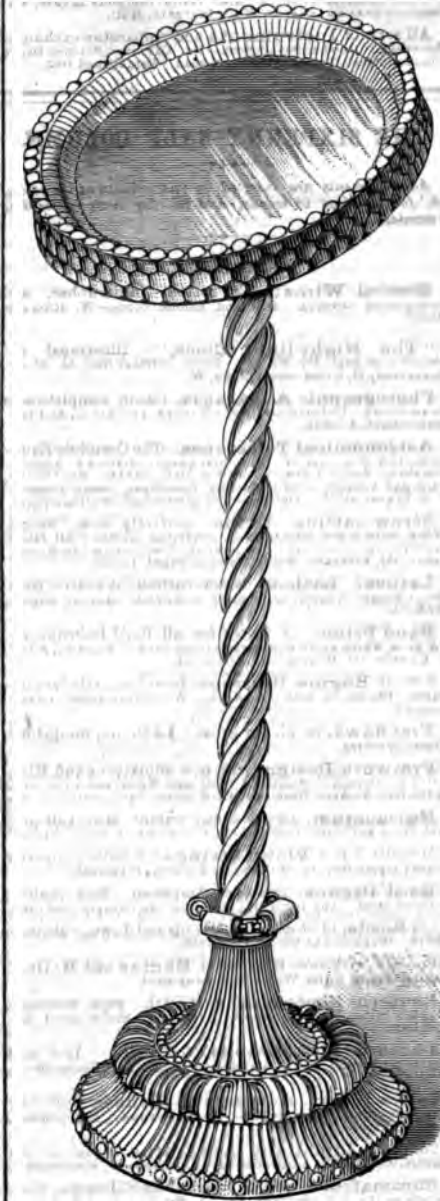
By J. H. EVANS.

THE present illustration, as above named, affords scope for bringing before our readers' notice the manner and use of a variety of tools connected with the ornamental turning lathe. I have already described a number of tools, but the present specimen is one in which many of them have been applied, and, although it looks a simple thing, no fewer than five separate parts of the apparatus were employed to produce it, viz., spherical slide-rest, spiral apparatus, universal cutter, oval chuck, and drill spindle. Any amateur turner possessing these tools as adjuncts to a good lathe, need not crave for more, and with such can, in a short time, have an elaborate collection of specimens. I will not dilate, however, upon what any one might do, but presume that those who take sufficient interest to read these subjects will be better pleased with the information how to reproduce the same. The pillar or column does not appear to present any difficulty with regard to the material; but, unless a turner has a large stock of cut-up ivory, it is not an easy thing to get without waste. This, again, I must leave to the turner and his own resources, and will proceed at once to describe the way to make a stand similar to the illustration.

The base is 4in. in diameter, and, on the extreme edge, it will be seen, are a series of half-beads. There are 40 of them, obtained by using the 120 circle of division, and advancing three at each cut; it will require what is termed the astragal or flat-ended drill to give these beads a prominent effect, and it is the flat end of the drill that clears away the superfluous material between each bead. In some cases it is preferred to leave a point between each bead; then the pointed drill may be used.

Having this row of beads cut to satisfaction, the concave curve will form the next part to do. This should be turned to the curve by hand, and the horizontal cutter will then be necessary to cut the pattern; a double hollow tool will be the one to use, and must be extended sufficiently from the centre to allow the tool to cut the same curve as turned. It may happen that, having been turned by hand, it will be difficult to set the tool to exactly the radius required; should this be the case, it must be set as near as possible, and it will be cut up to a perfect curve with the revolution of the cutter. The division of 96 was used, cutting at every hole, consequently, 96 cuts are the natural result. We now come to the convex curve: to do this it will be necessary to use the spherical slide-rest; but the turner about to copy this need not have such a tool: other means, of which there are plenty, must be used. The present having been, however, cut with the spherical rest, I will show how it was done. In order to facilitate the proportions, it is better to rough it all out first; therefore, this curve may also be turned by hand, prior to being finished with the rest. To turn this curve with the circular rest, the tangent-wheel must be adjusted so that its centre is under the centre of the curve to be turned; this done, the drill-stock takes the place of the fixed tool in the slide-rest, and in it a step-drill with four

steps; there are 24 cuts round this piece, and to do them nicely it will take about four or five cuts, and for the last cut the tool should be taken out and set, as it naturally becomes dull after such a deep pattern. The next part, it will be seen, is simply a small ring of ivory, having upon it 30 beads smaller than those upon the base, but with a drill of similar character. The following piece is a long concave curve: this is also cut with the horizontal cutter, which forms the curve; it has 30 cuts in all, as will be seen by each one pointing to every consecutive bead. At the top of this part the points were again cut with a very fine-pointed cutter, in order to vary the patterns; the next, and last piece, forming the base,



IVORY PHOTOGRAPH OR MIRROR-STAND.

is turned somewhat after the shape of a crown, and cut over the curve with the spherical slide-rest. To effect this pattern there must be so many cuts and the same number of divisions passed, so that the plain parts show the same width as the cuts. This pattern might be cut to correspond with a crown exactly; but this is a matter of taste, and must be left to the operator. The base may be now looked upon as finished, and it contains five separate pieces. The parts may be screwed together or fitted with plain fittings, but screws should always take precedence of plain fitting, and this for very many reasons, one of which has just come forcibly under my notice; for one

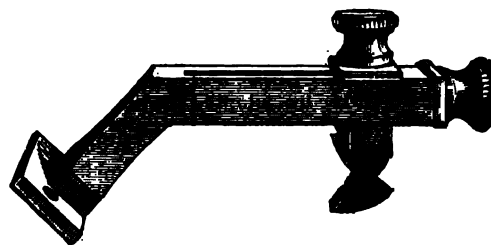
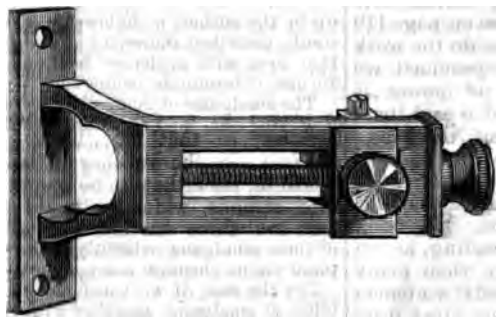
rather elaborate piece of work has come to grief through plain fittings, from the material shrinking or the cement giving. While being moved by the servant the body fell off, and broke away much of the ivory. I need scarcely say how annoying this is, and, therefore, as a preventive, recommend nothing but screws to put any work together with.

We now come to the stem, which is cut with the aid of the spiral apparatus, and as it is a simple specimen of this class of work, it forms an excellent lesson in the production of the so-called Elizabethan twist. In setting about this part, the ivory should be placed in a boxwood chuck of small diameter, so that it will not in any way interfere with the working of the apparatus. It will be seen that there are in this piece three strands, which indicates really that there are three starting points, and these adjustments must be effected with the spiral chuck, which, having a wheel of 96 teeth, must be divided into three parts. The ivory having been turned to a perfect cylinder with the slide-rest, remove the fixed tool and place the drilling instrument in the rest with a round-nose drill. The wheels used to produce the twist were—on the chuck 120, on the arbor 36 and 60, and on the slide-rest a pinion of 24. Being long and slender, it is not one of the easiest parts to do, and will require great care, and as the material is gradually cut away with the tool, it naturally becomes more susceptible to vibration. In cutting spirals in ivory, I would here suggest that it is always better to let each and every finishing cut end in the same direction. I have heard many amateur turners argue that there is no grain in ivory to matter; but this is a great mistake, and experience would soon verify the fact that there is a great deal to contend with in this respect; therefore, if the cuts are all finished in the same direction, it will save a deal of trouble in finishing off the work. As stated, there are three different cuts in this particular stem, but as they all terminate differently to each other at the bottom, to finish them it must take three consecutive tools, but the round-nose drill will do for all to clear away the rough material; this done, the same drill may be set to a fine-cutting edge, and one of the cuts finished out with it. The next, it will be seen, although perhaps not very distinctly, from the nature of the engraving, is cut with a drill of the same shape but about three-hundredths larger, and the third has two distinct hollows in the bottom; but here, as in many cases, a little deviation from the illustration will not much matter, and it is very often that, having a pattern to look at, the turner may suggest an improvement in his own mind; however, the three spirals being cut and finished at the bottom, it may be seen that the top of each has been cut with a bead tool. To do this the drill-stock must be removed, and the universal cutting frame substituted, in which a bead tool the desired size is placed, and the cutting-frame must be then set to an angle to correspond as near as possible with the pitch of the screw, or twist that is being turned. I think I have mentioned before that in all cases I prefer to use the universal cutter where most convenient, but sometimes the drill is of great assistance, especially for step patterns; when all the material is cut away from the centre of such a piece of work as this, it will be, as I say, subject to much vibration, and will, in some cases, necessitate the support of a slender guide. There are several kinds of this instrument; but the one which is of most service is that which is fitted to the front of the slide-rest, and in order to better explain it I give an engraving of the same. This, then, being fixed to the rest, travels with the tool; the consequence being that the resistance is equal to the pressure throughout the whole distance of the work so traversed. It will be

obvious that something of this kind is absolutely needed in long and slender work. It may occur to many of our readers that the guide being made of steel is likely to injure the work; but it does not if the correct amount of pressure and no more is brought to bear on it. At the same time, there is no reason why the rubber should not be made

hollows, whichever are being cut, may be brought to a correct termination. So far, then, the front of the frame is finished, and it only remains to ornament the edge, and all is done connected with this specimen. The pattern on this part is what I call the honey-comb pattern, and is produced in the following way. Have in the drillstock a

original memoir by the student. Following a good example, Mr. Balfour has had his books printed in two types, the larger giving the matter to which the student may, with advantage, confine his attention, while the smaller is used for theoretical and controversial matter. Both volumes are freely illustrated by woodcuts, from the



of ivory just where it bears upon the work; but if properly used no harm will come to the work.

I will now leave the spiral part, for anyone trying such a thing to have a little practice, and I should strongly recommend such to be upon boxwood, or with many failures it might be deemed expensive. On the top of this stem I have made a ball-and-socket joint, so that the photo or mirror, whichever is fitted to the frame, may be placed in the most convenient position. With the base and stem finished to satisfaction, great progress may be said to have been made, and it brings us to another class of work—viz., that of oval turning, and as the frame mounted upon this is a simple specimen, it will also form a good subject for this class of turning, and a gentle reminder of what has been before said upon the same subject. A piece of ivory cut from a well-selected hollow will, of course, be the best, and this glued to a sound beechwood chuck with a metal back may be faced over, and the recess for picture or glass turned out. When done so far, it must be removed from the chuck and reversed by the fitting on to another, where it should also be held with glue. I will take the opportunity of referring to the fact of the necessity of not moving the sliding ring of the oval chuck, and to prevent this I now add to the ring a small set-screw, so that if it is necessary to remove the ring for any purpose, by fixing one of the screws the ring may always be placed back in its original place. When I say that this idea was suggested to me by so efficient an amateur turner as General G. C. Clarke, it will be sufficient guarantee of its efficacy. This point, then, being well looked to, there will be no difficulty in turning the second chuck to fit the recess turned in the ivory. To proceed with the turning and ornamentation of the oval frame: the first thing will be to rough it all over, and determine the shape of the front moulding, which for this is a simple ogce; the pattern was cut with one large drill of the same shape, which I made for the purpose. There are 96 cuts, and although there is a difference between these at the two axes, it is not very noticeable in a pattern of this nature. We now come to the beads on the front of the frame, and these are what we call compensated; that is, all the same relative distance apart. This I effected with the segment apparatus. There is a small apparatus called the "compensator" for the oval chuck, but it is rather an expensive tool, and I think I can explain how to effect its purposes without its aid. The present beads, at all events, were so done. It is simply to set the bead tool each time with the aid of the segment wheel, and, by a little careful testing, the beads or

sharp, clean cutting, round-nose drill; set division at 96, cut round at every hole; move the slide-rest two whole turns forward; adjust the index peg-one hole forward, and cut round again; return the index to same hole used at the start; move slide-rest again two whole turns forward, and so on. I have a massive ivory box cut with this pattern which is most effective, and it is a most simple one to do. It involves only a considerable amount of patience. This forms a conclusion to the frame, and it only remains to mount it on the ball of the universal joint. This I did by fixing a cross piece of ivory on the back of the frame, held to its place by two small screws. The whole of the back is covered with a piece of white velvet. The stand, as finished, makes a very pretty specimen, and is as useful as most things produced as specimens of ornamental turning.

REVIEWS.

A Treatise on Comparative Embryology. By FRANCIS M. BALFOUR, M.A., F.R.S. London: Macmillan and Co.

THE second volume of Mr. Balfour's treatise on embryology having made its appearance, the work is now complete, and as the first attempt to deal with the whole science of embryology in one connected treatise, it will undoubtedly find much favour amongst students of the science. Beyond that fact, however, are the sterling merits of the work itself, for in its pages we find the results of all the valuable researches and observations that have been made by biologists throughout the civilised world, classified, digested, and arranged in systematic order. It might be urged that it is impossible to write a complete treatise on embryology at the present time, and it is not unlikely that some, perhaps many, of the views put forward in Mr. Balfour's pages, may require modification in the light of future researches; but by gathering together scattered observations, theories, and facts, from papers, &c., which are too often literally "buried" in the Transactions of societies, he has performed a labour which will receive, as it deserves, the recognition of the scientific world. The first volume is limited to a description of the Invertebrata, while the second deals with the Vertebrata and with the special histories of the several organs. At the end of each chapter, and where advisable at the end of each section, a list is printed of the more important papers referring to the subject; these papers are indicated by numbers in the text, and a general appendix at the end of each volume facilitates the work of reference to the

works of Agassiz, Gegenbaur, Huxley, Kölliker, Lankester, Turner, and others, as well as by the original drawings of the author, whose work will become the recognised textbook in the continental schools, as well as in those where the English language is spoken.

Adolphe Strecker's Short Text-book of Organic Chemistry. By DR. JOHANNES WISLICENUS; translated by W. R. HODGKINSON and A. J. GREENAWAY. London: Kegan Paul.

AT the time of Strecker's sudden death in 1871, he was about to prepare the sixth edition of his handbook of Organic Chemistry—to revise and remodel entirely. Dr. Wislicenus, of Würzburg, undertook the task, and endeavoured, so far as the advances in organic chemistry permitted him, to follow the lines laid down by the author; but our knowledge of the subject has advanced so rapidly of late years, that the book before us might be described as based upon the handbook of Strecker, and written by Wislicenus, but with many additions by the translators and editors. The work is so popular in Germany that the editors were justified in thinking that an English translation would be acceptable, and it will, no doubt, be regarded as an important addition to the literature of organic chemistry in the English language. Prof. Wislicenus does not adhere to one method of writing formulae, because, as he says, there is a danger, in adhering to one system dogmatically, of substituting a concrete image in place of an idea; consequently, throughout the work, the formulae of one and the same substance may be found differently printed, according to the nature of the context. The translators, too, in the case of the naphthalene compounds, have thought it advisable to introduce the symbols proposed by Reverdin and Nölting as the most suitable provisional notation. The work will unquestionably become a favourite textbook with students of organic chemistry.

An Elementary Treatise on Electricity. By J. CLERK MAXWELL, M.A., F.R.S.; edited by WILLIAM GARNETT, M.A. Oxford: Clarendon Press. London: Henry Frowde.

STUDENTS of electricity will welcome the publication of the late lamented Prof. Clerk Maxwell's "Elementary Treatise," even though it has been finished by other hands, and is necessarily incomplete to a certain extent. The author had written the greater portion of the work seven years ago, and had used it in his lectures at the Cavendish laboratory; but during the last three or four years of his life more imperative

labours grew upon him to such an extent that he was unable to finish it, although he had commenced the preface, in which he explains that the book now before us was different to his larger treatise on "Electricity and Magnetism," which appealed to readers familiar with the higher mathematical methods. He also explains that he had become convinced of the superiority of methods akin to those of Faraday, and therefore he adopted them, in the endeavour to present, as compactly as possible, those phenomena which appear to throw light on the theory of electricity. Unfortunately, Prof. Maxwell died before he had finished his elementary treatise, and to complete the work, the editor has adopted a suggestion to utilise certain articles in "Electricity and Magnetism," some of which, in fact, are reprinted in accordance with directions contained in the author's MS. Dr. Clerk Maxwell was, it will be remembered, Professor of Experimental Physics in Cambridge University, and an honorary fellow of Trinity College; it was a graceful act, therefore, for the delegates of the Clarendon Press, to select his work for issue in their series, as it stamps it with their approval. For clearness of exposition without redundant verbiage, this elementary treatise is especially to be commended, as it is for the courage with which the author points out difficulties in the accepted theories and warns his readers against such expressions as the "electric fluid"; but those who expect, from what has been said above, to find it "free from formulae," will be disappointed. As the Professor said, however, they can omit those pages in their first reading of the book; but it would be advisable to learn sufficient of mathematics to conquer them on the second reading.

Tramways, their Construction and Working.
By D. K. CLARK, M.Inst.C.E. London: Crosby Lockwood and Co.

THIS is a "supplementary volume," rendered necessary by the progress made in tramway construction during recent years, and relates especially to the employment of mechanical power and the improvement in the "ways" themselves. The first part, however, which contains six chapters, deals with cost and expenditure of tramways in the United Kingdom. Part II. treats of the construction of tramways; and part III. is occupied with descriptions of the mechanical powers hitherto employed. The book is freely illustrated with wood-blocks, showing different sections of modern rails and "ways," and different types of locomotives and steam cars—mostly those, however, which are best known. There is a chapter on Franco's fireless locomotive, but in that devoted to compressed air-motors, we miss a notice of the Scott-Moncrieff engine, which many think is the best of its kind. In his general conclusions Mr. Clark says, "that horse-power will eventually be superseded by mechanical power on tramways is a foregone conclusion," and he expresses the opinion that steam ought to keep the lead it has taken, so long as power is generated by means of fuel and water and their product, steam. Electro-motive power he dismisses with the brief note that it has been employed in Berlin and Paris. The frontispiece is a picture of a Krauss locomotive and Imperial car as used in Berlin. So far as the construction of tramways is concerned the book appears to deserve its title, but the remarks on motive power can scarcely be described as an "exhaustive analysis of the various modes of traction."

We have also received *Economy*, by JAMES PLATT (Simpkin, Marshall and Co.), one of the author's readable handbooks on matters of universal interest. The book is obviously beyond our sphere, but we may say that Mr. Platt has sound ideas of political economy,

and that this, his latest work, is, like the others in the series, worth reading.—*The Science of Building*, by E. W. TARN (Lockwood and Co.), is the second edition, revised and enlarged, of a textbook long familiar to all architects and architectural students, and most useful for those who intend to enter the technological classes of the City and Guilds of London.—*Wonders of Electricity*, by ASCOTT E. HOPE (Gall and Inglis), is a readable book, suitable for schools. The author informs us on page 119 that "electricity is prepared to do the work of steam as well as of gas"—provided, we suppose, some other source of power is available. He tells us that it is said there is power enough in the Falls of Niagara to light up a whole continent, and yet spells Sir William Thomson's name incorrectly. We have heard the statement before, and appreciate it at its true value. The book may be suitable for school reading, as we have said, for it is no worse than many others; but it would be improved if sentences calculated to impart erroneous ideas were eliminated.—*Our Colonial Empire*, by R. ACTON (Cassell, Petter, Galpin, and Co.), is a book that may be read with advantage by intending emigrants to the Colonies.—*Toys and Toymaking*, by JAS. LUKIN, B.A. (L. Upcott Gill), is the second part of a work which will have an abiding interest for young mechanics, especially those who have an ambition to make a model steam-engine, the most useless and disappointing of toys.—*Mechanical Industries Explained*, by ALEX. WATT (W. and A. K. Johnston), will be useful as a school-reader, as it gives a fairly accurate idea of how things are made, and imparts knowledge while the pupil is learning to read.—*Tables of Quantitative Analysis*, arranged by H. G. MADAN, M.A., F.C.S. (Clarendon Press), are really a *précis* of analytical work, which the chemical student will know how to appreciate. They are in quarto form, printed only on one side, so that students can add notes on the blank page presumably—an arrangement which adds greatly to the expense without commensurate advantage. The tables are, however, very useful, and the Clarendon Press might issue them in cheaper form for the benefit of chemical students.

AMALGAMS.

OPINION is still divided with regard to the nature of amalgams, some considering them to be isomorphous mechanical mixtures, others, true chemical compounds. The former view derives support from those cases in which amalgamation is associated with an absorption of heat, as in the solution of a salt or in dilution of a solution; the latter is supported by the fact that many amalgams are formed with a strong development of heat. A contribution to the subject has been lately made by Herren Merz and Weith, in the Berlin Chemical Society. These chemists have investigated whether, with regular heating, amalgams part with their mercury continuously or in distinct gradations.

The experiments consisted in placing the amalgam in a porcelain dish within a glass tube, contracted below, and enclosed in a second tube, having a bulb at its lower end. This bulb of the outer tube contained the substance of the vapour bath (sulphur, mercury, or diphenylamine). To guard the amalgam from air, a lively current of an indifferent gas was passed through the interior tube while the experiment lasted. The amalgams used, which were always directly produced by known methods, contained on an average, 60 to 80 per cent. of mercury. This heating was continued, wherever possible, until after several hours no decrease of weight (or hardly any) was perceptible. There were examined gold, silver, copper, lead, tin, bismuth, zinc, cadmium, sodium and potassium amalgams. The results for the first eight are very briefly communicated, those for the last two, whose easy oxidability required special precautions, more fully. In the case of these alkali amalgams, the

authors also sought to determine the melting points, but, for certain reasons, very accurate results were not reached. In general, the melting points of the amalgams rise at first very quickly with the proportion of alkali-metal, then gradually fall. It was thus observed, that when mercury is heated under paraffin to 250°, and then some sodium is added in portions, the whole mass solidifies with 4 to 5 per cent. of sodium; but with further addition of some percentages the mass fuses completely.

The results of their investigation are summed up by the authors as follows:—A survey of the results described shows, for a series of amalgams, that even with moderate heating they do not furnish determinate compounds.

The amalgams of gold, silver, copper, bismuth, lead, tin, zinc, and cadmium lose their mercury entirely, or nearly so, even at or under the boiling temperature of mercury. Where no mercury remained, the cause is to be sought rather in a mechanical exclusion, than in a chemical action. But, on the other hand, the easy decomposability of these amalgams evidently offers no proof that there are no chemical compounds in them.

For the rest, if we consider the great variability of amalgams, together with the fact that, in squeezing the so-called mercury solutions of metals, these latter do not remain behind, but certain mercury compounds, the view acquires the greatest probability, that at least very many amalgams may be, indeed, molecular combinations, but in fixed relations.

Most pronounced does chemism appear to be in the amalgams of potassium and sodium. They lose their mercury extremely slowly, even at the boiling-point of sulphur, as also in a gas current, and so in circumstances highly favourable to removal of mere mixed substances. The remarkable relations, too, as regards the melting-point, seem to speak for the presence of true chemical compounds. Probably these amalgams, at a comparatively low, as well as at a high temperature, consist of different compounds, none of which, however, have a durable existence, and therefore recurrent, fixed relations of composition are not to be met with. Alkali-metal amalgams of fixed composition would probably be obtained on production of larger quantities of amalgam; perhaps also by heating considerably above the boiling temperature of mercury.

SOME AMERICAN LATHE CHUCKS.

AMONGST the lathe accessories invented by Americans are the ingenious and useful chucks some of which are shown in the annexed illustrations. Figs. 1, 2, and 3 give a front view and sectional details of Westcott's new combination chuck with three or four jaws, made in sizes from four to thirty-six inches by the Oneida Steam Engine and Foundry Company. This device is claimed by its inventor to contain all the good points of the great variety of chucks with which machinists are familiar, while it is at once simple, strong, and readily adaptable to the varying wants of the general turner. The improvement consists in not only making the jaws reversible, by which arrangement the small sized chucks can be used with facility in holding screws, pipes and drills, but also in making them act independently of each other when required, as well as to act concentrically and simultaneously. This chuck, is, therefore, enabled to seize and hold firmly, round, oval, oblong or eccentric shapes, as well as to hold work in an eccentric position.

The illustrations are self-explanatory. Fig. 1 shows one of the jaws reversed; Fig. 2 is a vertical section in a line with lathe spindle, and Fig. 3 is a plan view of one of the jaws reversed showing end of screw, and the box C. A in Fig. 2, is a jaw not reversed, which slides in a groove, in another sliding piece or block, a section of the groove being shown in Fig. 3. The block C has at its back a spiral screw-plate engaged by an annular ring D with a corresponding spiral thread. This annular ring D is held to its place by a nut E, working on the boss F of the face-plate. It is clear that all the working parts are well protected from dirt, and the reversibility of the jaws enables the workman to chuck a large piece of work, or to hold securely the largest or smallest drills and reamers. The jaws are reversed by running them out with the screws B, by which their relative distances are regulated. To get the full capacity, the boxes

are run out to the stop, by using a scroll wrench; then with a key wrench the jaws are run out over the boxes or block C. This gives a double support, and from two to seven inches larger working capacity than diameter, according to the size of chuck. Fig. 4, illustrates a drill chuck popularly known as the "Little Giant,"

smallest size up to half an inch, and being cheaper than the more complicated arrangement is a favourite with many. Figs. 6 and 7 illustrate Cushman's key or geared chuck with three pinions all working in the same rack and scroll. This chuck holds any article not larger than itself, and the improvements claimed are that

or "Acme" chuck for drills up to 3/8ths. Fig. 10, shows a Morse twist drill with taper shank, which fits into sockets the larger ends of which are left blank, to be fitted to the machine or lathe; by the use of the sockets all fitting of drills is saved, as a No. 1 socket for instance fits drills up to 19-32. Fig. 11, shows Horton's

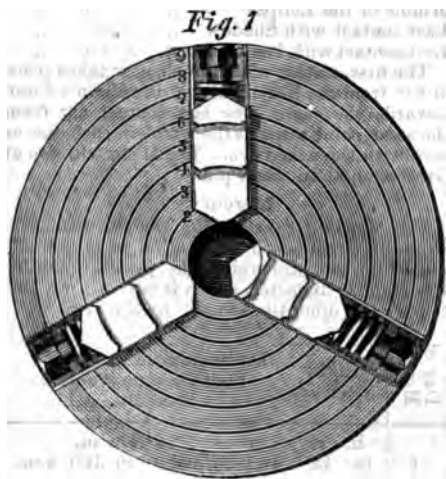


FIG. 6.

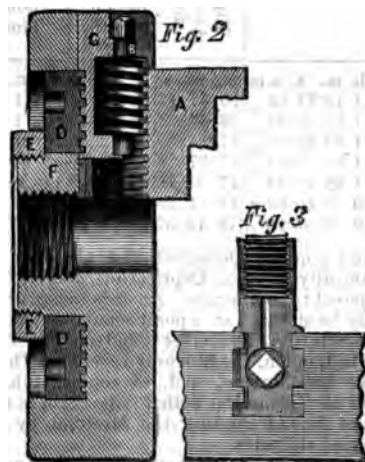
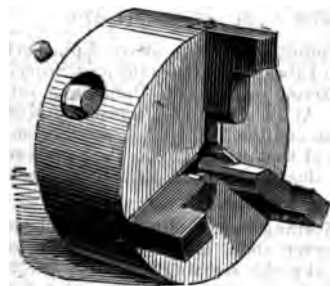


FIG. 7.

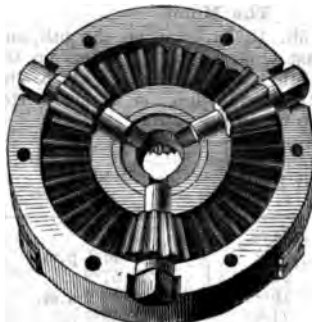


FIG. 10.



FIG. 11.

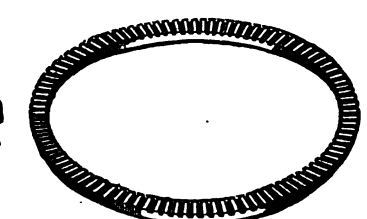
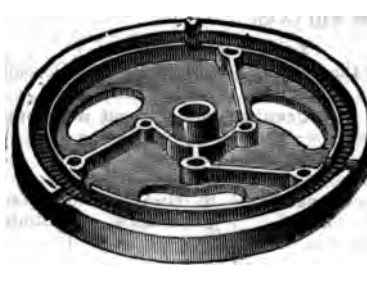
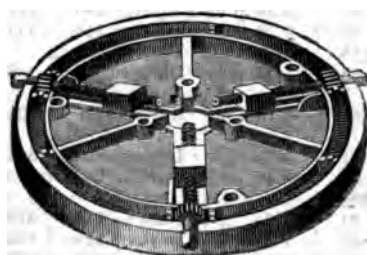
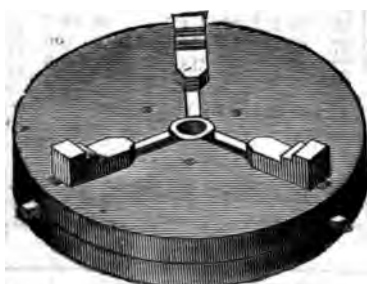


FIG. 4.

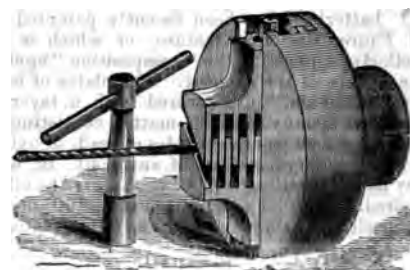


FIG. 5.

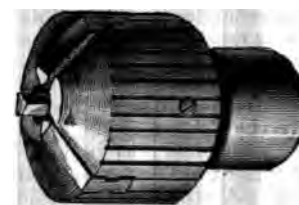


FIG. 8.

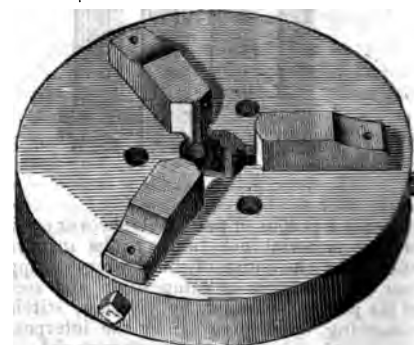
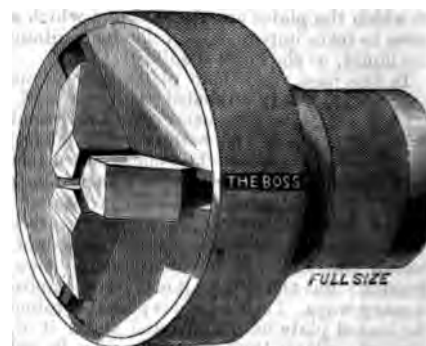


FIG. 9.



though its proper name is the "Oneida." The screw moving the jaws is out of the centre, so the hole is not obstructed, and a rod can be run through the chuck, if desired. It is positive in action, self-centring, and as its popular name implies very powerful in grip. Fig. 5, is the "1876" drill chuck which holds drills from the

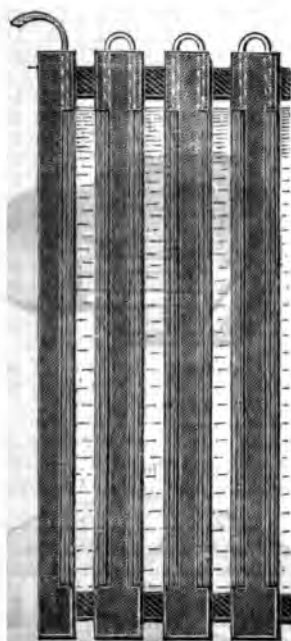
one of the pinions is always presented handy for the key; should one of them fail the chuck is not disabled while a new pinion is being procured; while, by using two keys a tighter grip can be taken without straining the working parts. Fig. 8 is a Horton inside jaw chuck for milling machines, and Fig. 9, is "the Boss,"

Lathe chuck in perspective with the details separately. When the rack is taken out, the device becomes an independent jaw chuck. This chuck is made in sizes up to 36 in., and larger for railway carriage wheels, &c. The illustrations we have given represent only a few of the best known American chucks for which

Messrs. Churchill, of Wilson-street, Finsbury, are the sole agents, as they are also for the Morse twist drills, which have firmly established their reputation in every workshop in the country.

IMPROVEMENTS OF FAURE'S SECONDARY BATTERY.

SOME further improvements in secondary batteries have been recently patented by M. Faure, the chief feature of which is the method of supporting the "composition" against the surface of the element. The plates of lead, the "elements," are covered with a layer of porous or spongy metallic matter consisting of either red lead or other oxides of lead, or oxides of tin, or manganese, or of antimony, or with any metallic salt capable of producing the effect desired. In order to maintain the substance or composition against the surfaces of the plates or



elements a porous or permeable sheet or covering of any material not liable to be injuriously affected by the action of the battery is applied over the substance or composition and secured to the plate or element by riveting, stitching, cementing, enveloping, or by the interposition between the plates of open work material. This porous or permeable covering may consist of felt, cloth, asbestos, paper, cardboard, gauze, or cloth made with lead or other wire, or any other similar porous or permeable material.

When thin flat lead plates are used, they may be supported by employing supports of wood, ebonite, or other similar impermeable material, to which the plates are attached and which also serve to form impermeable cells for containing the liquid, as shown in the illustration.

In this case, very thin plates may be used, and one side only is coated with red lead, or other composition, the other side being applied to the partition of the battery, thus obtaining the required rigidity. The plates are attached to the partition by screws, or lead-rivets, and the composition is held up to the surface of the lead by means of a porous or permeable covering.

The patentee illustrates several methods of securing the red-lead or other composition in position; but the fact is, it may be accomplished in many ways. The simplest is probably to inclose the coated plate in flannel, and stitch it right through; plates thus prepared, may be rolled up, or used flat as desired; but if rolled up, distance pieces of rubber, or other acid-proof substance, should be inserted in order to keep the plates apart, and to allow of the escape of the gases. In the illustration, the partitions of wood are shown separated by pieces of rubber at top and bottom, and, as will be understood, any desired number can be placed in a frame and clamped together, forming a series of separate, and impermeable cells.

ASTRONOMICAL NOTES FOR DECEMBER, 1881.

The Sun.

Day of Month.	At Greenwich Mean Noon.		
	Souths.	Right Ascension.	Declination. South.
	h. m. s. a.m.	h. m. s.	h. m. s.
1	11 49 21.12	16 51 17 21 53	16 41 55.22
6	11 51 22.41	16 53 12 23 37	17 1 38.00
11	11 53 36.46	17 14 57 23 2	17 21 20.79
16	11 56 0.01	17 37 4 23 20	17 41 3.58
21	11 58 29.14	17 59 16 23 27	17 12 18 0 46.37
26	0 0 59.08	18 21 28 23 21	18 20 29.16
31	0 3 25.10	18 43 37 23 4	18 40 11.94

At 4 p.m. on December 21st the Sun is said technically to enter Capricornus, and Winter is supposed to commence. At this instant he will really be situated at a point some $2\frac{1}{2}^\circ$ S.S.W. of μ Sagittarii. December 22nd is the shortest day in London, the Sun only remaining 7h. 44m. above the horizon, and, of course, 16h. 16m. below it. From the 20th to the 23rd is an excellent time for finding the Meridian by means of equal altitudes.

Spots, facule, and other indications of activity continue to appear on the Sun's disc.

The method of finding the Sidereal Time at Mean Noon for any other station than Greenwich will be found on p. 388 of Vol. XXXII.

The Moon

Is Full at 5h. 13.6m. p.m. on the 5th, and enters her Last Quarter at 8h. 4.7m. on the night of the 13th. She will be New at 5h. 7m. a.m. on the 21st, and enter her First Quarter at 8h. 41.5m. p.m. on the 27th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	9.8	8 36.1 p.m.
6	14.8	12 57.9 "
11	19.8	4 4.2 a.m.
16	24.8	7 37.6 "
21	0.3	0 15.8 p.m.
26	5.3	4 54.2 "
31	10.3	9 7.1 "

The Moon will be in conjunction with Saturn at Midnight on December 2nd; with Jupiter at 8 p.m. on the 3rd; with Mars at 2 a.m. on the 8th; with Venus at the same hour on the 20th; and later at noon on that day with Mercury. She will be in conjunction for the second time this month with Saturn at 4 a.m. on the 30th, and with Jupiter at 10 o'clock the same night.

There will be an Eclipse of the Moon during the evening and early night of December

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magn.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.				h. m.			
3	54 Arietis	6 $\frac{1}{2}$	4 40 p.m.	Dark	106	66	5 39 p.m.	Bright.	288	247
5	53 Tauri	6	1 12 a.m.	Dark	47	76	2 4 a.m.	Bright.	318	355
5	B.A.C. 1373	6	7 54 "	N.	178	218				
5	Tauri	5	6 23 p.m.	Bright.	95	53	7 25 p.m.	*Dark	280	238
9	1 Cancri	6	7 44 a.m.	S.S.W.	338	7				
10	1 Cancri	6	3 18 "	Bright.	351	351	3 40 a.m.	Dark	320	325
10	A* Cancri	6	7 13 "	S.S.W.	335	7				
11	ω Leonis	6	1 55 "	Bright.	47	21	3 13 "	Dark	263	251
11	14 Sextantis	6	7 51 p.m.	Bright.	80	43	10 49 p.m.	Dark	242	203
12	19 Sextantis	6	7 22 a.m.	S.S.W.	334	308				
12	B.A.C. 3726	6	10 37 p.m.	Bright.	69	31	11 35 "	Dark	249	210
12	55 Leonis	6	12 30 "	Bright.	82	45	1 35 a.m.	Dark	229	195
15	B.A.C. 4201	6	1 56 a.m.	Bright.	47	10	2 58 "	Dark	262	229
15	η Virginis	6	5 47 "	Bright.	42	31	7 2 "	Dark	259	261
26	κ Piscium	4 $\frac{1}{2}$	7 38 p.m.	Dark	87	114	8 36 p.m.	Bright.	326	0
26	9 Piscium	6	7 8 10 "	S.S.E.	26	57				
30	θ^2 Arietis	6	5 30 "	Dark	113	78	6 44 p.m.	Bright.	286	264
30	θ^3 Arietis	6	7 15 "	S. by E.	19	351				
30	54 Arietis	6 $\frac{1}{2}$	12 56 "	Dark	47	88	1 37 a.m.	Bright.	326	7

† Near approaches. * But apparently bright. ‡ Stars below the horizon.

5th, all the more interesting phases of which will be visible, although the first contact with the Earth's Shadow takes place before the Moon rises. At the time of maximum obscuration the magnitude of the Eclipse will be 0.973, her diameter being taken as 1.

	h. m. p.m.
1st contact with Penumbra, Dec. 5	2 16.0 G.M.T.
1st contact with Shadow	3 27.6 "
Middle of the Eclipse	5 8.3 "
Last contact with Shadow	6 49.0 "
Last contact with Penumbra	8 0.6 "

The first contact with the shadow takes place at 61° from the North Point of the Moon's Limb towards the east. The last contact 63° from the same point towards the west—in each case as seen with the naked eye. The Moon will rise at Greenwich at 3h. 50m. p.m.

Mercury

Is a Morning Star during the entire month. From his great south declination he is as badly placed for the observer as he possibly can be. His angular diameter, which is only $5.7''$ on December 1st, diminishes to $4.6''$ by the 31st.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	°	h. m.
1	15 15.7	16 13.5	10 34.1 a.m.
6	15 43.8	18 29.9	10 42.4 "
11	16 14.1	20 35.3	10 52.9 "
16	16 45.9	22 20.7	11 5.0 "
21	17 19.0	23 40.3	11 18.3 "
26	17 53.0	24 30.4	11 32.6 "
31	18 27.8	24 47.9	11 47.6 "

The path indicated by the above Ephemeris commences in Libra, and passes through Scorpio and the extreme south of Ophiuchus into Sagittarius. At 10 p.m. on December 8 Mercury will be in conjunction with β Scorpii, and only $5'$ south of that star. This is the only conspicuous one, though, to which he will approach.

Venus

Is also a Morning Star, and is no better placed for the observer than Mercury, whose track through the sky she seemingly follows pretty closely. She is now very nearly circular, and her angular diameter diminishes slowly from $10.6''$ at the beginning of the month to $10''$ at the end of it.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	°	h. m.
1	15 11.2	16 31.7	10 29.5 a.m.
6	15 36.5	18 14.9	10 35.1 "
11	16 2.3	19 45.9	10 41.2 "
16	16 28.6	21 2.9	10 47.7 "
21	16 55.2	22 4.7	10 54.7 "
26	17 22.3	22 50.2	11 2.0 "
31	17 49.6	23 18.3	11 9.5 "

Save that Venus only reaches a part of the sky where Sagittarius and Ophiuchus are conspicuous, the words used above to describe the path of Mercury might be well applied to hers. She, like that planet, will be in conjunction with δ Scorpi, and at the same distance from it, at 5 p.m. on the 10th.

Mars

Is now visible all night long, and his fiery-red disc is a conspicuous object in the sky. He comes into opposition to the Sun at 5 a.m. on the 27th, has very great north declination, and is admirably situated for observation. His angular diameter (increasing from 17.4" at the beginning of December to 18.4" by the middle of the month), though by no means approaching that of the memorable opposition of 1877, will yet be sufficiently great to enable the detail on his surface to be well seen by the aid of sufficient telescopic power, while his great meridian altitude will remove him far from the mists and undulations of the horizon. His gibbosity, but slightly perceptible early in the month, vanishes towards the end of it, and he becomes sensibly circular.

Day of Month.	Right Ascension.		Declination North.		Souths.
	h.	m.	°	'	h. m.
1	7	3.1	25	11.4	2 22.8 a.m.
6	6	58.3	25	32.8	1 58.3 "
11	6	52.0	25	54.7	1 32.4 "
16	6	44.6	26	15.7	1 5.3 "
21	6	34.5	26	37.8	12 31.7 p.m.
26	6	25.7	26	52.3	12 3.3 "
31	6	17.1	27	2.5	11 35.0 "

This retrograde arc is described in that very blank region in the sky between ϵ and μ Geminorum.

Vesta

May still be seen during the working hours of the night, so we give a short Ephemeris of her at intervals of 10 days.

Day of Month.	Right Ascension.		Declination North.		Souths.
	h.	m.	°	'	h. m.
7	2	7.3	3	41.3	9 6.2 p.m.
17	2	5.0	4	13.9	8 18.17 "
27	2	5.5	5	0.6	7 39.8 "

The path thus shown lies in a part of Cetus near to Pisces, and quite void of visible stars.

Jupiter

Is excellently placed for the observer during the whole of the working hours of the night. His angular diameter decreases from 45.4" on December 1st to 42.4" on the 31st. His considerable north declination affords facilities for the scrutiny of his curious and changeable superficial details.

Day of Month.	Right Ascension.		Declination North.		Souths.
	h.	m.	°	'	h. m.
1	3	5.4	16	17.1	10 22.8 p.m.
6	3	4.2	16	8.9	10 0.9 "
11	3	2.1	16	1.6	9 39.2 "
16	3	0.3	15	55.4	9 17.8 "
21	2	58.9	15	50.5	8 56.6 "
26	2	57.7	15	46.9	8 35.8 "
31	2	55.8	15	44.7	8 15.3 "

The short arc indicated by the above Ephemeris, through which Jupiter retrogrades during December, lies in the void part of the heavens to the S. by W. of γ and δ Arietis.

Saturn

Is very nearly as well placed as Jupiter for observation, being, like him, above the horizon during the whole of the working hours of the night. The north declination of Saturn is not so great as that of Jupiter, but his angular diameter is perceptibly from 18" at the beginning of December to 17.2" at the end of it.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	II	SA E	4	39	P.M.	13	III	Oc D	6	4	P.M.
1	I	Tr I	5	5	"	13	III	Oc R	7	42	"
1	I	Sh I	5	34	"	13	III	Ec D	9	9	"
1	I	Tr E	7	16	"	13	III	Ec R	10	43	"
1	I	Sh E	7	46	"	13	II	Oc D	11	17	"
2	I	Ec R	4	55	11	14	I	Tr I	2	9	A.M.
3	III	Tr I	1	16	A.M.	14	I	Sh I	2	54	"
3	III	Tr E	2	46	"	14	II	Ec R	3	19	"
3	III	Sh I	3	10	"	14	I	Tr E	4	21	"
3	III	SA E	5	0	"	14	I	Oc D	11	21	P.M.
5	II	Tr I	2	15	"	15	I	Ec R	2	17	20 A.M.
5	II	Sh I	3	20	"	15	II	Tr I	5	45	P.M.
5	II	Tr E	4	50	"	15	II	Sh I	7	19	"
6	I	Oc D	3	8	"	15	II	Tr E	8	20	"
6	III	Ec D	5	7	39 P.M.	15	I	Tr I	8	35	"
6	III	Ec R	6	41	52	15	I	Sh I	9	23	"
6	II	Oc D	9	0	"	15	II	Sh E	9	56	"
6	I	Tr I	12	24	"	15	I	Tr E	10	48	"
6	II	Ec R	12	44	25	15	I	Sh E	11	36	"
7	I	Sh I	1	0	A.M.	16	I	Oc D	5	47	"
7	I	Tr E	2	35	"	16	I	Ec R	8	46	18
7	I	Sh E	3	12	"	17	I	SA I	3	52	"
7	I	Oc D	9	35	P.M.	17	II	Ec R	4	37	36
7	I	Ec R	12	21	45	17	I	Tr E	5	14	"
8	II	SA I	4	40	"	17	I	Sh E	6	5	"
8	II	Tr E	6	0	"	20	III	Oc D	9	28	"
8	I	Tr I	6	50	"	20	III	Oc R	11	12	"
8	II	Sh E	7	17	"	21	III	Ec D	1	10	22 A.M.
8	I	Sh I	7	28	"	21	II	Oc D	1	35	"
8	I	Tr E	9	2	"	21	III	Ec R	2	45	20
8	I	Sh E	9	41	"	21	I	Tr I	3	55	"
9	I	Oc D	4	1	"	22	I	Oc D	1	8	"
9	I	Ec R	6	50	41	22	I	Ec R	4	13	1
10	III	Tr I	4	34	A.M.	22	II	Tr I	8	7	P.M.
10	I	SA E	4	10	P.M.	22	II	Sh I	9	57	"
12	II	Tr I	4	34	A.M.	22	I	Tr I	10	22	"
13	I	Oc D	4	54	"	22	II	Tr E	10	43	"

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's p to the horizon.

The amount of opening of his ring system is sensibly stationary.

Saturn.

Day of Month.	Right Ascension.		Declination North.		Souths.
	h.	m.	°	'	h. m.
1	2	21.0	11	17.3	9 37.5 p.m.
6	2	19.8	11	12.8	9 16.7 "
11	2	18.9	11	9.1	8 56.1 "
16	2	18.0	11	6.1	8 35.6 "
21	2	17.4	11	4.1	8 15.2 "
26	2	16.8	11	2.9	7 55.0 "
31	2	16.5	11	2.7	7 35.1 "

So that the planet travels through a short retrograde arc in Aries.

Uranus

Will be in quadrature with the Sun at 8 a.m. on the 10th. Southing, however, as he does then about 6 a.m., we shall defer our Ephemeris of him until next year, when he will come into a more favourable position for the observer.

Neptune.

Continues in a favourable situation for the possessor of adequate telescopic power, as he will be found to the east and north of the planet Saturn.

Day of Month.	Right Ascension.		Declination North.		Souths.
	h.	m.	°	'	h. m.
1	2	50.4	14	27.1	10 6.8 p.m.
6	2	49.9	14	25.1	9 46.6 "
11	2	49.5	14	23.3	9 26.5 "
16	2	49.0	14	21.7	9 6.5 "
21	2	48.7	14	20.2	8 46.5 "
26	2	48.3	14	19.0	8 26.5 "
31	2	48.1	14	18.0	8 6.5 "

Hence Neptune continues to approach α Arietis.

Shooting Stars

Are less plentiful in December than during the preceding month. Watch should, however,

be particularly kept on the nights from to the 13th inclusive, and again on the 24th.

Greenwich Mean Time of South Sixteen of the Principal Fixed Stars the night of December 1st, 1881.

Star	South	h. m.
α Aquarii	..	5 16 54
Fomalhaut	..	6 8 1
Markab..	..	6 15 54
α Piscium	..	6 50 51
α Andromedæ	..	7 19 11
α Cassiopeiæ	..	7 50 31
Polaris ..	..	8 32 55
α Arietis	..	9 17 6
α Ceti ..	..	10 12 32
α Persei	..	10 32 18
γ Eridani	..	11 8 48
Aldebaran	..	11 45 24
Capella ..	..	12 24 1
Rigel ..	..	12 24 56
α Leporis	..	12 43 31
α Columbae	..	12 51 22

The Method of finding the Greenwich Time of South of either of the Stars above List for any other night in December also that of determining the instant of Transit at any other station, will be for 390 of Vol. XXXII. The rules there, however, are not rigidly accurate when to Polaris or any other close circumpolar although they are sufficiently so for all purposes.

THE GREAT COMET OF 18

THE following is the substance of a lecture delivered before the Dublin Young Men's Association, by Prof. R. S. Ball, Astronomer Royal for Ireland, delivered before the Dublin Young Men's Association:—In his opening remarks he referred to an observation which he made regarding the title he had given to his comet of 1881, on the grounds that the comet was twenty thousand millions of miles long, as in proportion. He thought this was a justifiable him in calling it the "Great" C

31. He then proceeded to give some interesting particulars regarding the advent of the comet. The question as to who was the discoverer of the comet was not yet satisfactorily settled, and he did not think it would ever be settled. An American gentleman had some time ago offered a prize, to be given to the person who would first discover a comet, in order to encourage the study of these phenomena. Mr. Swift, an American astronomer, discovered a comet, and received for his discovery the sum of 5000 dollars. News of this appeared in the newspapers, and when the comet of 1881 appeared at summer this gentleman received on an average 10 letters daily from persons who claimed to be the discoverers of the comet, and demanding that the 5000 dollars should be sent to them by return of post. One of these gentlemen was really entitled to the prize. The fact was, this comet was seen by several thousand people, and perhaps, he should say, by several millions of people, long before it was visible in the northern hemisphere. The first gentleman to discover it was, so far as had been ascertained, Mr. Tebbutt, in New South Wales, who was in the habit of looking at the western sky in the evening, this being the part in which the comets generally appeared. Two or three days before it was observed by Dr. Gould in the Argentine Republic in South America. Seeing that the comet was coming northwards, and that it would be visible in Europe soon, he wrote to his friends in Europe telling them of its approach. After posting his letters he found on closer inspection that the comet was travelling so fast that it would reach Europe long before his letters could arrive, and accordingly he resorted to the telegraph. His efforts in this direction proved very unfortunate, endeavouring to keep the message within a certain limit, he succeeded in imparting to it such an air of mystery as to completely muddle the telegraph clerks on his own side. The message lost its way in its transmission, and by the time it was received here the recipients knew nothing more than that there was something coming from somewhere, but what it was they could not guess. So far as he (Professor Ball) knew, there was only one gentleman who took any great interest in the study of astronomy—he referred to the Emperor of Brazil. He was not, therefore, with surprise that the astronomer in this country received the first correct information of the appearance of the comet from the astronomer at Brazil. His Majesty, on making a discovery—more lavish of his money than Dr. Tebbutt—was enabled to send a clearer message, which was at once comprehended by the astronomers here. Mr. Ball here gave an account of the "Science Server Code," invented by Messrs. Chandler and Schiaparelli, for transmitting astronomical data by telegraph. A description of the code will be found on page 592, No. 357.] Besides this great comet he had visits from several minor ones this year, making in all five or six. They had also been enabled to view the wonderful sight of two large comets, which were quite brilliant at the same time. They should remember that looking through a telescope they could not see the comet all at once. Visitors to the Dunsink observatory had been appointed by their not being able to do so, but recommended those desirous of obtaining a full complete view of the comet to use an opera-glass, as by means of this little instrument they could sweep the heavens. Of course if they wanted to look at certain points of the comet they should use the telescope. In giving some details of the comet, the lecturer said the first question to be asked was "Was this comet ever seen before?" Frequently happened that comets appeared more than once. There was nothing more difficult than to establish the personal identity of these bodies. It could only be established in one way. They were always changing, so that it would be impossible to distinguish them by appearance. The only possible way they had of ascertaining the identity of the comet was by means of the path in which the comet moved. It was an ascertained fact that no two comets ever moved in the same way. The lecturer next referred to the habit which prevailed of associating tails with all comets. He had so far forgotten the respect due to astronomy as to petulantly remark that it was like a cat—it had no tail. Encke's comet, though it had no tail, was one of the most interesting of celestial bodies. This comet moved once round the sun in every five years. On one occasion it did not come up quite true to time. The astronomers on setting out to find the cause of this, discovered that the delay was caused by its having passed very close to Mercury, and it was delayed in consequence. From this they had obtained a result of the utmost importance. It was the duty of astronomers to put every one of the heavenly bodies into the weighing scales, and to give their weight. They had not previously known the weight of this comet, but by this occurrence they found that the comet had been kept back by the attraction of the planet, and by this means they ascertained the exact weight of the comet itself. A peculiarity of the comets was, that they "formed" as might be termed an island group in contrast to the widely scattered myriads of stars. The

comet consisted of no solid mass. They would be surprised to learn how excessively filmy the component parts of it were. They were almost perfectly transparent, and in their passage between the earth and the stars they in no way clouded them, but even if a hundred miles of comet matter intervened they would see the stars behind just as well as if the matter were not there. Considering the light weight of a comet, it was needless to fear the result of a collision between the earth and any of these bodies. The best answer to any fear which might be entertained on this subject was, that not only was there constant danger of a collision, but it often happened, and nothing was generally known about it. The last of these collisions occurred on a Sunday in June, 1861, and a good many people had survived it. In that year there was a great comet, and the earth actually passed through its tail. It was a whisk of the tail that the earth got. Had they passed through the dense part he did not know what might have happened, but he did not think there would be anything to fear, even had they been struck by the closest and most brilliant part of it. On the day he had mentioned the occurrence had been noticed by two or three who had no knowledge of the collision, but simply noticed that there was a peculiar hue or colour in the sky, and Mr. Lowe, a well known scientific contributor, said that although it was daylight there was a curious sort of glare which, had it been evening, he would have called an aurora borealis. It was thought that possibly that glare might have been connected with the circumstance that they were actually at the time imbedded in the tail of the comet.

COLOUR-BLINDNESS.—VI.*

By R. BRUDENELL CARTER, F.R.C.S.

(Concluded from page 227).

IN the face of the facts and arguments already stated, it becomes a serious question what precautions should be taken by the governing bodies of railways, if necessary under compulsion from the Legislature, to secure the traffic of their respective lines against the risks which colour-blindness seems in the long-run certain to entail. Considering the extent and character of these risks, and the inadequacy of any other defence against them, I think it is not too much to require that the colour-blind, for the future, should be absolutely excluded from railway or naval employment. The absolute number of persons affected by such a provision would, no doubt, be large; but the comparative number would be small; and there is no real hardship in excluding four per cent. of the male population from duties which they are not qualified to fulfil. The subject is one which might with great advantage be taken up by the Amalgamated Engineers and other trade societies, or, better still, by school boards, with a view to the early testing of the colour vision of children and of candidates for apprenticeship, and in order to exclude the colour-blind from occupations for which they are unfit, before they had spent time in preparing for them. Failing this, a strict examination should certainly be instituted by all railway companies, and no man should be permitted to enter their service, in any position in which colour-vision was or might be required from him, unless the results of the examination were entirely satisfactory.

It is strongly held by the majority of ophthalmic surgeons that every such examination should be conducted by trained experts; and in the United States, where this opinion has already found legislative expression, it is certain that passengers would not consider their safety adequately provided for, and that engine-drivers and others would not submit to be condemned, by any verdict save that of a trained scientific observer, thoroughly conversant with the whole range of the phenomena which he was called upon to investigate. In this country, at the present time, public opinion is hardly prepared to insist upon such an examination as this, and moreover, in its influence upon railway companies, it is singularly feeble. I would venture to suggest, as a compromise between what is theoretically desirable and what is practically capable of enforcement, that the preliminary examination of all candidates for employment should be left in the hands of the ordinary officers of the companies, acting under scientific instruction, and that doubtful cases should be referred to experts. It would be very easy for the companies to arrange with experts to examine the cases referred to them at some stated fee, and then to say to candidates for employment, whose cases were reported as doubtful, that they must obtain certificates from the appointed expert before they could be considered eligible for employment. Whether the fee should be paid by the

* The substance of a series of Cantor Lectures delivered before the Society of Arts.

company or by the candidate would be a matter of arrangement between them.

The mode of examination which I would suggest, as falling within the capacity of the officers of the companies themselves, would be very simple. I would let them call upon each candidate rapidly to sort into two heaps twelve skeins of wool, six of which should be red and six green, both in gradations of colour, and to throw all the red into one heap and all the green into the other. Any normal-sighted person would accomplish this sorting very quickly, and with absolute ease and certainty; and any candidate who did this should be considered as having passed in colour. Any candidate who rapidly made a wrong selection should be rejected without hesitation. Any candidate who sorted his wools slowly, and as a result of careful comparison, would at least have defective colour-sense, and should be referred to experts to decide upon his exact condition. He would probably belong to the class of the incompletely colour-blind; whose condition is such that they can distinguish red from green in certain circumstances and at short distances, but not under all circumstances, nor at all distances. It would then be the duty of the expert to pronounce upon the degree of the defect, and it would be the duty of the railway authorities to decide whether that degree amounted to a disqualification in the course of the particular man; due regard being had to his capacities in other respects, or to his claims, from past service or other causes, upon the consideration of his employers.

The visibility of an object depends upon the size of the surface within the eye which is covered by its image; and this again upon the two elements of size and distance, which govern the dimensions of what is known as the visual angle. The result of this is that we take objects of known magnitude, placed at known distances, and determine the acuteness of vision by dividing the distance at which any such object is recognised by the distance at which it ought to be recognised. In the same way, we can express the degrees of incomplete colour-blindness by the distance at which a given red light, or a given green light, would be recognised; and, when we have arrived at the normal standard, we can express all that falls short of it by a fraction. Thus, if a normal eye would recognise the character of a given light at a thousand yards, and an incompletely colour-blind person could not recognise it until he had approached within five hundred yards, the latter would have only half acuteness of colour-sight as compared with the former. An ingenious apparatus for determining this point is in use on the Belgian State railways. In principle it resembles the lamps of Professor Donders and of Mr. Nettleship, but it differs from them in details. The aperture through which the light is transmitted is covered by a disc furnished with what is called an "iris diaphragm," that is, a contrivance by which the size of the opening may be regularly increased or diminished by the action of a lever, the circularity of its outline being all the while maintained. Behind this variable aperture is another disc carrying coloured glasses. The person to be examined is placed five metres from the instrument; and a disc of coloured light is shown to him of such brightness and magnitude as a signal lamp, in clear weather, would present at 700 metres. He is not permitted to use any colour-names, but is directed, as soon as he sees a danger signal, to call out "stop," and as soon as he sees a forward signal to call out "right." If he makes no response when the light is first exposed, the lever is moved in such a way as to enlarge the luminous opening at the rate in which an actual signal lamp would appear to be enlarged to a driver approaching it at thirty miles an hour; and, as soon as the man calls out anything, either rightly or wrongly, the size of the aperture is read off, and the examination continued as long as may be required. In this way the expert becomes able to say that the candidate, instead of distinguishing the lights at 700 metres, confuses them until they come within, say, 100 metres, and it is then for the authorities of the line to determine whether this degree of colour-sight is sufficient for the duties about which the man would be employed. To some extent, of course, the question of the sufficiency or insufficiency of incomplete colour-vision is a question of the efficiency of brakes, and the less efficient are the brakes with which any train is provided, the more important it becomes that the driver should be able to recognise colour signals at the normal distance.

The Nautical Department of the Board of Trade, now for the last three years, has insisted upon an examination in colour as a preliminary to the professional examination for candidates for masters or mates' certificates, and there can be no doubt that great credit is due to this department of the Government for its prompt recognition of the requirements of the public safety in this respect. According to an official return, only 26 candidates were found to be decidedly colour-blind out of 5,967 examined in two years, or 0.43 (less than one-half) per cent. This small propor-

THE opening meeting of this Society for the present Session was held on Wednesday, the 16th inst., at the Institution of Civil Engineers, Mr. G. J. Symons, F.R.S., president in the chair. Twenty-seven gentlemen were balloted for and duly elected Fellows of the Society.

The evening was devoted to an account of the gale which passed across the British Isles, Oct. 13th and 14th, 1881, which had been prepared by Mr. G. J. Symons, F.R.S., with the assistance and co-operation of Mr. C. Harding and other gentlemen. There is evidence of the storm being formed in the Atlantic, about 150 miles off Nova Scotia, on Oct. 10th, and that at about the 13th, there was a considerable disturbance about 600 miles W. of Galway. At that time there were scarcely any instrumental indications in the British Isles of the coming storm, the barometer was falling at Valencia, but not rapidly, and at some of the western English stations was rising. The curves of barometric fluctuation were very plainly the advance of the depression from W. to E., for while at Valencia the minimum occurred at 2 a.m. on the 14th, on the east coast of Norfolk it is recorded that it did not occur till 4 p.m. This fact, coupled with others, seems to indicate an easterly progression of the barometric minimum at nearly 40 miles per hour. As to the sea is concerned, the chief force of the gale was felt in the afternoon of the 14th in the Gironde.

and there the great loss of life and damage to shipping seems mainly due to the extremely violent squalls which were peculiar to the south, as well as to the extremely sudden change in which the wind increased to hurricane force.

The afternoon became quite darkened by the water blown into the air, so that it was impossible to see a ship's length ahead. The barometer for 9 a.m. on the 14th, showed that the pressure in the North of England was an inch higher than in the south, and nearly two inches higher in the south of France. The area over which injury was produced was very large, and, though not without precedent, it was happily the record of 56lb. per square foot at the Observatory, Greenwich, was the highest registered in that locality, and close by 35 were blown down in the park, and 15ft. off the top of a spire which had been erected 40 years, the stone of which shows no sign of decay, and which had retained its position, if not wholly, by the gravitation of its mass.

The general opinion seems to be that the actual damage over the greater part of the country was by no means unprecedented, and in the greater part of Ireland and the S.W. of England was not even of an unusual character, but the east coast and in the east midlands the damage was excessive, and on the N.E. coast unexampled. In Scotland the destruction of trees was enormous.

J. Wallace Peggs, F.M.S., also read a paper on "Structural damage caused by the Gale as a force of wind-force," and remarked that since the Bridge disaster attention had once more been directed to the subject of wind-pressure. He suggested that a conference of delegates from societies specially interested in the subject should be held, who should make experiments and consider the whole question.

THE MICROSCOPICAL SOCIETY.

At the second meeting of the present session, Mr. Braham, F.C.S., introduced a new micrometer for measuring the angles of crystals. The body of the microscope tube was formed at angles. A rectangular prism is so adjusted that the plane of the hypothenuse is at an angle to the axis of rotation. On bringing the crystal into the centre of the field, a fibre in the of the eyepiece is made to coincide with one of its edges so that the degrees passed through easily be read. Thus, as the instrument resolves a magnified image of the crystal, and the itself is stationary, it will readily be seen the angles of any crystal visible under the powers of the microscope can easily be read. Mr. Braham then gave an address on transparent crystals formed by the action of carbon disulphide. The experiments he had carried out were explained as follows:—Mr. Braham had sealed up in glass tubes, several metals in carbon disulphide, and had recently examined them under the microscope. From the date of sealing them there were chances of incipient crystallisation in most of them. After two years' rest, the tubes containing gold, antimony, and bismuth, showed transparent crystals, the shape of which coincided with the form which carbon takes in the diamond. Braham then recapitulated his experiments, to the society from time to time, all of which upon crystallisation or analogous subjects. He considered crystallisation to be one of the most studies that the chemist and physicist can study, and one in which the microscope played an important part, for by its use the time at which crystals were to be discovered was shortened. He considered crystallisation to be the first effort in building up a structure, and to observe the manner in which crystals form under the microscope, we have ocular demonstration of the exerted by matter under certain chemical physical conditions. Speaking of the time was required to produce such crystals as crystals of large size, he gave it as his opinion was impossible to conceive the time they had of form, and their purity depended on circumstances of large masses of matter in a solution lying heterogeneously until nothing but the element was left, and that a slow process of on through ages completed it. At the close address the sealed tubes were exhibited in cases.

Lean Brass.—Rub the surface of the with rotten-stone and sweet-oil, then rub with a piece of cotton flannel, and polish with a cloth. A solution of oxalic acid rubbed on polished brass soon removes the tarnish, and the metal bright. The acid must be washed off with water, and the brass rubbed with a soft leather. A mixture of muriatic acid dissolved in water imparts a golden colour to brass articles that are steeped in it for a few days.

SCIENTIFIC NEWS.

IN the *Science Observer* Circular, No. 19, Mr. S. C. Chandler, jun., states that Denning's comet of 1881, has a period of about eight years (8.343). The elements calculated by him were telegraphed to Dun Echt, and we gave them on p. 228; but to determine the date of the next return, as many observations as can be obtained will be necessary: hence the advantage of telegraphing astronomical observations.

Dun Echt circular No. 40 contains the elements of a new comet, sent by Science Observer code telegram. The elements have been calculated by Mr. Chandler, from observations made by Mr. Wendell at Harvard College, on Nov. 17, 19, 20. T 1882, Feb. 5.35, G.M.T.; $\pi = 192^\circ 26'$, $\Omega = 205^\circ 46'$, $i = 181^\circ 47'$ mean equinox, 1881; log. $q = 0.14959$. The ephemeris for Washington, midnight, Nov. 29, is R.A. 0h. 5m.; N.D. $55^\circ 21'$. The comet is increasing in brightness.

Prof. W. E. Ayrton has issued a corrected translation of his lecture "On the Economical Use of Gas-engines for the Production of Electricity," which he delivered at the Salle du Congrès of the Electrical Exhibition, Paris. It is published by Dawson and Sons, 121, Cannon-street, E.C. It contains a table showing the relative cost of a steam-engine, and of an Otto gas-engine, the latter worked with ordinary coal-gas and with Dowson's water-gas, a description of which we gave on page 49. The table shows that the Dowson process is much the cheapest. We understand that Messrs. Crossley are making an Otto engine capable of indicating 60 horse-power, which is to be worked by the Dowson gas.

An Order in Council having been made last August directing that the Whitworth gauges should be Board of Trade standards, as if they were mentioned in the second schedule of the Weights and Measures Act, 1878, Sir Joseph Whitworth and Co. have reprinted extracts from the well-known "papers," and are circulating them amongst all persons likely to be interested in the subject.

The Midland Railway Company are considering a scheme for lighting the Erewash Valley section of their line by means of electricity. The section extends from Chesterfield to Nottingham, and engines and dynamo-machines will be erected at each end. On this part of the Midland system, junctions, sidings, and stations are very numerous, and it therefore offers a favourable site for an experimental trial of the electric light.

Open Scholarships of Natural Science are offered by Trinity College, Cambridge, the date of the examination being March 22, 1882, and the subjects those of the natural science tripos. Some of the other colleges also offer scholarships, the subjects being chiefly chemistry, physics, and biology.

A compressed air-motor has been lately tried on one of the New York elevated railways with satisfactory results. The motor carries four reservoir tanks, in which air is compressed to 580lb. on the square inch, and after making the double journey the pressure is reduced to 125lb. With proper facilities it is said the motor can be charged in about three minutes.

In Chicago an experiment is being made with a wire-rope tramway, in which the rope is carried in a tube sunk between the rails, the connection with the car being made by means of steel gripping bars which pass through a groove in the tube three-quarters of an inch wide. Interference with ordinary traffic is completely avoided, and if the experiment stands the test of winter, the tramway companies in other towns have undertaken to employ the system.

The centenary of Sir D. Brewster's birth is to be celebrated in Edinburgh on January 9th next—a public dinner, with Lord Moncrieff as president, being one of the features.

M. Paul Bert has recently communicated to the Academy of Sciences the results of his experiments on anesthetics. He finds that the fatal dose is, curiously, just double that which is sufficient to produce insensibility. He calls the interval between these points the working zone, and states that an animal which is made

to breathe a mixture of the anæsthetic which is about the middle of the zone is quickly anesthetised. The working zone is often narrow—for instance, eight grammes of chloroform failed to render a dog insensible, while 20 grammes kills. Ether, M. Bert finds, is much less dangerous; and protoxide of nitrogen has a more extensive working zone than any of the other anesthetics tried.

The last part of the *Transactions* of the Royal Irish Academy is occupied by the papers of Prof. the Rev. Samuel Haughton, describing his new researches on sun-heat and terrestrial radiation, and on geological climates. Dr. Haughton's researches rank amongst the most valuable made in connection with the subject named.

It is stated that a tunnel will shortly be commenced through the Col de Somport, near the Pic du Midi, in order to shorten the railway route from Paris to Madrid.

The Royal Agricultural Society is about to offer prizes for the invention of a mechanical means of draining land, and one of the objects aimed at will be the introduction of an automatic excavating machine, capable of working on the land which now suffers from want of proper drainage.

Professor Bell has submitted to the Paris Academy another electric method (in addition to that of the induction balance), for detecting a projectile in the human body. It consists in inserting a fine needle near where the ball is supposed to be. This needle being connected by wire with one terminal of the telephone, while a metallic plate laid on the skin is connected with the other terminal, when the point of the needle reaches the ball a current arises (the ball and the metallic-plate naturally forming a couple), and a sound is heard in the telephone. The needle may be inserted in several places with little pain, and the pain may be prevented by means of ether spray. The method has been tested on a piece of beef containing a ball. Contact of the needle with bone gave no sound, but there was a distinct sound whenever the ball was reached. The arrangement may be modified by introducing a vibrator into the circuit; a musical sound is then heard when the needle meets the ball. The circuit may also comprise a weak battery. In this case there is a sound from the moment the needle enters the skin; but at contact with the ball the sound is greatly intensified.

The magnetic photometer recently invented by M. Coulon consists essentially of a radiometer bulb, with aluminium needle, hung by a silk fibre, and having two vanes and two pieces of iron acted on by an exterior arching magnet, which can be slid up and down on the upper tube. When the instrument is not in use, the needle is let down to rest on the mouth of a tube a little below it; this being done by moving a spring runner, from which the fibre is hung, by means of a magnet outside. The instrument is sensitive at once to heat, light, and electricity, and so may serve as a thermometer, or electrometer, as well as a photometer. To measure one form of energy the others are rendered constant. The graduation will be guided by direct experiment.

An exact reproduction of a photograph of comet *b*, 1881, taken by M. Janssen, at the Observatory of Meudon, appears in a recent issue of *La Nature*. A telescope of 0.50m. aperture, and 1.60m. focal distance, was used on the occasion. The extra-sensitive gelatino-bromide-of-silver plates were prepared and developed in darkness. The time of luminous action was 30 minutes. Arrangements were made to correct the proper motion of the comet, as also the diurnal motion. The method was such as to give the tail, which extends more than $2\frac{1}{2}^\circ$, and the exposure was, therefore, somewhat excessive for the head; but the details in the tail show that the comet was well-followed by the telescope. The photograph reveals certain straight lines, not otherwise observed, also some very small stars which do not figure in any celestial atlas.

Considering that a fall of the barometer in general indicates coming rain only when the moisture increases at the same time, Herr Klinkerfues, of Göttingen, has devised a combination of the barometer and the hygrometer. The horizontal axis of a rotating index has two supports behind, and between these a short piece project-

ing in opposite direction to that of the index (which is more or less oblique). Over this piece passes a thin, soft cord of hygroscopic fibres (e.g. of human hair deprived of grease), reaching from the outer support to the middle of the corrugated plate of an aneroid case. It will be understood that when the air-pressure increases, the cord is stretched, and the index rises. But, if the moisture increases, the cord slackens, and the index falls. The instrument is figured in *Dingler's Journal*.

It is known that deaf mutes can be taught to speak in a manner. According to Mr. Hémet, the individuals so taught have the peculiar accent of their native place. Since they cannot have acquired this by imitation, being deaf, he supposes that the fact indicates organic conformations similar to those of their parents: a new example of physical resemblance, transmitted hereditarily. M. Blanchard (in the French Academy) expressed doubts about this. The hoarse, metallic, guttural sounds produced by persons deaf from birth, without modulations or inflexions, seemed to him to be beyond the characterisation of accents by which human voices are distinguished. The question, as to whether the presence or absence of certain articulations, in the idioms of peoples, was connected with peculiarities of the phonetic apparatus, was (in his opinion) quite uncertain. The probability of such peculiarities he was disposed to affirm some time since, considering such facts as that the Chinese substitute *t* for *r* in French or English words (Europe, America), but he had since met a Chinaman, familiarised with French, who articulated the *r* distinctly.

With a view to render the spectroscope more powerful and more convenient for researches in physical astronomy, M. Zenger has been seeking birefringent substances other than quartz for the parallelepiped in the direct-vision instrument. None do better than calcareous spar, which is very transparent for ultra-violet rays. He combines a prism of this, of 78° refringent angle, with a fluid prism (sulphide of carbon or oil of cassia) of the same angle, and thus gets a dispersion-parallelepiped exceeding 22°. When the limiting value of the refringent angle is passed, one easily obtains total reflection of rays as far as C, for example, while the orange rays from D to L pass. Thus the monochromatic red image of the protuberances may be had with great intensity, owing to the small loss by absorption, while the loss by reflection becomes nil. The extraordinary rays are all reflected by reason of the small value of the index of refraction, and the spectrum is simply that of the ordinary rays.

Herr Hempel finds that absorption of oxygen gas takes place very rapidly and without any development of gas, when the gas examined is brought into contact with metallic copper and a liquid consisting of equal parts of saturated solution of carbonate of ammonium, and diluted caustic ammonia of 0.93 specific gravity. The method (described in *Chemiker Zeitung*) is not applicable to gases containing carbonic oxide. Copper has the advantage over pyrogallate of potassium of greater power of absorption; and over phosphorus, that the work is quickly finished at any temperature, even - 7°, while phosphorus at temperatures under 14° absorbs oxygen very slowly.

Various improvements have been made on the Lyman Haskell cannon, and (according to the *Scientific American*) the new gun is expected to throw a projectile four calibres in length a distance of ten or twelve miles, leaving the gun with a velocity of 4,000ft. per second. (On the accelerating principle adopted in these guns, a succession of cylindrical chambers, called pockets, are formed at an angle below the bore, and pointing towards the muzzle. These contain accelerating charges of powder that ignite after passage of the projectile, which is started in the usual way.) Last month a casting was made at the Scott foundry for the breech section of a 6in. Lyman-Haskell gun. After the muzzle and breech portions are joined, the whole is lined with steel in one continuous cylinder for the bore, and smaller ones for the pockets.

Among prizes to be awarded by the French Society for Encouragement of National Industry in 1882 is one of 1,000 francs for an industrial application of endosmose of liquids. In stating the question, it is mentioned that the action of membranes in the phenomenon observed by

Dutrochet, was proved by Graham to depend on their porous quality, not on their organic nature (porous porcelain, &c., having a like effect); a molecular mechanical force is at work which may overcome, not only the affinity of a body for its solvent, but even weak chemical affinities. Industry will some day doubtless make large use of the action for concentrating the principles disseminated in large masses of natural or artificial products, for eliminating hurtful substances, for displacing the juices of plant-cells, &c. In some cases endosmose produces double decompositions which without it would require in some cases too low temperatures, in others agents too expensive or apt to alter useful products. M. Dubrunfaut has given endosmose a practical industrial form in treating molasses. Alcohol can be concentrated in membranous reservoirs. Certain processes of tanning, &c., have profited by endosmose. The Society desires to encourage research in such directions.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 21, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

* * * In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physics: a vice from whence great inconveniences derive their origin."—Montaigne's Essays.

ORDER OF BRIGHTNESS OF STARS.

[19430.]—MR. GEMMILL (letter 19249, page 88) inquires for the results of any observations of mine with regard to the order of brightness of the principal stars in Ursa Major. Below are the preliminary results, expressed in stellar magnitudes of the observations made here in 1880 and 1881. These observations form part of a series undertaken with the view of measuring the brightness of all stars visible to the naked eye in this latitude, by means of photometric apparatus mounted in the meridian. This work, when completed, will include observations on twelve nights of each star of the first or second magnitude, on six nights of each star of the third or fourth magnitude, and on three nights of each of the remainder. For 1880 and 1881 about five observations each year have been made of the bright stars in Ursa Major, and the figures given below depend upon these measurements. I prefix the results obtained by the photometric determinations of Seidel and Wolff, also expressed in stellar magnitudes:—

	Seidel.	Wolff.	H. C. Observatory.
	1860.	1870.	1880. 1881.
ϵ	1.9	2.0	1.8 1.9
η	1.9	2.0	1.9 2.1
α	2.3	2.1	2.0 2.0
ζ	2.2	2.3	2.3 2.3
γ	2.6	2.5	2.4 2.5
β	2.5	2.4	2.6 2.6
δ	3.6	3.6	3.4 3.5

Seidel was aware that his instrument made reddish stars appear somewhat too faint, and his result for α Ursa Majoris is doubtless to be explained in this manner. In other respects, the discrepancies between the order of brightness of the stars, as determined at one time or at another, are not large enough to suggest anything more than the effect of accidental errors in the observations.

Observations of magnitude by sequences, such as those of Mr. Gemmill, are much increased in value when the observer estimates the fractional differences between the separate steps in the series. Thus, if he places α Ursa Majoris, with respect to its brightness, at five-tenths, or three-tenths, for example, of the interval from α to γ , instead of recording simply that it is intermediate in brightness between them, his observation becomes a precise measure of magnitude. It should also be noticed that, in order to render the effect of atmospheric absorption insensible, the stars should be observed on the meridian at their upper culmination, or else the time of the observation and the latitude of the observer should be recorded, so that the proper correction may be computed and applied. It often amounts to several tenths of a

magnitude in the case of such stars as those above discussed.

It may not be known to all your readers that the publications of this observatory are distributed gratuitously, not only among professional astronomers, but also, so far as the stock of copies permits, among amateur observers, who are making valuable contributions to the science.

Edward C. Pickering.

Harvard College Observatory,
Cambridge, U.S., Nov. 2.

ASTRONOMY FOR OCTOGENARIANS.

[19431.]—MR. VALLANCE will find, in Mr. Grubb's catalogue, the figure and description of a telescope mounted in the way he suggests. But Mr. Grubb places the stand of his telescope on a railway; when it is pushed out of doors the window is closed behind it, leaving aperture for eyepiece, &c.

I hear, on good authority, that a telescope of this construction, with object-glass 6in. in diameter, supplied to the Cork Observatory, performs admirably. P. Q. M.T.

SATELLITES OF SATURN—JUPITER—MARS.

[19432.]—THE apparent major and minor semi-axes of the disc of Saturn, of the outer rim of the ring, and of the ellipses described by the five inner satellites, will be:—

	1881.	Dec. 5.	Dec. 15.	Dec. 25.
Disc	9.7	8.8	9.6	8.7
Ring	22.3	7.0	22.0	6.9
Mimas	30.4	9.5	30.0	9.4
Enceladus ..	39.0	12.2	38.5	12.0
Tethys	48.3	15.1	47.7	14.8
Dione	61.9	19.4	61.1	19.0
Rhea	86.5	27.1	85.3	26.6

The satellites move in their apparent orbits in the direction of decreasing position-angles, and will be at their inferior N. (north), and superior S. (south), conjunctions with the centre of the planet about the Greenwich mean times given in the following list:—

1881.	Gr. M.T.	1881	Gr. M.T.
Dec. 1	1.0 Di. N.	Dec. 13	17.1 En. S.
	9.2 En. S.		23.4 Te. N.
	10.5 Mi. S.	14	9.5 En. N.
	17.0 Te. S.		15.1 Mi. S.
	20.9 Rh. N.		17.3 Di. N.
2	9.1 Mi. S.		22.1 Te. S.
	9.8 Di. S.	15	10.0 Rh. N.
	15.6 Te. N.		13.7 Mi. S.
	18.1 En. S.		18.4 En. N.
3	7.7 Mi. S.		20.7 Te. N.
	10.5 En. S.	16	2.1 Di. S.
	14.3 Te. S.		10.9 En. S.
	18.6 Di. N.		12.3 Mi. S.
4	2.9 En. S.		19.4 Te. S.
	3.1 Rh. S.	17	3.3 En. N.
	6.3 Mi. S.		10.9 Mi. S.
	12.9 Te. N.		11.0 Di. N.
5	3.5 Di. S.		16.2 Rh. S.
	4.9 Mi. S.		18.0 Te. N.
	11.6 Te. S.	18	9.6 Mi. S.
	11.8 En. S.		12.2 En. N.
	16.2 Mi. N.		16.7 Te. S.
6	4.3 En. N.		19.8 Di. S.
	9.3 Rh. N.	19	4.6 En. S.
	10.2 Te. N.		8.2 Mi. S.
	12.3 Di. N.		15.3 Te. N.
	14.8 Mi. N.		22.3 Rh. N.
7	8.9 Te. S.	20	4.6 Di. N.
	13.1 En. N.		6.8 Mi. S.
	13.3 Mi. N.		13.5 En. S.
	21.1 Di. S.		14.0 Te. S.
8	5.6 En. S.	21	5.4 Mi. S.
	7.5 Te. N.		6.0 En. N.
	12.1 Mi. N.		12.6 Te. N.
	15.4 Rh. S.		13.5 Di. S.
9	6.0 Di. N.	23	4.5 Rh. S.
	6.2 Te. S.		11.3 Te. S.
	10.7 Mi. N.		14.8 En. N.
	14.5 En. S.		15.3 Mi. N.
10	4.8 Te. N.		22.3 Di. N.
	6.9 En. N.	23	7.3 En. S.
	9.3 Mi. N.		9.9 Te. N.
	14.8 Di. S.		14.0 Mi. N.
	21.6 Rh. N.	24	7.2 Di. S.
11	3.5 Te. S.		8.6 Te. S.
	7.9 Mi. N.		10.7 Rh. N.
	15.8 En. N.		12.6 Mi. N.
	23.6 Di. N.		16.2 En. S.
12	2.1 Te. N.	25	7.2 Te. N.
	6.5 Mi. N.		8.6 En. N.
	8.2 En. S.		11.2 Mi. N.
13	0.8 Te. S.		16.0 Di. N.
	3.8 Rh. S.	26	5.9 Te. S.
	5.2 Mi. N.		9.8 Mi. N.
	8.5 Di. S.		16.9 Rh. S.
	16.5 Mi. S.		17.5 En. N.

Gr. M.T. h.	1881.	Gr. M.T. h.
0.8 Di. S.	Dec. 29	11.3 En. N.
4.5 Te. N.		18.5 Di. S.
8.4 Mi. N.	30	0.5 Te. S.
9.9 En. S.		3.7 En. S.
2.4 En. N.		15.6 Mi. S.
3.2 Te. S.		23.1 Te. N.
7.1 Mi. N.	31	3.4 Di. N.
9.7 Di. N.		5.3 Rh. S.
23.1 Rh. N.		12.6 En. S.
1.8 Te. N.		14.2 Mi. S.
5.7 Mi. N.		21.8 Te. S.

not yet heard of any other observation of the present year, but that of a Sept. 4, mentioned on p. 61, so that I do not know the prediction may be correct that it be in conjunction with the end of the 23.5 hours before, and about 2.5 hours after the listed times of conjunctions with the other satellites; approximations may be easily found by taking the time between the time, for which the places are given, and the times of the nearest (preceding) conjunctions with the centre, and with the time intervals the correspondences of x and y from the following little table: x is positive, or the satellite is on the wing side of the minor axis of the ring, and a N. conjunction, and it is negative, the preceding side between a N. and S. one; y is north or south of the major axis, according as the nearest conjunction centre is N. or S.

Disc.	Dione.	Tethys.	Encel.
x .	x .	x .	x .
2.9	0.0	0.0	0.0
2.9	0.6	2.1	0.7
2.9	1.2	2.1	1.4
2.9	1.8	2.0	2.0
2.8	2.4	1.9	2.6
2.8	2.9	1.8	3.2
2.7	3.5	1.7	3.7
2.7	4.0	1.6	4.1
2.6	4.4	1.5	4.5
2.5	4.8	1.4	4.7
2.5	5.2	1.2	4.9
2.4	5.6	1.0	5.0
2.3	5.8	0.9	
2.1	6.1	0.7	
2.0	6.2	0.5	
1.9	6.3	0.3	
1.7	6.4	0.1	
1.5			
1.2			
0.9			
0.5			
0.2			

centres of right ascension between Iapetus and the centre of Saturn, at Greenwich noon:—

$\alpha - A$	$\alpha - A$	$\alpha - A$
Dec. 12	1.0	Dec. 23
28.8	13	2.1
28.6	14	5.2
24.2	15	8.3
21.7	16	11.3
19.0	17	14.2
16.2	18	17.0
13.3	19	19.7
10.3	20	22.2
7.2	21	24.6
4.1	22	26.8

difference is +, Iapetus follows, if —, it is centre of the disc. Iapetus is south of the centre till Dec. 24, when it passes to the north of the parallel.

The following is a list of the passages of the reddish spot across the middle of the disc of Jupiter, which have been observed during the present apparition of the planet, and which I have yet received. The observations were made by the following observers, been good enough to communicate them to me:—

Barnard, Nashville, Tennessee, U.S.A., 10in. power 173.
Jenning, Ashley Down, Bristol; 10in. power 450.
Williams, 35, Lansdowne-crescent, Bayswater, reflector, power 200 and 120.
McCance, Limavady, Co. Derry, Ireland; 4in. power 123.
Williams, 1, Medina-terrace, West 5th, reflector, with various powers, and 2 1/2 in. refractor, power 102.
The passages of I.V.V. are taken from the "E. M." of August 12.
The times are Greenwich mean times; the longitudes are deduced from the ephemeris in the *Monthly Notices* of the Royal Astronomical Society.

Observed Passages of Great Reddish Spot.				Corresponding Longitudes.		
1881.	Proc. E.	Middle.	Foll. E.	Observer.	Proc. E.	Middle. Foll. E.
h. m.	h. m.	h. m.	h. m.			
June 24	13 38.5	14 6	14 28	Williams	—	6.6 19.8
July 6	15 5	15 31	15 53	"	353.5	6.1 16.5
8	15 12	15 36	16 4	"	350.6	5.1 22.0
10	16 48	17 14	—	Denning	346.4	2.1 15.4
11	22 34.7	—	—	"	349.3	5.0 —
13	—	14 40	15 5	Barnard	349.1	—
13	14 15	14 41	15 4	L. V. V.	—	2.9 18.0
15	15 56	16 21	16 49	Williams	347.8	3.5 17.4
16	21 24.2	22 5.5	—	Denning	349.5	4.6 21.5
18	13 29	13 53	14 14	Barnard	350.3	3.1 —
20	15 5	15 28	15 54	Williams	351.6	6.1 18.6
21	14 59	15 32	16 0	Denning	350.3	4.2 19.9
22	20 54.2	21 12.9	21 37.0	Williams	346.7	6.6 23.6
27	15 48	15 12	15 37.5	Barnard	350.2	3.6 17.6
28	22 43.4	23 59.5	24 23.5	Williams	347.5	3.2 18.7
Aug. 4	12 22	12 50	13 18	Barnard	352.6	3.6 18.1
4	—	12 50	13 15	Denning	348.4	4.1 21.0
6	—	14 30	—	I. V. V.	—	4.1 19.2
6	14 10	14 36	15 0	G. Williams	—	5.3 —
8	15 38	16 10	16 37	I. V. V.	353.2	6.3 22.4
16	12 19	12 47	13 11	Denning	347.2	6.5 22.6
18	13 54	—	—	"	350.0	7.0 21.5
21	—	11 55	12 23	"	350.7	—
27	16 28	16 50	17 21	"	—	7.6 24.5
1	15 30	15 58	16 25	"	350.3	8.6 27.2
2	11 22	11 47	12 17	"	352.9	9.2 25.6
4	12 57	—	—	"	351.6	8.0 25.1
7	10 25	10 54	11 22	"	351.2	—
9	12 5.5	—	—	"	351.9	8.2 25.1
9	12 6	12 32	12 58	Williams	352.4	—
16	12 43.5	13 15.6	13 42	Denning	352.7	8.4 24.1
19	10 21	10 47	11 14	Williams	349.7	8.6 24.0
19	10 21	10 47	11 14	Denning	351.0	9.7 26.0
19	10 21	10 47	11 14	G. Williams	355.8	10.3 24.8
19	10 21	10 47	11 14	Williams	—	11.5 26.6
27	12 25	12 51	13 15	Denning	353.6	10.0 25.7
27	12 27	12 51	13 15	Williams	—	11.2 26.6
25	15 6	15 36	16 2.5	"	349.3	7.9 23.4
26	—	11 31	—	Denning	—	9.8 —
26	11 2.5	11 33	11 58.5	Williams	352.1	11.0 25.3
27	16 48.5	17 15	17 43	"	352.3	8.3 25.2
28	12 36.5	13 3.5	13 30.5	"	350.5	6.8 23.1
28	12 43	13 11	13 38	Denning	354.4	11.3 27.6
29	—	8 59	9 24.5	Williams	—	4.5 24.9
30	14 18	14 46	15 15	Denning	352.8	9.8 —
30	14 18	14 46	15 15	Williams	352.8	10.1 27.3
Oct. 1	10 14.5	10 38.5	11 7.5	"	356.3	10.7 28.2
2	15 52.5	16 22	16 51	"	351.0	8.9 27.0
3	11 45	—	—	"	351.9	—
3	—	12 15	12 44	Denning	—	10.1 27.6
6	13 21.5	13 50	14 23	Williams	351.3	8.6 28.5
6	—	9 45	10 7	"	—	11.0 24.3
15	11 34	12 3	12 36	"	351.7	9.2 29.2
15	11 48	12 13	—	G. Williams	0.2	15.3 —
16	—	7 58	8 27	Denning	—	11.7 29.2
18	9 7	9 34	—	"	354.5	10.8 —
25	9 50.5	10 15	10 42	Williams	354.7	9.5 25.8
25	—	10 21	10 48	Denning	—	13.1 29.4
27	11 32	11 59	—	"	357.2	13.5 —
30	8 50	9 19.5	9 48	Williams	350.9	8.7 24.8
30	8 58	9 25	9 52	G. Williams	355.7	12.1 28.4
30	9 2	9 30	9 56	Denning	358.2	15.1 30.8
Nov. 1	10 38.2	11 5.9	11 33.4	Simms	357.4	14.2 30.8
2	6 27	6 57	7 25	Denning	356.1	14.3 31.2
4	—	—	7 7.3	Simms	—	— 34.2
6	9 40	10 11	10 41	Williams	355.0	13.8 31.9
6	9 49	—	10 42	G. Williams	0.5	— 32.6

A list of the observed passages and corresponding longitudes of the bright equatorial spot was given in the *Eng. Mech.* of Feb. 18, 1881, on p. 564, the longitudes in the last column being computed with the daily rate of rotation 878.48", which was indicated by the observations, and which corresponds to a period of 9h. 50m. 6.6s. This rate holds good as the spot's mean rate to the present time, and I have, therefore, reduced all the observations which have come to my knowledge to the system of longitudes adopted in the last column of the old list. A number of additional observations of last season were sent to me afterwards, and I give them now, together with those of the present season, which I have yet received. The longitudes under the heading 870.42" are those deduced from the ephemeris, with which the observations of the great reddish spot are compared.

Passages of bright spot.	Observer.	870.42	878.48
h. m.			
1880.			
Oct. 29	Williams	—	22.6
Nov. 27	"	—	22.8
Dec. 21	McCance	—	26.8
24	"	—	25.0
25	Williams	—	31.0
30	McCance	—	25.8
31	"	—	23.0
1881.			
Jan. 6	"	—	26.7
7	"	—	26.1
15	Williams	—	27.4
16	Denning	—	24.1
Feb. 23	"	—	13.1
July 10	"	274.9	16.6
17	"	217.6	15.4
24	"	160.4	14.3

Passages of bright spot.	Observer.	870.42	878.48
h. m.			
1880.			
July 26	Denning	144.6	15.1
Aug. 2	"	91.1	17.8
4	"	74.8	18.0
8	"	41.6	17.8
17	"	329.0	17.9
18	"	322.9	18.4
27	"	249.4	17.5
Sept. 1	"	212.1	19.9
7	"	164.8	22.1
9	Williams	149.8	23.7
15	Denning	105.3	25.6
"	Williams	105.7	25.9
16	"	91.1	21.2
19	Denning	65.8	18.5
21	"	49.2	18.9
25	Williams	13.5	16.1
26	"	7.1	16.4
27	"	350.8	9.9
28	Denning	352.6	18.4
Oct. 30	"	337.1	19.4
3	"	318.1	23.5
11	Williams	255.8	27.4
17	Denning	213.6	31.4
25	"	144.3	28.1
25	Williams	144.6	28.4
26	"	138.5	26.9
28	Denning	118.7	26.6
30	Williams	101.2	24.7
30	Denning	102.1	25.6
Nov. 6	Williams	47.0	26.6

The variations in the motion and apparently also in the brightness of the spot render flagging diligence and carefulness in observing very desirable.

The following is a continuation of the list, on p. 61, of the times when the assumed First Meridian of Jupiter passes the middle of the illuminated disc.

h. m.	h. m.	h. m.
Dec. 2 1 8.9	Dec. 12 9 17.3	Dec. 22 7 30.8
11 4.4	19 12.8	17 26.4
20 59.0	13 5 8.4	23 3 22.6
3 6 55.5	15 3.9	13 17.5
16 51.0	14 0 59.5	23 13.1
4 2 46.5	10 55.0	24 9 8.7
12 42.0	20 50.6	19 4.3
22 37.6	15 6 46.2	25 4 59.9
5 8 33.1	16 41.7	14 55.5
18 28.6	16 2 37.3	26 0 51.1
6 4 24.2	12 32.8	10 46.6
14 19.7	22 28.4	20 42.2
7 0 15.2	17 8 24.0	27 6 37.8
10 10.8	18 19.5	16 33.4
20 6.3	18 4 15.1	28 2 29.0
8 6 1.8	14 10.6	12 24.6
15 57.4	19 0 6.2	22 20.5
9 1 52.9	10 1.8	29 8 15.8
11 48.5	19 57.4	18 11.4
21 44.0	20 5 52.9	30 4 7.0
10 7 39.5	15 48.5	14 2.6
17 35.1	21 1 44.1	23 58.2
11 3 30.6	11 39.6	31 9 53.8
13 26.2	21 35.2	19 49.4
23 21.7		

MARS.—The angle of position P of the axis of Mars, the areographical latitude of the centre of the disc, the diameter of the disc, and the amount q and position-angle Q of its greatest defect of illumination, are the following:—

1881.	P.	Lat.	Diam.	q .	Q.
Dec. 5	311.0 + 5.7	14.8	0.4	271	
15	339.3 + 4.0	15.4	0.1	264	
25	337.2 + 2.0	15.4	0.0	—	

The spring of the Planet's Northern hemisphere begins on Dec. 8.

Approximate times, when some of the most marked spots are near the central meridian. *vide* p. 61.

Dec. 1 d 6.1 r 11.9	Dec. 17 a 9.6 d 15.8
2 d 6.7 r 12.5	18 f 5.1 a 10.2
3 d 7.3 r 13.1	19 f 5.7 a 10.8
4 d 7.9 r 13.7	20 f 6.3 a 11.4
5 d 8.5 r 14.3	21 f 6.9 a 12.0
6 d 9.1 r 14.9	22 f 7.5 a 12.6
7 d 9.7 r 15.5	23 f 8.1 a 13.2
8 d 10.3 r 16.1	24 f 8.7 a 13.8
9 a 4.8 d 10.9	25 f 9.3 a 14.4
10 a 5.4 d 11.5	26 f 9.9 a 15.0
11 a 6.0 d 12.1	27 f 10.5 a 15.6
12 a 6.6 d 12.7	28 r 3.6 f 11.1
13 a 7.2 d 13.3	29 r 4.2 f 11.7
14 a 7.8 d 13.9	30 r 4.8 f 12.3
15 a 8.4 d 14.5	31 r 5.4 f 12.9
16 a 9.0 d 15.2	

A. Marth.

66, Lambeth-road, S.E., Nov. 12.

ASTRONOMICAL.

[19433].—In reply to letter (19299) in "E.M.," October 14th, I tried my 8½ Calver reflector last night on P XXIII. Cass. I saw the seven components of the group at once, but not the eighth, though sometimes I fancy I glimpsed it. A was so unsteady—though the others of the group were not—having very much the appearance which Cygni always has to me in my atmosphere, and which I have given up all hope of ever seeing here. Sadler's C was rather difficult—by the bye, we have now two or three different systems of nomenclature for this group, which is a pity. I compared it with the Dehliissima, and found that it was certainly smaller than either of them, but a size larger than either of the three small stars H, I, J, preceding them in the ϵ Lyra group; therefore, I suppose of the 13th magnitude. I will try for the small companion to A again and report.

Allow me to ask through your columns whether the publishers of Mr. Webb's book would undertake to supply spare copies of the map of the moon mounted on cloth—they would, I fancy, find a very ready sale.

November 16th.

B. M.

ENCKE'S RING ON SATURN ON THE 9th NOVEMBER.

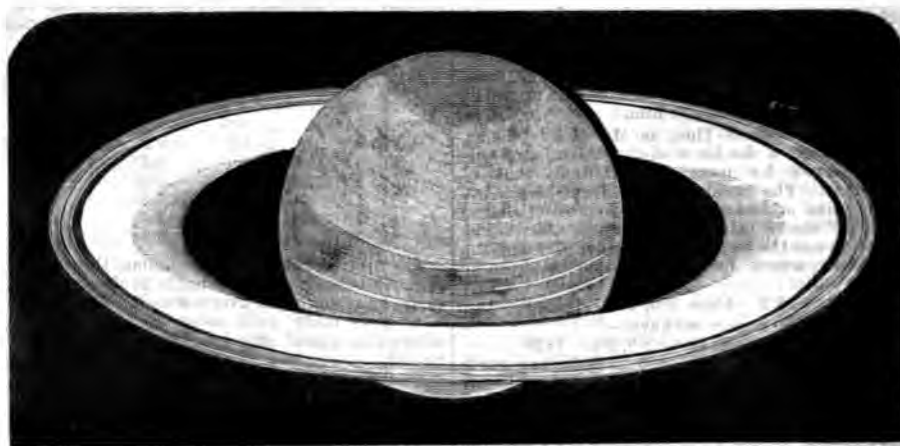
[19434].—ALTHOUGH one cannot expect very great things from an 8½ reflector (I, in my last letter, was printed for I). I must relate the observation four of us made on Wednesday evening, Nov. 9, between 9 and 11.30. Saturn, in spite of a considerable mist, which hid all his moons except *Iapetus*, behaved most handsomely. He or the sky, or both, must have been in exceptionally fine humour. We could hardly believe the evidence of our own eyes.

Colonel Abadie expressed unbounded praise and delight. His description was as follows:—Saturn's body, faint blue cap on S. pole. Two equatorial belts, shadow of ring made another

dark belt all round. The inner ring brilliant; the crape veil conspicuous as a nebulous gauzy projection inwards within the ansa. A small black notch in ring behind Saturn (shadow notch). The outer ring of a dusky grey again divided by a secondary ring, much fainter than the deep black ring traced on the inner bright ring. A most unusual sight. This appearance is called Encke's Division.

I then pointed out a brilliant bright narrow band immediately to the north of the equatorial belt, between it and the ring. It was a very bright thin zone, much brighter than the general ball.

I cannot help thinking the misty sky had some-



thing to do with increasing the distinctness of the Saturnian features. I noticed a wide halo round the Moon, nearly 30 degrees in diameter.

I can certainly compliment Mr. Calver on his workmanship in the 8½ in. reflector. The Colonel writes:—

"Jupiter was a sight to be remembered. The distinctness of all the belts was enhanced by bright zones. One to the north of the uppermost belt was particularly to be noticed. The belts were well defined, and seemed quite dark in colour. The clouds between the equatorial belts changed in appearance from being very fleecy to a long wavy white streak.—H. R. A."

P.S.—Last night Colonel A. and myself watched the progress of a transit satellite immediately preceding, and, as it were, clinging to the black spot shadow; suddenly sparkling into emergence, its shadow rapidly vanished also.

G. W. Royston-Pigott.

Eastbourne, Nov. 16.

LUNAR PHYSICS.

[19435].—MARE CRISIUM, THE WHITE SPOT.—In my letter, No. 19346, Oct. 28th, 1881, p. 182, col. 3, I solicited the attention of my readers to a feature which I observed on the *Mare Crisium*, early in the decade of 1860, and adduced as its terrestrial analogue the dense cloud which not infrequently is observed over a volcanic orifice, when in eruption. The superficies of the *M. Crisium* is, according to Neison, 78,000 square miles, or 1.94th of the visible hemisphere. For a student carefully to examine all its features would necessarily consume much time. Nevertheless, as mentioned in letter 19272, Oct. 7th, 1881, p. 110, col. 3, students would, by adopting Mr. Elger's suggestion, find it a very interesting and instructive portion of the Moon's surface. The special object for search recommended to students in letter 19346, Oct. 28th, 1881, p. 182, col. 3, was an obscuring medium, which apparently presented itself in the form of "a white spot," the terrestrial analogue being, as already stated, the dense white cloud hanging over a terrestrial volcano some times for days together. The exact locality of the white spot was stated, in letter 19346, to be west of the crater Picard. This crater is situated on the eastern portion of the *Mare*, and is the southernmost of those which present some interesting features, and which I will now mention, with a hope that students may be induced to observe these features, and when suitable opportunities occur, to publish them. The three craters which, according to Neison, lie in a right line are *Picard*, *Peirce*, and *Peirce A*. The feature that should be first looked for is the white spot west of *Picard*.

To endeavour to detect a repetition of the phenomenon before alluded to, it will be necessary to examine, whenever opportunities may occur, the surface of the *Mare* within a certain distance of the crater *Picard*, and especially the localities of the craterlets in that part of the *Mare*. This may not be a very attractive proceeding, and certainly not, should nothing be discovered as ex-

pected; but it would have this advantage if the examinations are sufficiently consecutive. It will prove that during the time of search there was no appearance of a cloud or spot on that particular part of the *Mare*, nor could such a result be regarded as simply negative. If, as just remarked, the observations are generally consecutive, i.e., the locality is examined as suggested every time the moon is visible. The time occupied by the observation would be so short and the character of the surface so thoroughly impressed upon the memory that the slightest subsequent change could not fail to be detected as the observations proceeded. Whatever may be seen may be recorded somewhat as follows:—

1877, April 21, 10.30, bright spot about one-third size of Picard.

1878, March 13, 10.15 to 45, white spot ill-defined, smaller than Picard.

1879, March 8, 9.40, white spot W. of Picard all but disappeared.

1879, April 14, 9.55, white spot W. of Picard just visible, very small and faint.

These records come up to the spring of 1879, and if only one observation were recorded every month they would keep up the consecutive character of the observations. It would, of course, be easily seen that the value of the series would be greatly increased by the observations being made about the same age of the Moon in every lunation; but if they were made about the same age of the Moon in every alternate lunation, the value would be proportionally increased.

THE INTERIOR RIDGES.—It appears, from various notices that have come to hand, that the ridges of the *Mare Crisium* are not at present satisfactorily mapped. In *Lunar Work*, by the Rev. Dr. Richards (see the *Astronomical Register*, March, 1881, p. 69), it is stated that it would be most useful if several observers would separately make drawings for comparison and discussion of these ridges, of which the author specifies two—one on the east, the other on the west, of *Picard*. By a very few observations the observer will become acquainted with the fact that the ridges of the *Mare* generally extend from north to south, and those of the *Mare Crisium*, when not so, are roughly parallel with the mountain border. This appears to indicate that the forces operating in producing these features opened up fissures about the central portions of the *Mare* which had a general direction from north to south; and from these fissures a semi-fluid material, probably not unlike basalt, welled up, extending east and west, until, by the cooling of the horizontal sheets of flowing strata, their further progress was arrested, and the ridges then formed marked the extent to which each successive outflow extended.

TERRESTRIAL ANALOGUES.—Taking the ridges of the lunar *Maria* as a distinct class of lunar features, we have their terrestrial analogues set forth very graphically in the following extract from Geikie's paper in *Nature* on "The Lava Fields of North-Western Europe" as follows:—"We had been riding for two days over fields level as lake bottoms among the valleys. On the morning of the last day we emerged from the mountains upon the great sea of black lava which seems to stretch illimitably westward. It was as if the great plain had been filled with molten rock, which had kept its level and wound in and out along the bays and promontories of the mountain slopes as water would have done. I became convinced that all volcanic phenomena are not to be explained by the ordinary conceptions of volcanoes; but that there is another and a grander type of volcanic action where, instead of issuing from separate vents, piling up cones of lava and ashes around them, the molten rock has risen in fissures and has swelled forth so as to flood the lower ground with successive horizontal sheets of basalt." (*Astronomical Register*,

process, and quite good results may be obtained. Dr. Draper used such a selected piece for many years without any retouching in his 16in. Newtonian. I leave this telescope in the hands of "our" telescope workers. At Harvard they have the very best instruments for the photometric determination of the light of the stars; and these instruments are *used*, not lying idle. The transit instrument is one of the most perfect of its kind, and the methods of collimation superior to anything I ever saw. The library is a magnificent one, and everything about the observatory is in such order—so cleanly, so methodical—that one would think it were indeed "a plant of the skies." Paul's command to women to keep silent in the churches has not deterred Prof. Pickering from breaking this command so far as this "church of the skies" is concerned, for I found the "gentle" sex among the computers in the observatory. And why not? Have not Caroline Herschel, and Mrs. Somerville, Mrs. Ward, Mrs. Jackson Gwilt, Miss Sheepshanks, and our own Miss Mitchell, done such work as to entitle women to take a high place in this noble work. And to sum up, Prof. Hall, in his work on the "Satellites of Mars," says, had it not been for the encouragement of his wife, he would have abandoned the search that afterwards proved so successful. And in all probability, such women, though unwritten, have done a noble part in this great work in the past history of astronomical discoveries. I would like to say more of this great observatory; but in saying the little I have said I find I have "flew the track" more than once; but I hope they are side-issues of interest to those interested in this great work. My visit to the Clarkes will have to be postponed for a future letter.

J. A. Brashear.

Pittsburg, Pa., U.S.A., Oct. 23.

P.S.—I find, in looking over an old work on reflecting telescopes, that the form I have suggested in the above letter was invented and actually constructed by an optician by the name of Martin, a hundred and fifty years ago. So, dear Editor, I withdraw my claim to originality with the best possible grace. I may have seen this before, and thus had the impression left on my mind; but I had no such recollection when I wrote the above. However, this only adds to the suggestion that, for the purpose named, it might be a very efficient instrument.

B.

DOUBLE OBJECT-GLASSES.

[19439].—In reply to "Orderic Vital" (letter 19413), I use at present a crown-glass object-glass, 9ft. 8in. focal length, and a flint-glass plano-concave of 100in. focus; its precise situation is not necessarily definitely fixed; but it answers well at 6ft. from the o.g. when looking at Saturn. I think for Jupiter it shows it better at about 7ft. from the o.g. I own a Huyghenian eyepiece. The field-glass, 3in., eye-glass, 1in., and several Huyghenians seemed to perform better for being rather more apart than the customary half the sum of the foci. A crown-glass o.g., of 100in., and a crown-glass concave of the same focus, placed half-way, answered fairly well, but not equal to the first described. This class of telescope is very cheaply made, and small inaccuracies in fitting are of less importance in this than in most other constructions: the intermediate concave seems to diminish them.

In focussing, the concave can, if desired, move with the eye-tube: it then comes to a focus with very much less motion than if it, "the concave," is fixed at its appointed distance in front of the o.g.

I consider they perform well if long foci and small apertures are used; but they have (in my hands at any rate) been very "rebellious" against a large aperture.

Arthur Hinde.

Bilston, Staffordshire.

[19440].—May I be allowed one more letter on this subject, to correct a false impression which my two last letters might cause with regard to the merits of the telescope proposed by "Query"? I therein said that it would make a very passable instrument; and so indeed it will, as far as correction of aberration is concerned; but there is one thing which I did not advert to, and that is, that the magnifying power will be much reduced by the introduction of the second lens. Thus, suppose that the focal length were in the proportion of 3:1, which seems to be the best that can be used, and suppose that the focal lengths were 60 and 20 inches, the image would be formed at a distance of 50 inches from the first lens, which distance would, therefore, be the length of the instrument; whereas the focal length would be only 30 inches; so that the magnifying power of such an instrument would only be in the proportion of 3:6 of that in which a single lens was used, having the same focal length as the length of the proposed telescope.

As a partial offset, however, against this disadvantage, it is evident that we may use a much deeper eyepiece, and I suppose also may use a larger aperture than we could with a single lens of

50in., and that therefore there will be a considerable gain. With regard to the form of the lenses, one of the best combinations, perhaps, will be a plano-concave lens, with the curved surface outwards, and a meniscus having the radius of the outer curve equal to one-third the focal length, and that of the other equal to the focal length itself of the lens. By this means the aberration of the pair will be reduced to less than a fifteenth of that which a 50in. plano-convex lens would have. If we were to take the lenses in the proportion of 2:1, we should gain a little in magnifying power, but at considerable cost as to the spherical aberration.

W. G. F.

P.S.—If "Query" is still in the mind to make a telescope, perhaps I might suggest that by way of trial, he would make one of the above dimensions, and of an aperture not exceeding 2in. to begin with, and try it upon such objects as Castor, Saturn's rings, &c.

MICROSCOPE OBJECT-GLASSES.

[19441].—In page 173 there are diagrams of the back lenses of object-glasses, with their respective apertures. May I ask if it is meant that a glass cannot be made of a large angle of aperture, unless the back lens be of the size in the diagram? It seems, from what the writer of the article says, that numbers of microscopes are quite misleading, and that what they show is anything but correct.

Edward Thomas Scott.

TRICYCLES.

[19442].—The comparison which your correspondent "Fal" (19423, p. 257) seeks to establish between certain tricycles, upon the result of an experiment mistakenly called "a simple test" of their hill-mounting capabilities, is so entirely at variance with my knowledge, derived from personal experience, of the relative merits of the machines in question, that I shall be glad if you will accord me space for a few observations on the subject of his letter. That any practical insight into the capacity of tricycles in general for surmounting steep gradients, is to be gathered by merely spinning their driving-wheels, I can hardly imagine, and assuredly anyone who should have the simplicity to place reliance in your correspondent's so-called "test," would, if my experience goes for anything, suffer most grievous disappointment when the time arrived for a practical trial on the roadway. But accepting such a test for what it is worth, it is obviously essential in order that the result may not be positively misleading, that the experiment should be carried out with the utmost nicety. It is necessary, for example, where chains are used, to see that they are not unduly tightened in one machine more than in another; the bearings, chains, and toothed-wheels should be equally clean, and where, as in the case of the Cheylesmore, the bearings are adjustable, care should be taken to see that they are not tightened up to such an extent as to prevent the wheels revolving freely. Even then, much will depend upon the amount of vigour which may be put into that variable quantity, a "sweep of the arm." As I find that the wheels of my own machine—a 52in. Cheylesmore—will spin freely for several minutes, I am led to the conclusion that "Fal's" experiment could scarcely have been conducted under very stringent conditions; but, however that may be, I can safely assert that, according to a tricycling experience, extending over three years, and embracing a practical acquaintance with many machines, my present one is, in many respects, notably in the matter of hill-climbing, beyond question far and away the best I have met with.

Your correspondent's views, as to the advantages of single-driving machines over those with double driving-wheels can hardly be taken seriously, and I should judge, from his remarks on the subject, that he is yet but a novice at the pastime. In that case I doubt not he will gain wisdom with experience, but to that end let him give up spinning tricycles in the air, and betake himself and his machine to their natural element. If the district is at all a hilly one, abundant evidence will be forthcoming to induce him to modify his opinion; but should this fail to convince him, I fear nothing short of a surgical operation will suffice.

F.

[19443].—"Fal's" spinning test (19423), page 258, can hardly command notice on account of its novelty. Dispensing with the "counting," it should be applied pretty regularly to every wheel of every tricycle, just to see that all the bearings are in good running order, and not clogged by old oil. But as a comparative test it is simply worthless, unless it has been first ascertained that each machine is equally well set, and in equally good running order as regards the bearings of its wheels and the crank axle, &c., connected with them. If a wheel shows no fly, it does not necessarily prove anything more than that it wants oiling, or that it, or some of its connections, have been set a trifle too hard. In the best-made

machines 1-50th (or even less) of the turn of a nut will often make the difference between a smooth and shakeless run and a sticky bind. I should think something of this kind must have been the matter with "Fal's" Cheylesmore. Though I always "spin" before starting for a long run (especially if the machine has been standing idle a short time), I cannot say I often "count revolutions." But as I happen to possess two of the three machines from which "Fal" draws his statistics (viz., the Excelsior and the Cheylesmore), I amused myself by checking his comparisons after reading his letter. For one sweep of the arm the driver of the Excelsior gave 40 revolutions (or 5 more than "Fal's"). As the Cheylesmore does not move its crank-axle when spun forwards, I spun it backwards, so as to make it do so, and the result was 31 revolutions for the first sweep—or 25 more than "Fal's," disparaging 6. Spun forwards, one driver gave 37 revolutions, and the other 101; and both came to rest, as every well-set wheel ought to do, with a little oscillation. Of course the Cheylesmore, with its 44in. drivers, could not be expected to carry on so long when driving the crank axle as the Excelsior with its 50in. I am not giving these results as anything very remarkable—it is about what every thoroughly well-made and well-set machine should give. Both machines can claim credit for good workmanship, and the setting of the wheels, &c., is a thing I never take on faith from the hands of any maker. I have only noticed "Fal's" "spinning" test to show how valueless it is for comparative purposes unless both machines get equally fair-play. As to "Fal's" inferences about "hill-climbing capabilities," it is to be noted that, provided there was no actual bind, the injurious influence of friction would be least felt when the pace was slowest, as in hill-climbing. I fully admit that the Excelsior and the Coventry are quite at the top of the tree for hill-climbing among the single-drivers, and there are few of any class to equal them for smooth and easy running. But I am bold enough to attribute this mainly to the fact that both these machines cover plenty of ground, while the position of the driver is, in both cases, such as to modify the drawbacks inseparable from all single-driving machines when the driving axle coincides with that of the loose wheel. But granting riders equal in power, skill, and fitness, a really good double-driver must always have the best of it in a hilly country, or on deep or rutty roads. Such conditions are, however, practically unattainable in any race. The nearest test as to the positive merits of any two machines would be one against time, over the same road, and with the same rider on each machine in turn. But, even then, the roads could hardly be in exactly the same state two days running, nor would it be possible to insure precisely parallel conditions of the same jockey's muscles or bellows; or, most difficult of all, to propitiate the tricyclist's worst enemy—the wind.

D. H. G.

[19444].—I VENTURE to ask a few questions that ought to lead to practical answers:—

1. When the seat is placed directly over the driving-axle, does not the weight of load fall behind axle, when ascending hills, unless the rider nearly stands upon the pedals? The reply is self-evident, and I only put this query to enable me to record that I object to being compelled to sit upon the pedals when there is a seat for me to stand on.

2. Which is it better that the load—up or downhill, or on the level—should fall directly over driving-axle, or as near as possible vertically over that portion of rim of driving-wheel that may be, for the time being, in contact with the road. This query should lead to some interesting speculations as to the best position for seat and steering wheel.

3. Is it a fair test of double-driving in balance gear machines, to experiment without the steering wheel, as "Sunlight" and "56-Inch" suggest? Is it not the steering-wheel that keeps up harmony between the two driving wheels, enables them to disregard unequal external resistance, and determines which of them shall revolve the quicker when rounding a curve? Surely, otherwise, these machines would be intolerable wobblers, which everybody knows they are not.

W. H. Staurope Westropp.

[19445].—For "Sunlight's" information, my experience of an open-front machine was with an "Excelsior," and I believe the owner had set his seat further forward than usual, to get more over his pedals. I, trying to get still more over them, sat on the extreme fore edge of the seat, and so got close over the line of centres. Another fault I found, which, I suppose, is common to all single-drivers, that when a great pressure was applied on a hill, the driver had not grip enough, and turned round without taking the machine with it. The machine was very light, and I am a very light weight, but with strong muscles from much bicycle and tricycle work, not to mention lathe-work—a rare thing to strengthen your legs. I think the "Otto," though a beautifully-made and planned machine, by no means an improvement in any way

on the regular bicycle. It is much more difficult to ride, as the balance has to be kept fore and aft, and you have no power of bringing the centre under you by steering, as with an ordinary machine. The only rider I have ever met said it did very well on a level, but was unmanageable downhill, steering wild, and running away unless tightly braked, when it was apt to stop suddenly and spill you. The sort of stirrups which are used as pedals seemed to me dangerous, as not allowing the feet to be cleared instantly. By the same care in balancing as is always required in the "Otto," I could always ride the "Salvo" as a bicycle, with the advantage of a third wheel to use when preferred—which was always. With a single-driver plenty of weight is needed on the steering-wheel to counteract the tendency to slow; but where both sides drive, a very slight pressure suffices. Of single-drivers, the "Coventry" steers best, owing to its having two guide-wheels, one fore and one aft, which seem to counteract the side action of the big driver completely. Treadle.

[19446.]—As "D. H. G." asks my opinion regarding the subject of his letter (page 257), I will give it. I agree with him entirely as regards the gain in point of easy running that would be obtained by some lengthening of the backbone. I have always had an idea that the rolling friction, or ground friction, was a more important element to consider in the tricycle than the friction of bearings, and that, therefore, everything tending to reduce it must be of importance. For the same reason, I do not consider the spinning-wheel test at all a fair one as regards the running resistance of a machine. It leaves out of account altogether the way the machine will meet and resolve the various ground resistances; and even apart from this, it does not follow that a comparison between plain bearings and ball bearings, made when the wheels are running light, will hold good when the weight is on. The only real test of any scientific accuracy would be a dynamometer test. If I had any time or liberty to prosecute strange experiments, I should carry out a series thus. I should procure (1) a light dog-cart and fast trotting-horse, (2) a good length of stout indiarubber cord, (3) a good accurate spring-balance, the requisite strength of both these to be ascertained by preliminary experiments. Then I should organise a procession in the following order: (1) the horse, (2) the dog-cart, (3) a rope coupled to the indiarubber cord, (4) the spring-balance, and (5) myself on tricycle, the whole, of course, coupled in series, as electricians say. Being then taken in tow by the horse, I should carefully note the amount of pull indicated by the spring balance at different speeds, with different machines, different gradients, and different states of roads, and I think the results in a tabulated form would form an interesting page in the MECHANIC. The rubber cord is, of course, to prevent sudden fluctuations in the pull. If a speed-measurer could be added, it would be an advantage; but I fancy nothing simple enough could be devised, and one would have to rely on stakes or marks at fixed distances, and his watch. As I might find enough to do in merely steering myself and avoiding a broken neck, perhaps I should place the spring-balance at the dog-cart end of the line, and consign all measurements to the party of observation occupying that more secure position.

Now, the question is, Can any of our readers carry out such experiments, and make himself the Captain Galton of the tricycle?

I wish "56-inch" would ride his "Salvo" a little at moderate, or, if he cares to, high, speeds, in the "Otto" style, and then say whether it swerves on encountering an obstacle with one wheel only. I feel interested to know. It seems to me it must do so, not because the differential gear would act so quickly in driving the free wheel round, but the momentum of the rider, and the free wheel itself, would carry it round, and the differential arrangement would, doubtless, act almost instantaneously in this passive sense, though not in an active one. If this be so, it follows that a machine on the "Otto" plan could never be ridden safely by any arrangement leaving the two wheels at all independent while running straight; but that they must absolutely be geared rigidly together as one system when so running, as they are, in fact, in the "Otto." It also follows that the steadiness of the "Salvo" under these circumstances is not due to the apparent coupling together of the wheels, but to the check imposed by the steering-wheel, notably when a momentary resistance to the momentum of the machine throws extra weight forward on to it.

Guido.

[19447.]—"FAL" (letter 19423) must surely be joking, for no practical man would seriously think for a single instant that upon the spinning of a wheel it was possible to decide upon the best hill-climbing tricycle. Now, I know from practical experience that the Cheylesmore is one of the very best hill-climbers, and yet the Cheylesmore is

put last in "Fal's" list, and is said that its wheel only spun round six times. On reading the letter, I tried the first Cheylesmore I came across (a nearly new one), and with a very moderate push the wheel revolved 48 times. My own machine, a well-worn one, will spin considerably more than this.

I, however, attach no importance whatever to such a superficial test, seeing that a little newness in the parts, or a little extra tightness in the chains, would make all the difference in the world, to the mere spinning of the wheels, while the position of the rider, in conjunction with a free-revolving wheel, may altogether neutralise any benefit which might be supposed to attach to their easy revolution. A heavy-tired wheel will, from its mere weight, outspin a light-tired wheel; but there is little doubt as to which would best ascend a hill.

When "Fal" (or anyone else) is able to ride a "Coventry" up Muswell-hill, then he may, perhaps, in reason, claim for it a place as a hill-climber, along with the Cheylesmore and the Devon (both of which have surmounted the hill); but certainly not because one particular wheel in one particular machine happened to spin longer than certain other wheels in chance machines he happened to try.

From the fact that he puts six revolutions only for the Cheylesmore, it seems to me that "Fal's" letter is intended as a side attack upon the Cheylesmore machine, as an old cart-wheel will spin more than six times. Lal.

[19448.]—In the tricycle discussion now proceeding no one says anything as to the arguments for or against connecting-rods in place of the usual chain-gear. Is there any sound reason for the general preference for the chain? It may have occurred to others of your readers besides myself that a connecting-rod (or two for a double driver) would, in simplicity and saving of friction, if in no other points, be an improvement on the chain-gear. Of course, in the case of a double-driver, it would be necessary to have means for temporarily disconnecting either wheel in order to turn sharp corners. This, however, would be easy to manage if connecting-rods were found advantageous. I may point out that it would then be possible for the rider to adjust the length of stroke to suit himself. Porcupine.

BICYCLES.

[19449.]—Among the readers of this journal are riders of all classes of machines, and I should like to hear what they have to say, from practical experience, on bicycles which have not a direct action from foot to crank-pedal. I leave out of consideration the ordinary machine, whether with a high or low wheel; it has had enough space devoted to it. Most riders prefer a moderately high wheel, and the main question seems to be—How and where must the rider be placed with respect to the driving-wheel, so that he may obtain a maximum speed with the greatest safety and least exertion? As a low-wheel machine, the "Facile" is, no doubt, an excellent one; but for higher wheels, what is the best arrangement for utilising the propelling power? Some time ago I had occasion to notice Mr. F. W. Jones's arrangement in the "Devon" bicycle, but have not heard much about it lately. The universal practice in bicycles is to have the driving-wheel in front; but is this imperative? A rigid driving-wheel placed behind would seem to offer several advantages in economy of power and safety if the steering and propelling arrangement can be efficiently provided for. Probably experiments have been made in this direction; if so, some of your correspondents will be able to say how far such a plan would be likely to succeed. Orderic Vital.

HUGHES' NEW OIL-LIGHT

[19450.]—It will have been observed that Mr. Hughes, of 151, Hoxton-street, has recently introduced a new mineral-oil lantern lamp with four flat wicks, stated to give a light equal to 200 candles. Such a light being of considerable interest to me, I have had an opportunity of practically testing it by appointment; but in some respects I was unfortunate. It happened that Mr. Hughes was unusually bothered by other business on the appointed evening, which cut our time rather short; and it also happened that, by some misunderstanding, the foreman had taken the lamp intended to the factory, where he supposed we should be, and away from the exhibition-room, where we had to content ourselves with one temporarily laid aside for some slight fault. I cannot say how much should be allowed for this, and it will be some time, at least, before I can give any actual measurement, if at all.

Under the conditions as stated, however, I satisfied myself perfectly that the new lamp fully illuminated a coloured circular photograph slide of the standard size, on a disc 12ft. in diameter, uniformly all over to the edges, and as well as I have several times seen done by an oxy-calcium

jet. The light is slightly yellower, of course; but a 12ft. disc, well lighted, certainly surprised me.

This, however, was not the main object of my visit. I took with me a "lantern polariscope," with reflecting bundle of glass, as described some time ago in these columns. The large end was too small to fit any lantern Mr. Hughes had, being fitted for 3½in. condensers, while his were 4in. All we could do was to prop it up on packing, and insert as centrally as possible into the larger flange-nozzle; and the disadvantage in want of exact centring must have been perceptible. But such as it was, I proved by experiment with (1) selenite and (2) crystallisation slides, 1½in. diameter, and (3) with crystals of calcite, nitre, and topaz, that the lamp had power enough to project these well on a disc of 5ft. in diameter.

I never expected to see this attained with any oil-light; and that it can be done will place many experiments, before impracticable without gas apparatus, within the reach of country teachers and others. That is my reason for recording as briefly as possible the result of my trial of the new lamp. Lewis Wright.

SPECULUM-WORKING.

[19451.]—I HAVE been greatly pleased by the letters of H. A. Wassell, which I consider most valuable additions to the literature of this subject. I am glad to see that his experiments confirm the opinions I have formed from the results of my own work. Careful systematic experiments such as these will be of immense service in demonstrating the conditions essential to success. I quite agree with him in the advantage of using light grinding and polishing tools, the weight of my own for 5½in. specula being 2lb., including half the weight of the connecting-rods of my machine.

Even now I do not quite understand H. L. Baldwin, 19187 and 19389; but I decidedly object to using a razor and a 15-candle paraffin lamp. When I first began I used an Argand reading-lamp with gas, mounted on a heavy foot, and sliding up and down a rod—this was convenient, from the facility with which its position could be varied in order to suit the speculum; it was, however, very unpleasant to use, in consequence of the heat generated by it, which caused much discomfort when the lamp was brought as close as possible to the screen. Reflecting, however, that the area of flame actually in use is very small, and that the middle of a small flame is practically as brilliant as a corresponding area of a large flame, I discarded my large lamp and substituted one of the small paraffin lamps used as night-lights. I have soldered the burner of this to the top of a small tin oil-reservoir, made from a blotter-paste tin, and with a little chimney, 2in. long and ½in. diameter, made from a bit of eyepiece tubing from a small telescope, I get on very well. I have mounted this on the arm of the reading-lamp, and can now bring it close to my face without causing headache or burning myself, as occurred more than once. I have found some difficulty in making the hole small enough, but have succeeded fairly well with a reamer made from a very fine cambric needle, No. 9. I am, however, thinking of making a larger hole in my brass chimney, and soldering over it a patch made from the tinned copper-foil which is used to cover the cards on which pearl shirt-buttons are fixed when bought. A correspondent suggested tinfoil, but I think this copper-foil will be better, being stronger, and less fusible. I am using a hole 1-150in. diameter, and when the eye is in the proper position the speculum appears like a sheet of flame. This thin copper-foil also presents another advantage: it is sufficiently firm to allow me to make a smooth round hole, and to remove the burr, and its thinness removes one source of indistinctness—namely, that resulting from the hole in the original brass tube being necessarily slightly funnel-shaped, being made from the outside, and light being reflected from the sides of the tapering hole. For a screen for cutting off the rays I use a piece of a steel stay-bush, with a bit of brass wire soldered to the bottom of it, which fits one of the holes in the mechanical stage of my microscope. I thus get a very delicate motion forwards and backwards, and from side to side, and the distance between the hole in the lamp chimney and the acting edge of the screen is only ¼in. If I were to use the edge of the screen next the lamp this distance would be reduced to ¼in. I do not agree with H. L. Baldwin with reference to the use of a machine. I am quite aware that specula can be produced by hand-working; my own is an instance of success in so doing, but it is wearisome work, and, besides this, it is uncertain, from the length of stroke and pressure constantly varying. It is far better to use a machine, which will enable you to read or talk to your friends while working, which is impossible when you have to count every stroke. Besides which, there is a good deal of amusement in making the machine; and as to cost, the one I have described might easily be made for 10 or 12 shillings, the most expensive item being

the four bevel wheels, which cost me one shilling each at the foundry. The wooden wheels may be turned *in situ*, by rigging up a temporary rest for a chisel. Without a machine it is impossible to produce a regular motion of the grinding and polishing tools; all is haphazard; but with a machine all goes on smoothly and certainly.

A. Woolsey Blacklock, M.D.
Gateshead, Nov. 14.

PAINT FOR BOTTOMS OF IRON SHIPS—TRICYCLES.

[19452.]—I AM glad to see that some attention has been drawn to coatings for iron ships, although we have yet only a query. It is a subject on which light is much needed, not from the proprietors of the innumerable substances warranted to do a variety of impossible things. I sailed once in a vessel experimentally coated with two preparations, one on each side, and the difference between them was so great that the ship carried a little port-helm during the whole voyage. I need say nothing about the difference in consumption of coal in using these two compositions.

Everyone must welcome the clear practical letter by "D. H. G." (19123, p. 256), on the length of tricycle backbones. There are, it is evident, many advantages to be gained by lengthening the frame, and it can in no way injure the steering. I do not see the advantages of double drivers; there is considerable extra weight, and not much to show for it. There would not be much more weight if the wheels were geared, the one to 50in., and the other to 30in., and used separately, as I have before advocated; and what an incomparably more useful machine you would have for touring purposes.

If a single-driving machine swerves when the loose wheel passes over a stone it is, in my opinion, because of faulty construction elsewhere, or of careless riding. The seat described by Mr. Westropp would be immensely improved by a longitudinal adjustment; this is as necessary as any other.

Paugul.

SPIRAL APPARATUS.

[19453.]—I HAVE been absent from home, and did not see the MECHANIC of the 28th October, and since my return I have been sick and unable to write. I am very much obliged to "G. C. C." for so kindly offering to have his apparatus photographed on my behalf. I could not think of putting him to that trouble. My idea in first suggesting a photo. was that it would be of interest to the readers of the MECHANIC who were contemplating such an addition to their lathes, and I had heard, some years ago, from a mutual friend who served in the same regiment as the General, how perfect his lathe was in every respect.

Wm. Skues, M.D.

MEDICAL REPLIES.

[19454.]—INGROWING TOE-NAILS (45298).—These are caused by badly constructed boots. Instead of wearing boots made to fit the feet, people will make their feet fit the boots. Hence the toes are crowded together, the big toe is turned outwards, and lameness in various forms is caused. 1. Get proper boots, for which see answer to "Working Lad." 2. Cut the toe-nails short and scrape them thin, and keep them cut every Saturday night after soaking the feet carefully, so as to have the toe-nails as comfortably attended to as the finger-nails. 3. Ingrowing nail (unless reproduced by returning to bad boots) is, in my experience, always cured by a very simple operation as follows:—Take a keenly-sharpened pointed knife, and groove the nail from its end right up to its base, so that the inner third is practically separated from the outer two-thirds of the nail. Thus far there is no pain. Now the knife must be made to completely sever the pieces from each other, and its point must also be thrust directly backwards into the quick, so as to completely divide the nail up to the hilt inside the quick. Then the smaller piece must be seized with strong tweezers and pulled out. Unless the piece pulled out has a clean perfect edge, and an unbroken angle at its root in the quick, the disease will return as the nail grows again. There is no need whatever to take out the entire nail. The toes have been crowded together by a badly-made boot, the nail has not been kept short, the boot is too short, and the final result is that the nail, unable to grow out of its socket in length, gets broader than natural and spreads out "the quick," or matrix, in which the nail is formed. If the operation which I have described be properly done, the inner third of the matrix is left perfectly empty, the matrix shrinks up to its proper dimensions, and the outgrowing nail is sufficiently narrowed to cure the disease. No other treatment is of any avail.

ROUGH AND READY SURGERY (45320).—I have already promised the Editor to prepare some practical articles suited for use in the workshop to

meet emergencies, and hope soon to have time to write them out.

SALICYLIC ACID (45329).—I have no data on which to found an opinion as to salicylic acid being injurious when used to preserve food. Much would depend upon the quantity taken. I know that 10 grains to the pint of freshly-squeezed grape-juice enables the grape-juice to be kept and transported to England without undergoing fermentation; and I know that it is practically used for that purpose, and answers perfectly. But, to my own taste, salicylic acid spoils the flavour of everything it goes into which it is put.

SWELLING IN HIP-BONE (45312).—"E. H." might take 4 grains of iodide of potassium in 30 drops of tincture of yellow bark, thrice a day; and if the medicine does not disagree with him, may double the dose if it fails to relieve him. Any druggist will prepare the drops, and they should be taken in water. Read previous remarks on diagnosis, and if unable to get adequate medical advice, go to some good hospital. But this prescription may be tried safely. If it disagrees (causes a sort of cold in the head), leave it off for three days, and then re-commence it in half the former doses.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

THE DESFORD JUNCTION ACCIDENT.

[19455.]—THE signalman, Thomas Butler, was yesterday brought before the magistrates at Hinckley, upon the charge of "manslaughter," the prosecution being, of course, conducted on behalf of the Clerk of the Peace.

The evidence given was almost identical with that which was brought forward at the coroner's inquest, with the exception that under cross-examination, Loveday, the traffic inspector, admitted still more clearly the value of continuous brakes.

In my first letter upon this subject I stated "that the distance from the facing-points to the point of collision was 225 yards, and that the driver would see that the points were wrong for at least 50 yards before he got to them." The above statement was at first stoutly contradicted; but yesterday Loveday himself admitted the distance was 225 yards, which confirms the correctness of my letter.

The Court at Hinckley was perfectly unacquainted with the practical working of railways. Some of the questions asked were so absurd that much amusement was caused to those who did understand the subject. Ultimately the magistrates committed the signalman to the Assizes upon the charge of "manslaughter."

I am very much obliged to a large number of your readers who have written most courteous letters to me. I am also glad to see that they all agree that the signalman ought, under all the circumstances, to be acquitted, and that they approve of the action which I am taking to obtain justice.

Clement E. Stretton.
Saxe-Coburg-street, Leicester, Nov. 19th.

STATICAL PROBLEM OR FUNICULAR POLYGON.

[19456.]—IF with my notation (19318) "W. G. P." will put $M^2 = -D^2 + 2C^2 - c^2$ and $N^2 = -B^2 + 2A^2 - c^2$ he will find $\sin \alpha = M / 2cd$, $BO = M/2c$, $DO = (c + D)/2c$, $\cos BDC = (c - b)/2h$, $\sqrt{e}$, $\sin BDC = N/2b\sqrt{e}$, $\sin \delta = [M(c - B) + N(c + D)]/4bce$, $\cos \delta = [(c - B)(c + D) - MN]/4bce$, $a^2 - b^2 - c^2 + d^2 + 2hc \cos \delta = [(c + B)(c - D) - MN]/2e$, so that the mechanical condition becomes $[M(c - B) + N(c + D)][(c + B)(c - D) - MN] = 2(K - 1)(A - c)^2 M$, which reduces to the condition given in 19318, and on rationalisation becomes an equation of the sixth degree in c , as I before stated, by reason of the relation between its coefficients. Had we, before squaring, replaced c by its value and expressed the condition in terms of $\cos \alpha$, we should, after squaring, have obtained an equation of the eighth degree in $\cos \alpha$. It would not, however, have been obviously reducible to one of the sixth degree, so that the choice of c , instead of $\cos \alpha$, as the quantity to be directly determined, must be looked upon as an artifice.

The above shows that the result of elimination may sometimes be of lower degree than at first seems probable; in the present case the degree should apparently be 8, and not 12, as "W. G. P." concludes (19363); for his equation (4) is wrong, being really of the form $x^2(hy + k) + x(lg^2 + my + n) + (pg^2 + qy + r) = 0$.

I cannot agree with "W. G. P.'s" conclusion that the rationalised equation in c , though of an even degree, has, in general, two equal real roots; if the equilibrium is possible, the equation has certainly two real roots, but one of them may be negative, being foreign to the problem and introduced only during the rationalisation.

An unimportant corrigendum in "W. G. P.'s" letter is $\cos. y = -\cos. (A + C)$.

R. E. B.

REPLIES TO QUERIES.

*** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[44988.]—MATRICULATION FEES.—If there is any such society, information could no doubt be obtained by applying to the Registrar direct; but I should scarcely think it likely.—T. P.

[44989.]—GAS.—This question cannot be answered until the composition of the gas is known; then so many pounds of carbon and hydrogen give so many heat units in uniting with oxygen. Roughly, I should say, about 20,000 cubic feet would be equivalent to one ton of the same kind of coal from which the gas was made.—C. K.

[44991.]—STRAW-BLEACHING.—I think that at Luton many of the makers use sulphurous acid for bleaching, the straw being hung in chambers, and submitted to the vapours of burning sulphur.—HITCHIN.

[44991.]—STRAW-BLEACHING.—I believe the straw is inclosed in sulphur fumes, having been previously damped.—M. C. P.

[44999.]—SELF-FEEDING FOUNTAIN FOR AQUARIUM.—Many thanks to "Sunlight" and "Edwin" for their kind replies. Would they kindly say if it is possible to drive the water-wheel by a battery, and if so, what way to proceed? I have seen small machines driven by permanent magnets and armatures. Will they suggest some method to pump the water from the aquarium into the tank, self-acting, if possible.—O. F. C. C. O.

[45008.]—VIOLIN CONSTRUCTION.—They are fine strips of wood let in before the violin is varnished. Saffron will stain well enough.—T. G.

[45017.]—CO-OPERATIVE SYSTEM.—If I understand this query, the system alluded to consists simply in giving workmen an interest in the "shop" by awarding a certain share of the profits.—A. H.

[45023.]—CURLING HORSEHAIR FOR MATRESSES.—I have been told that the short hairs spun up loosely into a cord and then boiled, which gives it the peculiar springy property desired for stuffing.—U. D.

[45044.]—OXYHYDROGEN MICROSCOPE.—Whilst thankful for the attention, I have been somewhat puzzled by the conflicting advice given by various correspondents in reply to my query. To gain actual experience I have just tried a lantern microscope (kindly lent by an optician) with the limelight, and I am bound to say that the result was utterly disappointing. The highest of three powers failed to show a diatom so as to be recognisable, even with a disc only 2ft. in diameter. As I want to show living as well as mounted objects, I shall be much obliged for further information. Will "Antares" kindly say how he adapted his micro-objectives to the O.H. lantern?—W. H. SHUBSOLE, F.G.S.

[45044.]—OXYHYDROGEN MICROSCOPE.—Is not Mr. Lancaster's rejoinder just "a leetle" strong? My reply last week did not presume to be a "correction"; I called it a "protest" against the unqualified assertion, "You cannot use micro-objectives for an O.H. microscope." It is always difficult to prove a negative; and if A. says, "This can't be done," while B. asserts, "I have done it," the evidence of B., supposing him to be a credible witness, and to have experience of the matter in question, should hardly be met by a blunt and discourteous denial. I may venture to claim the ability to distinguish a good image from a bad one, whether in the telescope, in the microscope, or on the screen; and I must still maintain that such "powers" as I have tried—both of London and country make—have been inferior, for lantern use, both in definition and achromatism, to the micro-objectives which I mentioned. It would be obvious, however, that my remarks were restricted to objectives whose (measured) focal length is greater than half an inch; for I much prefer a well-defined image to a huge, ill-lighted, blurred picture; and do not believe that a linear amplification of 300 can often be exceeded with a 9ft. disc, on the screen, to advantage. And it is only fair for me to add that I have not had the pleasure (to my knowledge) of seeing the performance of the particular lenses which Mr. Lancaster prefers—and manufactures. But I will gladly ask him to show them to me at some favourable opportunity; and if I find Tricratium clearly exhibited on a scale of 6ft. to the diatom—well! I will not forget to write to the ENGLISH MECHANIC to say so.—ANTARES.

[45053.]—PANCRATIC EYEPiece.—I am much obliged to Mr. Lancaster for his reply; but, as the diaphragm is soldered in the end of tube, would not find it easy to move it. I also tried the lowest power of the astro-eyepiece, which has a large opening in the cap, and, with it the appearance was

an area of 940 square feet and in firebox 90 square feet. No. 422 has 151 tubes 11ft. 4in. by 2in., heating surface 870 square feet, firebox 92 square feet. No. 443, a very heavy class built by Dübs, 1873, has heating surface (tube) 864 square feet, and firebox 109 square feet. The weights of these classes vary from about 33 tons upwards. I should say that 436-464 or thereabouts weigh close on 40 tons. Nos. 583-592 are about same size. The weight of 191 to 215 class is:—

	Tons.	Cwt.
On leading wheels	11	2
On driving wheels	11	13
On trailing wheels	12	2

417-435 Class (Neilson 1866-7) weighs:—

	Tons.	Cwt.
On leading wheels	9	14
On driving wheels	13	3
On trailing wheels	10	10

33 7

I am not sure but that the latter is weight of engine empty. I had almost forgotten to mention the 59-64 class, built by Jones and Potts long ago. Though now used for branch passenger and shunting traffic, they may have formerly been used for goods. The cylinders are 15 by 20, and the heating surfaces are tubes, 693; firebox, 64 square feet. I could give fuller details of most of the above if required. As I have said so much about the 6ft. goods I will have to leave the other classes of goods and mineral engines till afterwards. With regard to the other query, I am unable to give a definite answer. What 320-323 are like I don't know, but 324-5 are mineral engines.—CARSTAIRS.

[45199].—**Re-gilding Picture-Frames.**—The tools required for the job are the following: A pint basin with a lip, two moderate sponges, and two small finger sponges, three fitches, one flat, 1/2 in. wide, one round 1/2 in., and one 1/2 in. or 1/2 in. round. We will count these three one set, for sizing. You will want another set for whitening, another for claying, one fitch for skewing, one small sash-tool for washing off, and one about 1 in. in diameter for duster, a gilder's cushion, a gilder's tip, a camel-hair dabber, a gilder's knife, some fat pipeclay, some prepared whitening, some plumbago, oil gold-size, crystal size, or parchment cuttings to make some, two agate burnishers, one round, about the diameter of a goose-quill, and one oval, larger, or about double the above on the broad part, and some composition made of glue, whitening and linseed-oil. The picture taken from the frame, dust well, and proceed to wash off with clean water, not letting your brush held too much, to make your work too wet. When washed off let stand by for some time to get dry and steady. Now is your time to make all ornamental work good, or repairs. To work the compo you will need two pieces of brass wire, one about 1/2 in. and one about 1/2 in. full, bent in the shape of an f, the ends being flattened to form a kind of trowel in miniature, such as are used by artists in clay modelling. Make your compo warm, and work it well, that it may not work lumpy. Having some hot glue, dab some upon the sore place, press your compo upon it; in a few minutes you may proceed to shape it to correspond to the rest of pattern. Having made all things shipshape, that which is to be matt, i.e., the bottom of design, is to be laid down with gold size very sparingly, and after that has been gilded, if the prominent parts or that which is in relief is to be burnished, is to be sized and clayed; then, after being allowed to dry, another coat of weak size: this is allowed to dry. When you are about to lay the gold on, wet it with clean water. The oil gold-size will take from two to five hours before it will be fit to receive the gold, and will depend, in a great measure, upon the weather. This oil gold-size is composed of prepared linseed-oil, very finely-ground litharge, and stone ochre. The cushion-knife and tip can be dispensed with, although these and the dabber are all held in the hands when laying on the gold by the professional. The cushion is a board about the dimensions of a half-sheet of note-paper, the back half of which is walled around with a piece of parchment about 2 1/2 in. high; the floor of the cushion is wash-leather, as it is usually called, prepared with red chalk; on the under side is a strap to strap it upon your thumb, or the gilder's thumb of the left hand, the hooded or walled part projecting over back of the hand, the fingers being curled. The tip is placed between the second and third finger, and the knife between the little finger and next, and the dabber between the forefinger and thumb. He takes a book of gold and shakes out three or four leaves into the hood—pell-mell as it would seem to the uninitiated, places the book down in a safe place, takes the knife and picks up one of the leaves and tosses it about, gives it a puff of wind from his lips, and there it is spread out upon the cushion without a wrinkle in it. He then proceeds to carve it up into the shape or size pieces that he

sees most convenient to cover his job. He then returns the knife to its proper place, and takes the tip, which is some long badger-hair between some card for a handle. He whisks the tip over the hair upon his head or down his whiskers, and applies it to a piece of the leaf gold; it instantly picks it up like a magnet. By these means he conveys and deposits the gold where required, replaces the tip, and takes the dabber and dabs it down. Some will dab with the dabber between the little finger and next upon the right hand with the dabbing part outside, and will pick up and dab and cover a frame in a few seconds. After covering (see that it is all covered), let stand for an hour or two, and skew off. That is done by the skewing-fitch; the tool is held between the thumb and forefinger of right hand, and pressed lightly down upon the gold, and a slight skewing or twisting action given to it, and the fine gold or pounce liberated by the action is skewed by the same action into the interstices and angles of the pattern that the dabber could not get at. Continue this action with the powder under your brush, until you have gone around your frame; then skew your gold powder off on to a highly glazed piece of paper and preserve. When you commence gilding, the best plan is to spread a sheet of manilla paper under your work—this is a very highly glazed paper of a whitey-brown hue, and very tough; the parts to be burnished should have at least two coats of size and whitening and of clay before gold is laid on. Thus far I have spoken about the matt and ornamental work; now for the dead and burnished. Having washed and repaired mitres, &c., and set aside to steady or dry, have some No. 1 glass-paper and rub down with finger or cork rubber. Give one coat of parchment size and whitening; the size must not be too thick or thin, that it will not congeal at the ordinary temperature of the room or atmosphere. But the test of the thumb and finger is the best criterion to go by; if too thick your work will peel off when placed in a warm room, or on a hot summer's day. If new work, a coat of weak size first, next whitening and size; let dry and rub down. A second coat, dry and rub down, then a coat of clay, then drop down and go over with weak size, and set by to dry. When dry, see that there are no cracks or chance of its peeling off. Then, with clean water and soft brush lightly damp, and lay the gold on immediately after, and dab down. Let stand by to dry. The flat remaining dead, the hollow or bead may be burnished. The burnishers here mentioned are curved like a horn that you can get into a hollow, a quirk, or over a bead. When completed so far, you may either size or varnish; but let me tell you that neither improve gilding. It is usual to size matt and ornamented work, and dead upon mouldings. It is a great protection against dust. If not sized, it would soon be smothered in dust, and no dusting or washing would remove it or improve it. Now for sizing: Take a clove of garlic about as thick as a quill, and finely grind up with a little water. Mix with a couple of table-spoonfuls, let settle and filter. Dissolve size in it and apply. This will lay the rough surface, and is said to protect it from that nuisance, fly-soils, but if you would like to varnish that, you may remove the fly-soils with impunity. Take 1/2 oz. gum-sandarac to half-pint good spirits of wine, and in another small phial (about an ounce), put one pennyworth of saffron. When the former is dissolved and settled clear, pour off, and add some few drops of stain until of the desired colour; go over the gold with a coat of very weak size, and when dry, varnish and turn upside-down to dry free from dust. The way I have made oil gold size—take, say, a pound of white-lead and red-lead, mix with half-pint of good raw linseed oil, pour about a gill of boiling-water into it; when well mixed up let stand for a day, then add another half-pint of oil and well stir up twice a day (morning and night), and in a few days you will have a beautifully clear, fat oil, almost colourless; this must be mixed or ground up with stone ochre and litharge, not as a paint but as a stain, and to render it siccative; this may, when prepared, be kept some considerable time, without drying, in a jar or gallipot, if covered with a piece of paper, dressing the top with oil, but will dry in a very little time when put on very thin, as for gilding, as I said before, subject to the state of the weather. I have known it to be ready in an hour, and not to have been fit in five hours. Being a great fumbler with the cushion-tip, &c., through not having practice, your humble servant used to cut his books in half from front to back, or into three, and fish out with a small damp fitch or camel-hair pencil, and deposit and dab down. Deep, extra deep gold, is used for the purpose. If you prepare your own whitening, it must be well washed, and remain to allow the coarse to settle a few seconds, and then decanted into another jar to settle; finally, make a tray of a square of blotting-paper double, pinch up the corners, and put upon a Bath-brick; pour the water off as far as you can, and the thick into the tray. The brick and paper will soon absorb the water, your whitening, after the paper covers are removed, will be free from grit, and may be placed

in a jar or bottle fit for use. Your plumbago must be served the same, and your clay, and about 2 per cent. plumbago is mixed and washed with your clay, after being washed separately, and your clay is fit for use. By the Bath brick the liquor is absorbed very readily, and preparation of this kind, and precipitates, filters, &c., reduced to a minimum of trouble. Your sponge you will find use for in case of swamping.—JAC OF ALL TRADES.

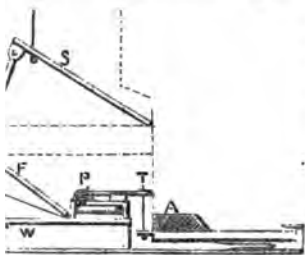
[45304].—**Oil in Watches.**—No doubt your watchmaker is right; but if he is right, either the oil or the watch is wrong. Good oil should not corrode in a good watch, neither should a good watch vary at all; some jobbers over-oil a watch; no oil should be left idle, or the weather will play upon it. Why not try another watch?—A FRANK WORKMAN.

[45205].—**To "Sunlight."**—I think that there is but little wonder that you cannot get the three pumps to throw after the first stroke or two. Look at the excessive length and small diameter of the suction-pipe. You cannot alter it as the matter stands. If a large suction-pipe were put in some little better result would be got, as then the pipe-friction would be reduced; but owing to the great length of the pipe, enlarging the size would not effect a complete cure. With such a length of water in motion, the air fails to push it forward; the pump as fast as the pump can and would discharge it. I should, however, use tallow with packing. Very probably in so great a length the pipe air leaks in through a porous part, or a bad joint. This would aggravate matters; but you would never get the three pumps to work with such a length of small section.—SUNLIGHT.

[45206].—**To "Sunlight."**—The alteration of the stroke from 3 1/2 in. to 5 in. would certainly be an improvement, as the expansion would be better utilised. If making an entirely new engine, I should, for simplicity and cheapness, make it of the tandem class. Supposing the bore, 3 1/2 in., still retained for the high pressure, the size I give in the issue of Nov. 11th would be still quite right, so that you might proceed on those dimensions. But don't make a start until you have made a couple of drawings showing the engine two ways, so that there will be no bother afterwards for parts to come in. I should not advise a large engine for the size of boat you have, as the boiler would have enough to do at full speed. There is one point where you and I do not hold the same opinion, and that is as to the link-motion. There is nothing that will beat it if properly made. And for small boats, if the links are of steel working in a steel block on the plan I use for small launches, the wear is almost nil, and can be taken up as well. The great trouble is that link-motion is too often a bad fit at starting, when, of course, away it goes to wear and tear itself to pieces. The substitutes for it are quite as costly and require more parts—to say nothing of the valve-rod not working in direct line with the valve-bore, making thereby still more parts, such as rocking shaft, &c. You do not give such a description of the gear you propose to substitute either, so I cannot say if it is good or not. Do you mean a single eccentric with step motion? The condensed water can easily be brought to the pump, which must project through the bottom of the hull with a piece of smaller pipe; and the main condenser should both stop just short of the engine. The steam being the lowest, all condensed water would gravitate aft, where it would be removed by a pump. The whole engine would require some scheming so as to avoid unnecessary parts; but there is no very great difficulty to be got over, and the idea is not a new one, and we have plenty of examples to guide us.—SUNLIGHT.

[45208].—**Pedals to Harmonium.**—The following describes a method of attaching pedals to harmoniums, &c., which can be applied to any sized instrument with but little ingenuity. Every instrument to which it is applied will be required to be elevated on a frame about 6 in. high, in order to allow the following to be applied to it:—W represents a small wind-chest; R a reservoir; S a weight to force the air into the chest to supply the air to the reeds; F is a feeder, connected to each footboard S of harmonium by link Q, which is hinged by two small bolts at each end; P shows the pan, reeds, pallets, and levers, &c.; A shows the pedals, which are connected by a pull-down wire to the pallet-levers T. Each wire has a screw and small nut at each end for the sake of convenience of attachment or detachment of pedals. It is made to run through the end of pedal and pallet-lever. The action will at once be clearly understood. The instrument is merely placed over the pedal-organ, and the feeder connected with the footboards of the instrument. When using the pedals, both instrument and pedal-organ is blown by the aid of one foot. Each foot can be changed in blowing at pleasure. V, in diagram, shows valve leading from feeder F. It is made of thick but soft leather, and is used in order to prevent return of air to the feeder. The reeds are

8 ft. tone, and if there is sufficient vibrators may be employed. The side is done before the feeder is connected to footboards. The whole arrangement



plied to any harmonium for about exclusive of labour. The dotted line shows the frame and instrument placed over the harmonium.

Using Old Verge Watch.—See holes are not worn; if they are, holes inside with a centre-punch, until the arbor fits; see that the right, and the holes good. Is there for the barrel? Does it bind FELLOW WORKMAN.

Pistons of Fast-Running Locomotives.—I think "Loco" will find any provided the metal is a suitable mixture of narrow outside rings, with one just the width of the two inside de rings are cut aslant, with a nick to which fits a small brass stud, side ring; this, of course, prevents rings from coming opposite. The o the rings is, that sometimes the out; yet, on drawing a piston, I d the cuts opposite each other, and a with two or three other descrip- l to do with, I find these, on the han any. They stand wear well, t week I took a set out of one of r-engines, which were worn down ginal thickness, and they were as ; only the inner ring broke at the is was after nearly two years of nt work, and "Loco" is probably tions are not usually spared very J. SCUTT.

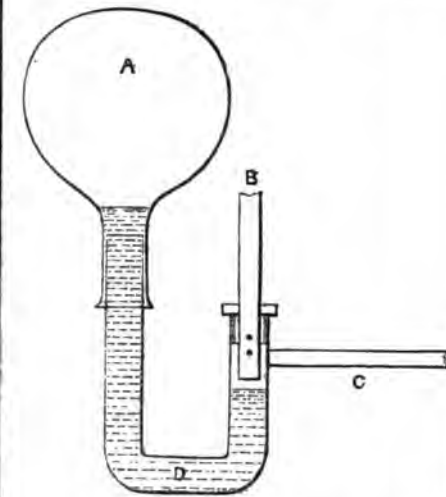
Electric Fire-Fly Lighting-up will have read the description of a last number, and all that I need mull bichromate cell, with the zinc to a rod and kept out of the liquid ill light up an enormous quantity of lculity is taking the lighter to the er way is to make up a larger ve wires laid on (guttapercha aving a 1-16 inch between each of r each gas burner, then by bring- to circuit the whole of the jets will e moment.—W. J. LANCASTER.

Graphic-Lantern Slides.—There are slides—the one in which slides are er the other is very good; but I e much better than any of the long ly a double slide, or, rather a slide ble carrier. The moving carrier and goes to a dead stop at either one picture is being exhibited the ace, and in an instant the carrier is goes into position without any hing backwards and forwards, and er of the slides being pushed out. dissolver for a single lantern, is ve as a pair of lanterns, few people a between the two. I would give ut having devoted some thought to it, I do not think it wise to give it all be pleased to give instruction to nateur exhibitor per letter.—W. J.

Underground Fernery.—You should have warm water underneath the soil in are growing. This could be heated and thus, no gas, consumed or ld get into fernery. You might ing in the bottom of the soil con- hot-water apparatus; but it is ave a double bottom, and let the ate between them. This plan has af in several ferneries I know of. ming the air inside the fernery, : soil cold, is a bad one in every ee undertakings amateurs should uch as possible. They will find ts are subjected even to a temper- slow zero, yet their roots will be arm.—W. J. LANCASTER.

Underground Fernery.—The plan I uld be to carry a pipe with hot-air

in it round the inside of the case. Supposing you had outside the case a small vertical tube—mine was iron gas-pipe, 6 in. long and 1 in. bore. From this went the tube round the case, finally returning into the room again at a higher level. The piping inside the case was compo gas-pipe, and was laid at an incline to one corner, at which was a siphon to draw off the condensed products, and this led outside. The gas flame was but a tiny pencil of flame, except in very cold weather. The regulator was similar to the sketch; A being a chemical flask,



cemented to a U-tube of wrought-iron, D, which was filled with mercury; B is the gas inlet passing through a screwed plug, with a very fine hole drilled in the pipe to prevent the gas being entirely cut off, and so extinguishing the light. C is the pipe to the jet. The bulb and tube were inside the case, hidden behind some rockwork, and by experiment set to maintain the case at 60°. If the door of the case was opened and cold air allowed to flow in, the air in A instantly contracted and opened the gas way full, gradually closing it as the temperature again rose. To prevent the heat being too dry, I had a miniature lake in the case, that by its evaporation kept the air moist. Your tank would do that nicely. For the benefit of other readers, I may add that a friend has a similar arrangement in use, except that a lamp is the source of heat. To keep the heat regular the mercury carries a light float, which opens or closes a throttle-valve, which thereby increases or diminishes the flow of heat through the tubing.—SUNLIGHT.

[45243.]—**Electro-Metallurgy.**—I have thought over your query, and cannot see any reason at all for the solution of any part of the platinum anode. The only way in which I can account for the apparent corrosion is, that the platinum was covered with minute gas vesicles.—W. J. LANCASTER.

[45250.]—**Ice-Yacht.**—"Yachtsman" will find a capital article on ice-yachts and their construction in Scribner's *Monthly Magazine* for August, 1881.—DEVONIENSIS.

[45251.]—**Micro-Photography.**—You will find a number of letters upon this subject in recent volumes. Dry plates will do beautifully, and you can work with ordinary daylight; there is no need of sunlight for an ordinary enlargement.—W. J. LANCASTER.

[45252.]—**Plaster of Paris.**—Small articles made of this material can be rendered, to some extent, impervious to the action of the weather by boiling them in a strong aqueous solution of curd soap, the plaster partially decomposing the soap, and leaving a surface film of hard stearine.—GAMMA SIGMA.

[45255.]—**Surveyor.**—Your best course would be to go up for one of the examinations for local surveyors held by the Sanitary Institute, Conduit-street, which would give you a good idea of the knowledge required; but I fear you will find it difficult to obtain an appointment, unless you have had actual experience in a surveyor's office.—S. J. S.

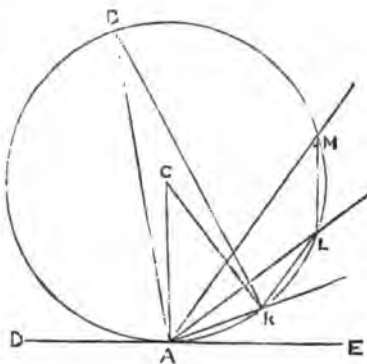
[45259.]—**Surface Condenser.**—Many thanks to "Sunlight" for his notice of my inquiry. Supplementing my former letter, the engine is a stationary, horizontal one, 17 in. cylinder, 300 ft. piston speed, working at 60 lb. pressure, with automatic cut-off, driving sawing machinery, &c., and is situated near a running stream, so that I think a circulating pump would not be needed in Cornish boiler, about 250 ft. heating surface. I should also be glad to know what size air-pump would be required.—F. CONNOR.

[45262.]—**L. and N. W. Engines.**—"Hawk-

sero" has got together a wonderful collection of names certainly, but many of them are not L. and N. W. ones at all. Balachava and Iron Duke are broad-gauge 8 ft. singles, without numbers, G.W.R. Firebrand, Vesuvius, and Zephyr are L. and S.W. engines, numbers 74, 119, and 172 respectively. The former is 7 ft., the others 6 ft. 6 in., all coupled engines of Mr. Beattie's, with outside cylinders. The L.B. and S.C.R. have a 5 ft. 6 in. side tank, coupled in front, called Wimbledon No. 6. Auckland and Shildon were Stockton and Darlington engines, built in 1839 and 1845. They were at the Darlington Exhibition four or five years ago.—W. B. P.

[45267.]—**Power.**—Thanks to "G. F. C." and "Glatton" for kindly answering query. To the latter gentleman, I shall esteem it a favour if he will give a brief description of experiments as offered.—THOS. HARDCASTLE.

[45268.]—**Railway Curves.**—The method I have always adopted for setting out railway curves is one which, I believe, is in general use. There is a proposition in Euclid which proves that if a straight line touch a given circle, and another straight line be drawn from the point of contact in any direction cutting the circle, the angle which this line makes with the tangent will be equal to the angle at the apex of any triangle inscribed in the opposite segment having the chord for its base, and its apex somewhere in the circumference. Suppose D A a straight line from which we require to set out a curve of a radius C A, the straight line to be a tangent to the curve (D A may also be a tangent to another curve already set out). Suppose A K, K L, L M each to represent a chain, either 66 ft. or 100 ft., as the case may be, then, as shown by Euclid, the angles M A L, L A K, K A E are equal to each other, the two former being on equal bases, having their apices at the circumferences of equal segments, and the latter also equal, for reasons given above. The diagram is exaggerated to



show the lines clearly, but in practice the chain-lengths A K, &c., are equal to the parts of the circumference which they subtend. The angle K A E can easily be calculated. Euclid shows that the angle at the centre C is double the angle at the circumference, or angle at C = 2 K A E. So we have the following proportion: angle at C : 360° :: A K : 2 π r. r being the radius, call K A E = α and A K = c, we therefore obtain from the above $\alpha = c \pi r \cdot 90^\circ$, which will give the angle for any radius and any length of chain. All we have to do then is to set up the theodolite at the point A. Set the line of collimation accurately to some point in line A D, reverse the instrument, and with the tangent screw move the telescope through the small angle calculated above; in the mean time the chain man should measure a chain length and hold up his ranging pole at the end of the chain, and by motioning him to right or left till the pole is in the line of collimation, the first point in the curve will be fixed. The chainman should then measure another chain, and at the same the telescope moved through another small angle equal to the first, and the second point fixed, and so on. In this way a curve half a mile long or more can be set out without moving the theodolite from its place. In practice, the chief difficulty is to get the exact point in the line D A from which to commence the curve, as a length of a few feet forward or back from the proper point will throw out the curve considerably if we wish to hit a particular point half a mile away; but this is a matter to be learned by practice. If the theodolite has to be set up at some intermediate point in a chain, the first angle would be some fractional part of α ; for instance, if the curve commences at 35 ft. from the end of a chain, the first angle would be $35/100 \cdot \alpha$ if the chain is 100 ft., and this must be added to all the subsequent multiples of α .—M. I. C. E.

[45269.]—**Age of Fossils.**—The fossils you mention belong to the Gault, a part of the Creta-

aceous series. The Gault is the lowest of the upper cretaceous rocks, and contains an immense quantity of fossils, more especially the cephalopoda; the fossils, however, do not keep well: they soon break up; this is owing to the great amount of pyrites contained in the Gault. —W. J. LANCASTER.

[45272.]—**Electro-Magnet.**—To Mr. LANCASTER.—A bar-magnet to lift 30lb. would have to be made out of lin. iron rod, say, 12in. long, and would require the wire on the bobbin, No. 16 gauge, to be wrapped to a depth of lin. all round. A horseshoe-magnet, with core one-fourth the area, would lift as much weight as the straight magnet. —W. J. LANCASTER.

[45274.]—**Underground Cistern.**—“Bar-naby” would find pipes fixed in brickwork always leaking. But why make the cistern of brick? A second-hand iron cistern could be bought, and cost far less than brick, into which any number of pipes could be fixed safely and permanently, and last for ever. —RAIN-WATER.

[45276.]—**Customs Officers.**—Notices of examinations for out-door officers of Customs are inserted in the London daily papers, but especially in those issued on Tuesdays and Fridays. As soon as an examination is announced, intending candidates should apply for a form of application to attend it to the “Secretary, Civil Service Commission, Westminster, S.W.” Examinations for these appointments are usually held three or four times a year; but owing to changes that are shortly expected to take place in the Customs Department, they are, for the present, suspended. A Customs out-port clerkship is a better appointment than that of an O. D. officer, but the examination to be passed is much more difficult. —C. S. COACH.

[45279.]—**Colliery Management.**—You are not breaking the law by employing sixteen men a shift underground, working two shifts, without having a certificated manager. The reading of the Act is—A mine in which less than thirty persons are ordinarily employed, or the average daily output of which does not exceed 25 tons; but it also stipulates that should the inspector of the district insist on a manager being employed he must be engaged, and you may rest assured that no inspector worthy of his post would permit you to work a mine with 90 men a day divided into three shifts without the supervision of a properly certificated manager. —T. E. J.

[45283.]—**Fossils.**—With the permission of “F.R.A.S.,” perhaps I may be allowed to suggest that the fossils mentioned are Lingulæ. These delicate bivalves, which are very like barnacles, had the mantle prolonged into a siphon, attaching them to foreign substances; hence the name. The genus, which is not yet extinct, is maintained through all the sedimentary deposits from the Lower Silurian downwards. —T. G. F.

[45284.]—**Palmurus.**—This instrument is used to correct compasses for variation and deviation by an azimuth of a star, precisely as the pelorus does by an azimuth of the sun. The divided card is usually transparent, and a lamp is placed beneath—the whole, of course, swinging in gimbals. It would be better if “H. J. A.” inspected one than if I attempted to crowd a full description of one into a reply. —PAUGUL.

[45286.]—**Amateur Silversmith's Work.**—To make what I think are called in the trade “jump” rings, get a piece of brass or iron wire, slightly smaller in diameter than the rings. Bend the silver wire round this, and cut the rings through with a fine saw. Make your own solder; two parts silver and one part by weight of common pins. —OS.

[45286.]—**Amateur Silversmith's Work.**—1st. Anneal the silver wire by heating to a warm red, then wind the wire on an iron mandril—the mandril to be a little less in circumference than the size of ring required. If you are using a small quantity of solder, it will be cheapest to buy: ask for best silver solder; can be bought where ordinary sheet silver is sold. If “Amateur” wishes to make his own solder I think one of the four methods I send him will give satisfactory results. Silver solder: (1) 3 parts of silver, 1 part of white spelter solder. (2) 1oz. of silver, 2oz. and 4dwt. of brass. (3) 4oz. of silver, 2oz. and 4dwt. of brass. (4) 4oz. of silver, 1oz. 6dwt. and 16gr. of brass, and 3dwt. and 8gr. of zinc. —THOS. ALLSON.

[45287.]—**L. and N.W. Goods and Coal Engines.**—As far as I know, there are three classes of the above engines—1. A few old engines with the leading and driving wheels coupled, about 5ft. lin., and a small trailing wheel. 2. Those with six wheels coupled, diam. 5ft. lin. 3. Mr. Webb's “Mineral” six-coupled, diam. about 4ft. 6in. I do not know the diam. of the wheels of the new goods fitted with Joy's gear. —DROMED.

[45291.]—**Horse-Power of Engines.**—You do not give a scale of pressures; therefore, I regret to be unable to help you definitely. What you want

is to lay off the scale of pressures, when it could then be easily calculated out. —SUNLIGHT.

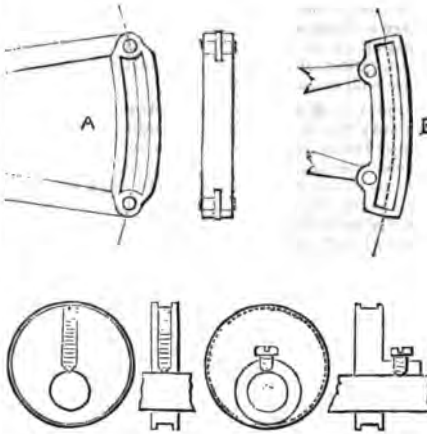
[45292.]—**Bread-making.**—Mr. Robin will find some at least of the information he asks for in the volumes of “Abridgments of Specifications relating to cooking, bread-making,” &c., published by the Commissioners of Patents. The first volume of this work was published in 1873, and contains descriptions of inventions from A.D. 1634 to A.D. 1866. The second volume, which comes down to 1876, is just announced for publication. By means of these books Mr. Robin can ascertain for himself which of the full patent specifications he need refer to. Abridgments and specifications alike will be found in the “Bibliothèque Nationale,” and in the “Conservatoire des Arts et Métiers,” Paris. I presume that the Abridged Bread Company's patents are those taken out by Dr. Daughlish. The earliest of these dates back as far as 1856. —ARTOTTES.

[45292.]—**Breadmaking.**—Mr. P. Robin can easily get the specifications of the patents for aerated bread by applying to any of the patent agents, whose address will be found at p. vi., the covers of this paper. A search would have to be made in the patent office. There are a number of patents, some of which must by time have lapsed. The machinery for any of the methods of carrying out the process is of necessity very costly. I have known £6,000 to be laid out on aerated plant by a breadmaking company, and before it had been three months in operation the directors were compelled, by the clamour of their customers, to revert to the time-honoured system of yeast fermentation. From the small quantity of bread Mr. Robin's orphanage would require daily, it does seem to me highly inadvisable to bury a large sum in the shape of machinery for the production of the bread by the aeration process. It should be borne in mind, also, that there is now not the same consensus of opinion about the superiority of aerated bread over bread made by fermentation with either *Saccharomyces cerevisiae*, or *S. minor*. With the machines now in use for sponging and dough-making, the one system is quite as cleanly as the other, and beyond all dispute, the fermented article is more nutritious, and gives less work to the stomach. I would have pleasure in helping Mr. Robin with any hints my experience might suggest, if he would give details of his present method of breadmaking, and the quantity of flour used daily. —A. BAKER.

[45293.]—**Oatmeal.**—Mr. Robin could not do better than state his wants to Dunham Fils et Cie, 42, Rue St. Genev., Rouen. That firm are thoroughly familiar with all the makers of the special appliances for the manufacture of oatmeal as made in Scotland and Ireland. Mere verbal directions to the miller, who most likely knows nothing of kiln-drying oats, and the special stone-dress for grinding, would be of no value. There is a fine paper on “Oatmeal and its Manufacture” in *The Miller* (London) for September. —A. BAKER.

[45295.]—**Chemical Calculation.**—I wonder “Photographer” did not see that in my reply 47 was a misprint for 4y. This represents the water contained in the y parts taken of the 96 per cent. solution of A, just as 15x and 10z represent the water in the parts taken of the original mixture, and of the 90 per cent. solution of B respectively. —C. E. F. N., Cheltenham.

[45296.]—**Link-Motion.**—In answer to “Guide Yoke,” the radius of the link should equal the centres of the eccentric rods if they are fixed to ends of links, as sketch, A; but if fixed as at B,



the radius will be so much more than the length of eccentric rods, and you will find that the point is just inside the line drawn through the centres of sheaves. The latter may be fixed to shaft by means of a long set-screw passing down the

thickest part of sheave, or through a boss cast on latter, as sketch. I have employed a method of connecting the eccentric rods to links, which does away with the fork at end of rod, by making link thicker than usual, and slit at each end (see sketch) for the rod (which would be a piece of flat brass or steel) to work in—a pin passing through link easily, and a driving fit through rod secures the whole. —E. L. P.

[45296.]—**Link-Motion.**—Radius of link struck from centre of shaft, set “forwards” sheave 90° + the lap in advance of crank, and “backwards” sheave in same position if engine were running in opposite direction. —W. S.

[45296.]—**Link-Motion.**—I should certainly prefer to strike the radius of the link from the centre of the crank-axle if with the ordinary lifting form of link. In a model the best way is to set the eccentrics by sight when coupled to the valve, and when right, secure them with a set-screw through a boss on the sheaves. Hence it is easiest done if the valve-chests next the frames, as the plan is then easily carried out. But if the chests are between the cylinders, with the gear direct, then the eccentrics must either be put on the branch shaft before it is built up, or else made in two parts, held together with screw-pins. There is a great difficulty in this way with models. —SUNLIGHT.

[45297.]—**Sulphate of Lime in Boiler Feed.**—The best way is to deposit the sulphate by heating the water before allowing it to enter the boiler. —NUN. DOR.

[45297.]—**Sulphate of Lime in Boiler Feed-Water.**—In my opinion, the best antidote for sulphate of lime in boiler is a good scaling-hammer, used every time the boiler is cleaned out; if there be much deposit, clean the boiler once a month at least. The use of solutions, fluids, and compositions in some places, is apt to remove something besides incrustation, and therefore ought to be carefully guarded against. —SRT.

[45301.]—**Float of Water-wheel.**—I should myself advise a Poncelet's wheel with curved floats, as giving the most power from the fall. The application of the water must be governed by local circumstances, such as the level of the tail race, and other points. One wants to see the place proposed to place the wheel in to properly advise, as there are many ways of both saving first cost, and preventing waste of power when at work, by careful investigation at the outset. —SUNLIGHT.

[45302.]—**Loco. Injector.**—The piping must be filled, or, as it is termed, loaded with resin, it having been first annealed. This prevents cripplés and dents forming in it. Sand may be used, but it is not so good as resin. The flanges should be brazed on to the pipe when it is bent as needed. —SUNLIGHT.

[45312.]—**Mars.**—Mars will be in opposition at 5 a.m. on the 27th of December. His angular diameter will then be 18'2"; he will then have his greatest angular diameter during this winter. —W. J. LANCASTER.

[45314.]—**Fossils of Ireland.**—You had better consult a library catalogue, and read over such part of the literature of the Tertiary and Quaternary periods which bear upon the subject. The performance of naming will be a matter of time and study. —T. G. F.

[45319.]—**Average Pressure on Piston.**—Rule.—Pressure / Ratio of Expansion $\times (1 + \text{hyp. log. of ratio of expansion})$. Example— $30 / 1.33 \times (1 + .285) = 30 + 1.285 = 38.55$. —W.S.

[45320.]—**Rough-and-Ready Surgery.**—“Lancet” should procure Mr. Smee's “The House Surgeon,” published by the Accident Assurance Co., Bank-buildings, Lothbury, E.C.—NUN. DOR.

[45320.]—**Rough-and-Ready Surgery.**—“Lancet” should join the “St. John's Ambulance Association,” which has “centres” for lectures, &c., in many places over the kingdom. In five lectures he will be taught all that he evidently requires to know. If he cannot do this, I can recommend the small book (used at the lectures), by the late Surgeon-Major Shepherd, price 1s., or Dr. L. Weatherley's Ambulance Lectures, also 1s. The membership of the St. J. A. A. is only 5s. per annum. If “Lancet” will write to the secretary of the Association, St. John's Gate, Clerkenwell, E.C., he will get full information as to lectures, &c. The Association sell the first book; Messrs. Griffith and Farran, St. Paul's Churchyard, E.C., the other. As a member of the Association, I can speak to the value of its instruction. —B. H.

[45321.]—**Removing Chemical Stains.**—If the acid has not yet burned a hole through the cloth, you should put some ammonia on to the cloth; or if there is any gold in solution, you can wash out the yellow colour due to the chloride of gold; then remove any other stain with ammonia. Don't use potash. —W. J. LANCASTER.

[45322].—**Imitation Flowers.**—You need not use nitric acid at all, neither need you depend upon Marseilles soap. I have always obtained the most brilliant effects with Castille soap. This can be obtained at any chemist's. Before lifting the wire-flower out of the soap solution, you had better leave it in for a few seconds; then take out carefully and let it drain for a few seconds until the colours begin to appear; then hold it nearly horizontal with the least inclination possible.—W. J. LANCASTER.

[45323].—**Sulphate of Zinc Battery.**—The only sulphate of zinc cell I know of is a Daniell, in the porous cell of which, and surrounding the zinc, is a solution of sulphate of zinc. The cell is very constant, but would not be of value to you because of its bulk. I should recommend a few small manganese cells; these would be less expensive than the chloride of silver cells. The latter to which you refer will require a new plate of the chloride made; the present one, I have no doubt, has been reduced. If you would care to make up a new plate, &c., I shall be pleased to tell you how to do it.—W. J. LANCASTER.

[45324].—**Faulty Electric Bell.**—The little spring which has a platinum tip, and rests upon the armature carrying the striker, is down too tightly; bend the spring up, so that when the armature is down on magnet, there the little platinum contacts are, say, 1-16in. apart; the bell will not refuse work then. You ought to have got over the difficulty in a moment. Just think how it is that the bell rings, and you will know more than you ever knew before.—W. J. LANCASTER.

[45324].—**Faulty Electric Bell.**—From your description it would seem that the position of the "contact breaker" spring at the back of the armature has become shifted, so that when the stroke of the hammer is completed, contact is not broken, as it should be; the bell is thus converted into a "single stroke." The defect may be remedied by altering the position of the spring until there is a small space between it and the armature, when the latter touches the magnet. With only one cell (and that probably weak from usage), this adjustment requires to be made with great nicety; but if your bell is of good quality you will find it to be provided with an adjusting screw for the purpose; but unless its working parts are mounted upon a metal plate, it will be liable to frequent derangement from the shrinking or swelling of the wood during atmospheric changes.—R. T. LEWIS.

[45328].—**Morgan's Process.**—Morgan's paper is to be obtained at the photographic chemists, and is usually sold in large sheets about the size of albumenised paper of the ordinary kind. It can be used for enlarging by the magic-lantern, or in the camera; in both cases the paper is made moist or damp with cold water, and then laid with its plain side on a piece of plate-glass of the required size. It can now be placed in the camera like a wet plate, or stood up to receive the image from a lantern; in this case a piece of ruby glass must be placed in front of the lens of the lantern, while the right focus is being obtained; it can be withdrawn for the exposure. It is developed with the "ferrous oxalate" developer, and fixed with hyposulphite of soda, and in case of a yellow stain a bath of dilute sulphuric acid is applied. It is very cheap to work with, and once the right exposure ascertained, is exceedingly easy.—WILLIAM PEEK, Hayward's Heath.

[45330].—**Galvanometer.**—Dr. Mann's medical galvanometer being one of the forms of my patent instruments, and made by me, I can explain that they can only be used directly to measure "current." As the graduation furnishes values corresponding to those calculated from a tangent or line instrument, they will furnish the other elements of resistance or E.M.F. by precisely the same calculations as are employed with a tangent or sine reading. In other forms, the actual resistance in ohms is graduated on the dial. A Daniell cell in short circuit through this galvanometer would give a current of $\frac{1}{100}$ of an ampere, while the highest graduation is equal to $\frac{1}{100}$. Of course, therefore, the needle goes to the stops and stops there, because the instrument is overweighed by a current passing of more than double what it is intended to measure. You might as well expect to weigh a leg of mutton upon a spring-balance intended for letters.—SIGMA.

[45332].—**Coil to give Quarter-inch Spark.**—You may make the core $\frac{1}{2}$ in. in diameter and $\frac{1}{2}$ in. long; use three layers of No. 18 silk-covered copper wire for the primary coil, and 4oz. to 6oz. silk-covered No. 36 for the secondary coil. A condenser is necessary to obtain a good spark. It can be made of three or four large sheets of tinfoil cut into pieces $\frac{1}{2}$ in. by $\frac{1}{2}$ in. Thirty or forty of these pieces will be enough. You must have twice as many sheets of paraffin-paper or gutta-percha tissue the same length and one inch or more in width,—say, $\frac{1}{2}$ in. by $\frac{1}{2}$ in.,—and a few extra for the top and bottom. No. 36 wire gives a better spark

than the thin wire, No. 39, so frequently employed, and is quite as cheap to use. The battery-power may be one or two cells, Bunsen or bichromate. You can get a contact-breaker from any London apparatus dealer, who will tell you the price.—J. SUTCLIFFE.

[45332].—**Coil to give Quarter-inch Spark.**—You must make the bobbin $\frac{1}{2}$ in. long, and $\frac{1}{2}$ in. diameter; then put iron wires, No. 24 gauge, sufficient to make a bundle $\frac{1}{2}$ in. in diameter, then you must insulate these from the primary, which should be two layers of No. 18 silk-covered wire, nicely wound, and one layer insulated from the other. Then, for secondary, you must have 6oz. of No. 36 silk-covered wire, and this must be wound as closely as possible, and each succeeding layer should be insulated with a piece of paraffin paper; then finish the coil to your own taste. You will want a condenser made of 40 pieces of tinfoil, each, say $\frac{1}{2}$ in. by $\frac{1}{2}$ in. If you do not know how to fit the whole up, I should be pleased to give you drawings, with full working details.—W. J. LANCASTER.

[45335].—**Wheat Flour, &c.**—Prices vary with the price of wheat. As to properties and preparation, see the lectures of Professor Graham, reported in this paper, beginning January or February, 1880, and onwards; also, for another view of the subject apply to the secretary of the Bread Reform League, Miss Yates, 17, St. Edmund's-terrace, Regent's-park, London. I find it the wisest plan to buy direct from the miller, and sift the meal to the required degree of fineness.—FLOUR WORKER.

[45336].—**Condenser.**—One would suppose the reason a condensing engine can be worked with a lower pressure than a non-condensing, would be apparent—certainly a few moments' consideration would make it so. Your gauge should show 26in. of mercury, if air-pump and injection are all right.—W. S.

[45336].—**Condenser.**—The net gain of the condenser is the effect of 15lb. nearly removed from acting against the piston, less the power required to work the air-pump. Therefore, taking your case, if you added a condenser and air-pump, the boiler pressure might be a little reduced if it (the boiler) was dangerously pressed. But the economy of fuel, owing to the alteration of cut-off, would suffer. Speaking broadly, you might take off 15lb. from the boiler pressure if a condenser were added; the gain would be in this—that the engine, as a high-pressure one, discharges its exhaust steam against an atmospheric resistance of nearly 15lb. to the inch. With a condenser this resistance or back-pressure should be removed; but against this there is the power needed to work the air-pump.—SUNLIGHT.

[45339].—**Salicylic Acid.**—The principal and probably the active reason of the French prohibition was that the use of salicylic acid enabled bad and injurious materials to be employed. It was remarked that the acid itself was injurious, but most authorities state that it has no ill effects; and it is probable that the remark was thrown in as a makeweight.—SIGMA.

[45340].—**Disinfectants.**—A solution of permanganate of potash should be put in a saucer or in a basin, and left in the room. I prefer the use of a towel dipped in a solution of the permanganate, and then hung up in the room until it is dry; then get another towel, and hang up; the first one should be dipped in boiling water and wrung out, and then dried before being again used; this method will disinfect a room very speedily.—W. J. LANCASTER.

[45341].—**Motor for Blowing Organ.**—As water and gas are not available, it remains an open question as to the employment of manual power, steam power, or hot air. The latter would do the work well enough.—SUNLIGHT.

[45344].—**Enlarging of Photos.**—There is only one way that I am aware of, and that is to render a copy transparent, and, by the aid of the lantern, throw the enlarged image on to a transparent screen, which would allow you to copy the major lines accurately. If you have not a lantern, then the matter is different, as it would be hardly worth your while to make one for that purpose alone. In that case the best and cheapest way in the end would be to send the card picture to London, and get an enlargement made, which you could afterwards colour and work up. It is simply impossible to throw it on a screen by the aid of light only. Lenses of a suitable kind must be used.—SUNLIGHT.

[45345].—**Enlargements from $\frac{1}{4}$ -plate Negatives.**—Without trenching on the question as indirectly addressed to "E. M.," may I add that, after trying myself several plans, I have found most conclusively that much depends on the lens that is used for the original negative. Then, if your Hunter and Sands single lens gives thoroughly good definition with a flat field, such as the Wilsonian made by Ross, then I would not advise you myself to

change your lens, as you won't better it. If the definition is not microscopic, then, by all means, get a better one. With all due respect to Mr. Lancaster, I should advise you to get one of his $\frac{1}{4}$ -plate bellows body Tourist cameras. I had one for a long time, and it gave me every satisfaction. I fancy "Le Merveilleux" must be too cheap. The one I named above was thoroughly good; and I am a firm believer in good apparatus at starting. A 12 by 10 landscape lens would not be much good at enlarging. What you want is a $\frac{1}{4}$ -plate or stereo lens, of the portrait class, as the aperture wanted is much larger than that of a landscape lens, and a lens of that class was used by Mr. Palmer, I note. Do not forget that you will also require a compound condenser. The 5in. size, I quite agree with Mr. Palmer, is the right thing. On the question of the lantern, I have written the querist who has been in communication with me respecting another matter; but any other querist who may require such will always obtain my attention by a personally addressed query. To the last question: If the negatives are sharp and clear, the prints, 10 by 12, would be well worth having.—SUNLIGHT.

[45347].—**Boiler Construction.**—"Vulcan's" boilers are seam-rippled. The cause is not due to pressure, but to dirt, or sudden contraction of the boiler bottom, and it is of frequent occurrence in externally-fired boilers. Double riveting will not prevent it: the only way is to keep the boiler bottom clean, and feed with warm water. Do not allow the fire-doors to stand open, as the rush of cold air against the boiler bottom when heated is sufficient to cause these rents.—SET.

[45347].—**Boiler Construction.**—A little consideration will convince "Vulcan" that the strain upon the circumferential cannot be so great as upon the longitudinal seams, and an example, taking pressure as unity, and plates as $\frac{1}{2}$ in. thick, diameter 48in. will make this clear. Area of circle 48in. diameter is $1809\frac{1}{2}$ sq. in., and the circumference of a circle having same diameter, is, say, 150in. Therefore, strain per square inch of section circumferential seams $1809\frac{1}{2} \div 150 = 12.06$, say, 12lb. Strain per square inch longitudinal seams, $48 \div 150 = \frac{4}{5} = 24\frac{1}{2}$ lb.; showing that strain on longitudinal is double that upon circumferential. Or, generally speaking, $7854 \div 31416 = .25$ as against $\frac{1}{2} = .5$. This is taking all terms as unity.—W. S.

[45348].—**Launch Machinery.**—One very good reason that boiler is slow to get up steam, as also that it will not maintain it with the pump on, is that it is not designed to give the best effect in size of shell. The furnace ought to have been 10in. diameter, and the tubes, instead of being 3in. diameter, should have been $\frac{1}{2}$ in. instead. The remedy, as far as it can be applied, is to make the firegrate 16in. long, with the bridge lowered to $\frac{3}{4}$ in. for crown of furnace. Then in the chimney, just where the exhaust-nozzle comes into it, fit what is termed a petticoat pipe, with 3in. aperture, so that the steam from the exhaust, instead of being thrown into the full diameter of the chimney, is thrown into a 3in. pipe only. By this means the exhaust will sharpen the draught better. Chimney should be, say, 6ft. long from smoke-box-joint, and should have a steam-jet or blower to help in getting up steam at starting. You will never get up steam very quick, as there is too large a body of water; but you would do better by doing what I name. In starting the fire, well cover the grate with coal—small lumps, and then slack over it, except 6in. at front end; on this place wood, &c., and light up. In a short time you ought to have just a little steam in the gauge, or even before that starts the blower will work. The fire will then draw more briskly. See there are no air-holes in the fire, and that the bars are free from clinkers. You will then get best result with the present boiler. 40lb. is quite enough pressure—in fact, too much, in my opinion; say 30lb., it should be for such a boiler. Boat would, of course, be slow, as the engine and boiler-power are both insufficient for the length and beam. Pitch of screw is also rather too much for two blades only. About 20in. to 24in. would be better. If wanted to hurry the getting up steam, why not try fire-lighters, such as are used for ordinary household purposes? They give a great flame and would soon start the coal well. To get a fair speed, you would want a much larger boiler, and a larger engine too. Sorry I cannot help you beyond this, as the facts do not allow of it.—SUNLIGHT.

Dressing Belts.—Leather belts will last double the usual time if treated with castor oil; they will be rat proof, they will always remain flexible, and will not crack. A belt $\frac{1}{2}$ in. wide will be equal to one $\frac{1}{4}$ in. wide which has not been oiled. It requires twenty-four hours to penetrate the leather. If used sooner the greasiness will make the belt slip.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for two weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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44722. Old G.W.B. Engines, 47.
44723. Leather-Drying House, 47.
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44746. Heating Model Boilers, 48.
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44752. Chloride of Zinc Battery, 48.
44751. Cambrian Engines, 48.
44755. Immersion Paraboloid Condenser, 48.

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44992. Fan for Planing Machine, 146.
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45022. Bottle Jack, 147.
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QUERIES.

[45349].—Specific Heat.—Suppose 1lb. of hydrogen is mixed with 94lb. of air, and exploded in an adiabatic vessel, the contents after combustion would be 9lb. of water-vapour and 96lb. of nitrogen. Should be glad if someone would work out the method by which it could be calculated what quantity of heat would be required to raise the mixture 1° Fahr. Also, what would be the temperature after combustion, assuming that before it was 60°?—L.

[45350].—Pig-Iron Analyses.—J. C. Belcher, in reply 44981, Oct. 23, in his reply to "Self-Taught Countryman," in reference to silica in minerals, says, among other things, "the contents are . . . gently ignited to 230° F." Now, this is a point on which I am somewhat ignorant, and I should like to know how I am to ascertain the temperature in this and kindred cases. Suppose I wish to heat the contents of a crucible up to 230° F., or 250° F., how am I to know when I have reached the desired temperature? And, would "J. C. B." kindly say, too, what is the best plan for increasing the temperature in the event of my wishing to go beyond the power of a three-wicked spirit-lamp? Does he know of any bellows, or such like arrangement, that I could make? There is another point on which I should be obliged to any of the "E. M." correspondents for a little information. I have made a few attempts recently to estimate the carbon (combined and graphitic) in pig-iron, with rather unsatisfactory results. Here is what I did. I put 25 grains of the iron in coarse powder in small glass flask, added H₂O and 150 grains sublimed iodine. This produced great agitation in the flask, and its contents immediately changed to red; shook flask gently two or three times, put aside for some hours, filtered, washed with cold H₂O, then with dilute HCl, and, finally, with alcohol till washings were colourless, dried at 212° F. in bath for two or three hours, weighed contents of filter as total carbon, and got a result three or four times in excess of what, as I knew from other sources, I should have had. I may add that, for an experiment, I ignited the filter and contents in a platinum crucible at the highest possible heat to be got from a three-wicked spirit-lamp and weighed again, but this made almost no difference in the weight. In one word, then, would anyone kindly inform me how I am to get the total carbon? And how to ascertain how much of it is combined? and how much graphitic?—AVON.

[45351].—Lathe.—Would someone kindly tell me the best way for reversing the motion of the leading screw of a screw-cutting lathe without stopping the machine? A sketch would oblige.—B. T. G.

[45352].—Dynamo-Machines.—Some few volumes back a series of very interesting letters and papers appeared on the construction of dynamos. Now, I have carefully read up all I can find on the subject, and have decided to build a dynamo that will give a light (or two smaller ones), equal to one of Siemens' £75 machines; but, before doing so, I want some information, and take the liberty of asking such kind friends as "Sigma," Mr. Lancaster, Mr. Rankin Kennedy, "Obm," and "Angio-Dane," from whom I should like to hear as to how he succeeded at last with his dynamo. What I want to know is, the best form of construction? (1) The best form of armature, with the lengths and sizes. Also, R's of wire. (2) The best form for the F.M.'s, with length, size, and R's, and if to be built on the shunt principle. I should like to know about what power it would take to drive. I may say that I have at my service one of the finest fitting shops in the Midland counties, so that, as regards mechanical work, nothing will be wanting. I should be only too glad to send my results for the benefit of readers, providing they will help me if they can. By the bye, what has become of our very valued friend, Mr. Kennedy, who has not yet fulfilled his promise about that little dentist's dynamo that he was to send us full working drawings for making?—G. C. ESTON.

[45353].—Tricycle Spokes.—I wish to put a new spoke into my ("Devon") tricycle. The spoke must be put through the hole in the felve before bending, as the

screw end is too thick to go through. Next, I suppose the spoke end must be heated in the forge; then, what tool is to be used for making the countersunk head? The ordinary nail-plate cannot be used. Is there a tool made like a bullet-mould to open after the head is formed? What length of spoke should be taken above the finished length to allow for upsetting in forging the head?—ARGENT SABLE.

[45354].—Lantern-Slides.—In painting lantern-slides, would "Sunlight" kindly give the following information?—How to get a smooth even background? I usually get it so streaky and blotchy. Will the method he describes for a peep-show do for magic-lantern slides—i.e., dipping paper pictures in paraffin, putting them hot on the glass, and rubbing off the paper back afterwards? I find that gelatine sheets are much easier to draw outlines on than the glass coated with gelatine, as the ink is apt to run on the glass, and the coating clogs the pen. Will paraffin answer to transfer the gelatine sheets to the glass when required for framing?—STRATTON.

[45355].—To Mr. W. H. Davies.—In consequence of a fair amount of work, the felt of the hammers of the trouble portion, and the ivory of the two middle octaves of the keyboard of my piano, are worn through. I would thankfully receive a little instruction as to how to proceed in order to remedy the above defects, and how to get the felt and ivory?—PLATINUS.

[45356].—Sulphurised Compound.—Will someone tell me whether there is any simple method of hardening the above preparation of rubber, without rubbing it of its melting powers?—M. C. P.

[45357].—Harmonograph.—Would some reader kindly explain the principle of action of Mollinson's harmonograph? the use of the two slotted weights? and how to obtain the spiral curve?—THORAX.

[45358].—Sulphate of Strontium.—I beg to inclose extract of a letter that I have received from a correspondent respecting the use of strontianite or native carbonate of strontia. Probably, the Sicilian sulphate of strontia is converted into carbonate. If so, by what process? I presume that after the sugar has been extracted from the insoluble compound, the strontia can be used over again. "STRONTIANITE."—Since it has been shown by Prof. Scheibler, of Berlin, that strontium is the most powerful medium of extraction in sugar refining, owing to its capability of combining with three parts of saccharate, the idea suggests itself that the same medium might be successfully employed in the arts, and form a not uninteresting subject of speculation for the chemist. Hitherto, native strontianite—that is, the 90 to 95 per cent. pure carbonate of strontia—has not been worked systematically in the mines, but what used to be brought to the market was an inferior stone collected in various parts of Germany, chiefly in Westphalia, where it is found on the surface of the fields. By Dr. Scheibler's important discovery a new era has begun in the matter of strontianite. Deposits of considerable importance have been opened in the Westphalian districts at a very great depth, and the supply of 10,000 tons per annum seems to be secured, whereas only a short time ago it was not thought possible that more than a few hundred tons in all could be provided.—KINA.

[45359].—Tricycle.—To "SUNLIGHT."—In a machine where back pedalling has sometimes to be done, what amount of energy is lost?—D. A.

[45360].—Iron Buckets.—Would be much obliged to any reader who could inform me of the process of manufacturing iron buckets and galvanising them. And, what machinery would be necessary for making them quickly? Address of makers of the required machinery would also be very welcome.—LEON BUCKETS.

[45361].—Centring Wagon Wheel Axles.—Will someone inform me the best method of centring wagon wheel axles true to bearing?—AGNES NOOK.

[45362].—Sulphate of Ammonia.—I should be obliged for a description of the commercial method of analysing this substance?—L.

[45363].—Instantaneous Shutter.—I have purchased for my 5 by 8 camera an instantaneous drop shutter. This shutter is very unsatisfactory: it lets light in both at the top and bottom, and so makes it necessary to fit a movable box at both these places, and, unless great care be used, it shakes the camera so much as to make several images. Will someone recommend some really effective instantaneous arrangement (in the market) which can be pretty easily fitted to such a camera as mine? I do not want to make one myself, though I can manage, perhaps, simply fitting it.—LABRADOR.

[45364].—Flotsam.—A white, rancid, something light substance is found round these coasts (Labrador) floating on the surface of the ocean, almost entirely out of water. It occurs in lumps of one cubic foot or more; has a greasy feel, burns brightly and completely. What can it be? It appears to be organic—can it be produced by a whale?—LABRADOR.

[45365].—Dry Plates.—Does warmth injure dry plates? I have much trouble in finding a really dry place. Is the kitchen mantelpiece too hot? I ask because some of Edward's plates so kept are quite useless from fog. Also, the high lights, and these only, uniformly blister.—LABRADOR.

[45366].—Mosses.—I should be very much obliged if any of the readers of the ENGLISH MECHANIC would answer these questions. (1) How ought I to press those species of mosses which grow in dense clumps or cushions? Should I cut sections of the clump, or separate single plants, or both? (2) I have found a species of moss which exactly answers to the description of *Tortula subulata*, in Stark's "Popular History of Mosses," except in one point—that is, Stark describes the peristome of *Tortula subulata* as being of a bright red colour, while the peristome of my moss is white, more or less tinged with pink. Could I correctly call my moss *Tortula subulata* or not? These questions may seem to be very trivial, but the fact is that I am only beginning to study mosses, and find difficulties on every side just at first.—NORFOLK DUMPLING.

[45367].—Protoxide of Nitrogen.—Could any of your numerous correspondents inform me, through your

paper, the best way to make protoxide of nitrogen? and whether, before it is taken, it ought to be purified? I have made some by heating ammonia nitrate, and passed the gas through caustic potash and protosulphate of iron, but this process does not answer my purpose.—AMSTERDAM.

[45368].—Screw-Shaft of Steam Launch.—The screw-shaft of my 30ft. steam launch has a small amount of play in the gun-metal of the sternpost; the result is a good deal of thumping, especially in a seaway. How should this be remedied? Should a thin ferrule be placed round the shaft? Or, should something be done to the shaft stuffing-box?—WALKER.

[45369].—Tallow.—For some time past I have been trying to ascertain the strength of various qualities of tallow. I have tried saponification, taking a known quantity of tallow, and a known quantity (in excess) of standard deci-normal solution of caustic soda, then neutralising the excess of soda with deci-normal hydrochloric acid solution, using phenolphthalein as indicator, and I find I cannot get uniform results by this method. By taking the melting point with a thermometer I seem to get more uniform results. Will Mr. Allen, or some of our chemical readers, kindly assist by informing me of the latest and most reliable method?—SOAP-BOILER.

[45370].—Model Locomotive.—Would "E. L. P." kindly answer the following query?—How can the cylinders be made for a model locomotive so that they will make the puffing sound that is noticed in the real locomotive? I have had some good models, and well made, but they did not deliver the separate beats of steam. I tried several methods, but failed to accomplish it. Also, how are long lengths of $\frac{1}{16}$ in. tube filled with lead for bending?—J. HUNTLY.

[45371].—Carbonated Soda or Refined Alkali.—Will someone kindly inform me how to test the strength of these? what test they use for it? and the quantity of alkali and water? I and oblige a constant reader of the "E. M."—F. E. T.

[45372].—Lathe Engine.—What fraction of 1 H.P. would be sufficient to drive my 6in. centre back-gear lathe, the bed of which is 8ft. long, and the mandrel 1 1/2 in.?—T. C. C.

[45373].—Non-Actinic Lamp.—Wanted, particulars for constructing a non-actinic lamp for use with very sensitive dry-plate photography?—F. W.

[45374].—Crystals for Microscope.—What is the best method of obtaining and mounting crystals for the microscope? I shall be glad of any information on the subject.—B. T. O.

[45375].—Microscopical.—Referring to your report at p. 251 of the meeting of the Royal Microscopical Society, I should like to gain some further information respecting the French Pocket Microscope, Nachet's New Pocket Microscope, and Salt's Pocket Microscope, these noticed as having been exhibited and described by Mr. Crisp. The information would probably be useful to many of your readers. Can you or any reader give detailed particulars of these instruments?—B.

[45376].—"Singer" Sewing-Machine.—My machine is worked by hand, and every five or six stitches it will miss for a time or two, and then go on all right. Can any of "ours" let me know how I could remedy this?—TOM TAYLOR.

[45377].—Straightening Steel Wire.—Having purchased several sizes of steel wire, it has come to me in coils. How can I straighten it? It is up to $\frac{1}{2}$ of an inch.—G. M.

[45378].—Fret Saw.—Having a lathe 2 1/2 in. centre, with face-plate, I wish to add a fret saw. Could any of "ours" kindly give me a good and simple plan to effect the same? A drawing would oblige.—A HIGHLAND OX.

[45379].—Dynamo-Electric Machine.—To "G. F. C. Clapham, S.W."—I beg to tender you my warmest thanks for your kind offer to assist me in regard to the above, and to state that the machine is intended for lighting purpose by means of the arc lamp. I regret I cannot avail myself of your proffered kindness to show me your machine, inasmuch as I reside at a very remote place out of London; but, may I be allowed to solicit your favour by communicating privately with me in regard to the above, and I would ever feel indebted to you? I publish my address in the "Sixpenny Sale Column."—GALVANI.

[45380].—Water-Glass-Soluble Alkaline Silicate.—Where could I get about a pint of this? If not, how could I make it? I want to use it on stone and wood 14ft. from the ground. The only information I have got is from a German friend in Berlin, who tells me to get some white glass from a pottery, but I am not near one, and do not know anyone who is. Any hints in the working of it would be thankfully received by a POOR ARTIST.

[45381].—Sledge.—Can anyone give me a plain and simple drawing and description of a useful sledge for visiting patients in snowy weather for one horse? I don't want to know how to put a carriage on runners, but how to have made an entire but simple sledge?—G. M. S.

[45382].—Cotton Belting (Endless).—Can any brother-contributor who has had experience with American cotton endless belts kindly inform me if it is adapted to steam thrashing purposes? And, in short, if it is economical as its price seems to warrant?—THOMAS J. SCUTT.

[45383].—Church's Slide-Valve.—Could "Sunlight," or some other brother-correspondent, kindly tell me whether Church's circular slide-valve is in use on some of the locomotives of Mr. Webb's, built at Crewe a year or two since? And, if so, how it works? I should like to learn all about this valve, as asked in my noticed query of a fortnight since (No. 45180, in your issue of Nov. 4).—THOMAS J. SCUTT.

[45384].—Friendly Society Valuation.—I have shortly to forward to the Registrar-General the Quinquennial valuation of the assets and liabilities of our Benefit Society. To save expense, I should like to do

ANSWERS TO CORRESPONDENTS.

* * All communications should be addressed to the Editor of the ENGLISH MECHANIC, 81, Tavistock-street, Covent Garden, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

* * Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 23, and unacknowledged elsewhere:—

CRAWSHAW and Co.—E. Haslaw.—T. B. Eddy.—W. F. Stanley.—Hunter and Sands.—J. N. Unwala.—H. Horncastle.—S. A. Steward.—Philo. Photo.—Tom.—A. Learner.—Manter.—M. H.—W. Moore.—Weaver.—John Hale.—Sarnia.—Blenheim.—Jupiter.—Sir G. B. Peckell.—Young Engineer.—Electron.—J. F. B., York.—Nil Sine Causa.—Poor Quill Driver.—A. Plaster Engraver.—Jack of All Trades.—Snowball.—J. C.—W. S. Brown.—G. A. S.—Fiddler.—Seconds' Practical Watchmaker.—A Fellow of the Royal Astronomical Society.—Prismaticque.—J. L. Long.—S. E. Peal.—C. E.—S. A. Elson.—Fiont Almon.—Arthur Wright.—H. A. Wassell.

TAICVCLIES.—It is impossible to insert all the letters that still continue to reach us. One or two are held over for use if space permits. We again remind our readers that what we want are not letters endorsing the merits of various machines or finding fault with them, but such letters as that of "D. H. G.," which appeared in our last number, and must have been read with interest by all.

G. W., NEW BEGINNER. (You had better buy the metal ready made, but a good white metal for bearings consists of tin 10, copper 1, antimony 1. You will find many recipes in back volumes.)—A.C. (Lacquer is simply shellac dissolved in alcohol, and tinged with saffron, annatto, &c., to colour required. It is better to buy it than make, and quite as cheap.)—A. HIGLAND OX. (Scrape; take marks out with powdered charcoal and oil, then polish with rouge and water, finishing by rubbing with the hand.)—BAASFOOTENERS. (Better use hot water; but what do you propose to do when the fire goes down at night? You will do more harm than good by warming up in the day and letting it cool down at night. See replies on page 237.)—B. M. (No, we should think not.)—GAS-FITTER. (You will find plenty of hints and recipes in back volumes, and a general article on the subject in No. 718, p. 390.)—EGROTUS. (You must be a little more definite. You can preserve some by stopping the bottles with cotton wool after boiling; but you do not say what infusions you mean.)—CROOKSTON. (It could be done; but it would be better to have a proper mill-race, and a screw would be preferable to the paddles.)—AMATEUR. (It is only clear size, such as can be made by dissolving white gelatine.)—LACQUER. (There are many recipes for bleaching lac in back volumes. See Vol. XX., for instance; on p. 44 you will find the commercial method. Either sunlight or chlorine must be employed to bleach.)—SER. D. H. (You will find details of a camera obscura such as you require on pp. 150, 193, 223, Vol. XXVII.)—B. H. (There are several instruments of the kind, but they are known as pyrometers, and, as you say, require a considerable rise or fall to make the index move. The reason that metals are not used in the way you suggest is because the coefficient of expansion is so small, being for zinc, the best, only .00029417 for each degree between 0° and 100° C. The coefficient, moreover, between those temperatures is not regular. The coefficient of mercury, on the contrary, is 1/5500 between 0° and 100° C, and it is moreover practically uniform within those limits. You have, no doubt, read the description of the instrument on p. 41.)—PUZZLED. (A vacuum is not a necessity in a thermometer; but obviously as the mercury falls air and moisture will be drawn into the upper part of the broken tube, and these will affect its indications sooner or later. You can rely on it in a "rough sort of way," but an optician would hermetically seal it at a merely nominal cost.)—K. B. (The processes are identical with those described on p. 238.)—C. WATERSTON. (They are Nos. 376, 589, both of which can be had, post free, for 5d.)—T. W. (No one could understand your query; whether cut out of the solid or built up, the channels must have certain proportionate lengths. See the indices of back volumes.)—STRICKER. (They resemble nothing so much as a feeder. A weight is generally attached to pull the underpart down and a treadle to pull it up, holes being cut in the top board over which the reeds are held by clips, or in the case of the reed being tuned by the tuner's fingers.)—MUSKETEER. (Try whether the divisions separating the rows can be removed; that is the usual method of getting at the reeds.)—DEVONSHIRE DUMPLIN. (Are you sure it is granite? There is no book on the subject. The only way to melt it is to get heat enough, and that, we imagine, will puzzle you.)—DEMETERIUS. (See p. 31, Vol. XXXII., and p. 94, Vol. XXXIII.)—S. M. C. (It is not a question of quantities, supposing you mean the chromograph or hektograph inks. Dissolve aniline

violet in spirit and dilute with water to the desired tint.)—AMATEUR CARPENTER. (If you mean French polishing, you will find a full description on pp. 175, 227, Vol. XXXII.)—M.L.R.S. (Drill a hole with an ordinary drill, and file out to shape, keeping the tools wet with turpentine. See answer to F. Darby, p. 267, last week.)—F. ROWS. (Several wire-covering machines have been illustrated in back volumes. See p. 332, Vol. XXXI., and pp. 14, 65, Vol. XXIX.)—E. H. B. (See p. 155, last volume, pp. 359, 428, 498, Vol. XXXII., and the index of Vol. XXXI. There are too many references in that index to copy out.)—JUVENUS. (Furniture polishes are invariably compounded of beeswax, boiled oil, and turpentine, or the last two are replaced by pearlash, soap, and water. The most important thing, however, is a sufficiency of elbow-grease. See p. 221, Vol. XXIX., and the indices of back volumes. For the second query, you should consult an etymological dictionary.)—K. SHEWIK. (Both paints are good. If any difference, the first-named is the best.)—J. PHILLIPS. (If there is any book of the kind published, we do not know of it. If it is worth anything it may be possibly obtained of Simpkin, Marshall, and Co., London.)—PATOUR. (Mad as a March hare! Such letters reach us at intervals, but are seldom even read. The last new idea of the "F.H.G.S." is, indeed, very funny.)—GZOMETA. (Your own address must be appended. We cannot undertake to receive replies.)—K. J. TAIT. (No. Crushed and mixed with cement, such refuse has proved a valuable ingredient. The tinned meat business is an industry employing large capital, and scarcely to be explained to or engaged in by an amateur. See, however, indices to back vols. for details.)—J. T. LAURENCE. (It could not have reached us.)—W. L. O. (Have you not seen the reply to your query on p. 205? Surely that contains all you require without further inquiry of the other correspondent you name.)—EASTER. (The "system" is nonsense, and the alleged "support" humbug.)—J. T. MARSHON. (You had better consult an engineer, or take the usual means of communicating with "Sunlight" privately. We like to oblige all readers, and the correspondent you name is not backward that way; but we cannot afford to engrave sketches of all the second-hand boilers our readers buy, in order that they may be told what they are good for.)—ENGINEER. (That is just the real point at issue in the discussion now occupying so much space, so that it is hardly likely you will get a satisfactory answer within the bounds of a reply.)—MUSKIEAN. (We said some time since we regretted our inability to spare space for long specifications of organs, in order to elicit opinions as to their merits.)—J. C. BRAND. (What you ask for was given on pp. 415, 474, last volume. Several self-centring chucks in back volumes.)—F. MORRIS. (See pp. 175, 227, Vol. XXXII.)—A good "reviver" is methylated spirit (pure) 3, linseed oil 1, French polish 1.)—BOOTS. (See answer to "Niger" last week, No. 267.)—SURYANA. (Fill up their holes with coal tar. See back volumes.)—NO SIG. CORK. (You will find what you want on pp. 219, 263, last volume.)—YOUNG DRAUGHTSMAN. (Given many times—most recently on pp. 241, 252, 354, Vol. XXXII.)—PIMPERNEL. (It is exhausted in time; the carbon is only a conductor. 2. See p. 409, Vol. XXX. It is simply a tissue charged with pigment, which is affected by light.)—BRIGHTON. (In almost any back volume. See p. 564, No. 725, Vol. XXVIII.)—TOM TAYLOR. (Clean the parts to be cemented, and use plaster of Paris mixed with alum water. Get the best plaster, not that sold at the oil-shops.)—BLACK SPOTS. (Faint manipulation or bad paper.)—KERALL CELL. (You do not say for what purpose the lye is to be used, but soda ash is cheapest.)—JOSHUA R. BARWICK. (It consists of a small case or body, and about a dozen wire strings, which are struck by the hand while the instrument is waved up and down. We do not think it is patented.)—AN ANXIOUS INQUIRER. (Procure the "Emigrant's Friend," published by the Tyno Publishing Co., 14, Ivy-lane, E.C., and you can select the other works from the catalogue of Messrs. Lockwood and Co., Stationers' Hall-court, E.C.)—BRIGHTON. (Clean them with Bath brick and washleather. Quite possible to get a new commutator, but how can anyone give probable cost without knowing size?)—INVENTOR. (Do you mean an electro-magnet or an engine which will turn a crank and wind up the weight? Any how, see back volumes.)—JACK. (See replies now appearing under No. 45092.)—E. H. (Read the discussion on tricycles in the last few numbers. There is no reason why they cannot be driven direct.)—C. E. R. (What do you mean by an "indicator"?)—YOUNG SUBSCRIBER. (You must either bind them up with the rest, or cut them out altogether. It was for that reason the arrangement was altered.)—B. H. (You want a copper-plate printing press, which in its simplest form consists of a couple of rollers pressed together. See p. 390, No. 328, and the index of Vol. XII.)—PLUMBER. (Certainly not.)—BAD WATER. (We believe if you buy a pump, that is all.)—GAS FITTER. (Badly fitted; could not possibly explode without being mixed with air. The information should be given through our columns.)—X. Y. Z. (Subject long ago exhausted in our columns, and of so little interest that we cannot resuscitate. See *Scribner's Magazine* for August and September, in which a full account appears.)—B. K. JONES. (Send, with a short description, and if possible we will insert.)—AN OLD SUBSCRIBER. (It is impossible to say; if you exactly observed the proportions, there should have been no failure unless some of the ingredients were bad. Try some of the other formulae given in subsequent numbers.)—H. MOV THOMAS. (We have already had one discussion on the subject, and have no space to spare just now for another.)—MASCULUS. (No dependence can be placed upon the thermometer till it is repaired. 2. Nobody can tell you till it is known what the "something" was, and as a tradesman has concluded, it is not worth his while to waste time in trying to find out, it will probably be cheapest to buy a new hat.)—ONE IN A FOOT. (A clever patent agent would take some time and some money to answer your query, and then his reply would only be an opinion. The whole thing is as you say, "very conflicting," and has engaged, and probably will again engage, the attention of the lawyers for some time.)—AGRICOLA. (1. Dozens of such compositions are given in back vols. 2. We have no space for instruction in playing billiards.)—CHERTS. (Yes; but some trees shed their bark naturally; perhaps those

you have noticed are among them.)—TEMPUS VER PECUNIA. (It is quite a usual thing to colour such enlargements, see advertisement pages of any of the photographic journals.)—W. B. (There is nothing mysterious about it. The four men equally divide the weight of the fifth at the moment of greatest combined exertion.)—D. SIMMS. (No drawing inclosed as stated.)—DEMETERIUS.—E. HARDCASTLE.—Your queries can only appear in the "Sixpenny Sale Column."

GEO. E. R.—SUNLIGHT.—D. T., and others have replied to queries already similarly or adequately answered.

To remove bolts that have rusted in without breaking them, the most effectual remedy that is known to the *Boston Journal of Commerce* is the liberal application of petroleum. "Care must be taken that the petroleum shall reach the rusted parts, and some time must be allowed to give it a chance to penetrate beneath and soften the layer of rust before the attempt to remove the bolt is made." Bolts and studs on which the nuts are fixed with rust are often broken off through impatience. In most cases a small funnel built round a stud or bolt end on the nut with a little clay, and partly filled with any of the searching petroleum oils, and left for a few hours, will enable the bolt or nut to be moved.

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Advertisements must reach the office by 5 p.m. on Wednesday to insure insertion in the following Friday's number.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, DECEMBER 2, 1881.

THE STORAGE OF ELECTRICITY.

ONE of the most remarkable replies ever given to a question was that of Prof. Clark Maxwell, when some little time before his fatal illness he said that the greatest scientific discovery of the past quarter of a century was the fact that the Gramme machine was reversible. Exactly what he saw in the future as connected with the fact we shall never know; but there is little doubt that he had recognised the principle which renders possible the electric transmission of power, and which, properly developed, will bring about changes in the industrial and social world that, as Prof. Sylvanus Thompson observes, few of us have yet begun to realise. Besides the fact that a Gramme machine is reversible, we now begin to recognise the full value of the apparently simple discovery made by Gautherot in 1801, when he found that electrodes of platinum or silver, which had been employed to decompose salt water, acquired and retained, after being detached from the pile, the power of yielding a transient current. Bitter, in 1803, observed the same phenomenon, which was studied to a certain extent by many physicists, and in 1869 Planté brought out his secondary battery, which has been "improved" by M. Faure and M. de Meritens, while in the United States, Prof. Houston and Elihu Thompson, and in Europe M. d'Arsonval and M. J. Rouse have made other departures, all of which serve to show that the voltaic battery is reversible, and that the storage of electricity is possible. A proper understanding of the phrase "storage of electricity" will inevitably lead to a better knowledge of the phenomena of electricity than is to be gained from the old textbooks which speak of the fluid hypothesis, for it is difficult to find in the Faure cell anything which resembles "stored electricity," the work done by the lead plates and the acid solution being certainly quite as much chemical as electrical. What is really stored is energy, which is put in and taken out as, for want of a more accurate term, what we agree to call "current." In his recent lecture before the Society of Arts, Prof. Sylvanus Thompson covered the whole field as it presents itself for occupation at the present time, by showing clearly the theory of action and reaction in voltaic cells, and giving a résumé of the progress already made with secondary batteries, with some suggestions as to their possible utilisation in the future. In the ordinary voltaic cells current is produced by the consumption of zinc and acid, which, like coal or petroleum, represent a store of energy; but, whereas an ounce of coal represents a theoretical energy which, if entirely expended in doing work, would raise 895,000lb. one foot high, an ounce of zinc represents only a store equivalent to 113,060 foot-pounds. It is quite possible to utilise the energy in zinc to more advantage than that in coal—to use it more economically that is—but it is obvious that the price differs so much that there is no real comparison. While zinc was the cheapest source of current, Planté's secondary battery was of little use beyond the laboratory of the scientist; but with the invention, or rather development, of the dynamo-machine,

which generates current as it were from mechanical energy, the conditions of the problem were changed, and the attention of several inventors has been attracted to the improvement of the accumulator. Planté's cell, as is well known, consists of two plates of lead separated by canvas, and immersed in diluted sulphuric acid. The plates are arranged in different ways to suit various purposes, and the cells are made large or small as may be desired. When first made these cells are practically of no use at all, for they give only the most transient current, even when charged by three or four nitric-acid cells. The plate of lead by which the current enters is attacked by the oxygen from the decomposed acidulated water, and becomes gradually covered by a thin layer of peroxide which is powerfully electro-negative towards metallic lead, and to the hydrogen which accumulates at the other, or cathode plate; consequently the cell in this condition is capable of yielding current. In so doing, however, the peroxide of lead is partially reduced to the metallic state, and assumes a spongy condition. If the cell is now charged in the reverse direction, the other plate becomes peroxidised, and the hydrogen which flows to the plate previously peroxidised there unites at once with the oxygen, and reduces still more of it to the metallic state; and so, by repeated changes of direction in charging the cell, the coatings of peroxide or of spongy lead, become gradually thicker, and the cell is said to be "formed." The reason why a new Planté cell is capable of yielding but a very small secondary



current, is simply because the separated oxygen and hydrogen escape as bubbles to the surface, and the clean lead plates receive only the merest film of peroxide. M. Planté has long ago given directions for preparing his cells, and recommended that on the first day the alternate charging should be done at intervals of half an hour, discharging between each operation. The next day, for the reason above assigned, the duration of a charge may be increased to as much as an hour, and on the day after to two hours. The cells are then given periods of rest for days or weeks, when the charge may occupy several hours; but it should be carefully noted that as the film of spongy metal, or of peroxidised lead increases, the operations must be stopped before the whole thickness of the plate is bitten through. At the end of a few months, therefore, the cells should be charged in one direction only, because they are then said to be "formed"—that is, they have as thick a layer as the plates will carry. When formed, a Planté cell can be charged by two cells of Grove or Bunsen, or by a dynamo machine; but one cell is unable to raise it to its full power, for the simple reason that the E. M. F. of a Grove is less than that of a fully-charged Planté, which may be made as much as 2.7 volts. M. Planté states that his cell gives back about 89 per cent. of the whole current put into it, and according to M. Géraudy a Planté cell containing 1.45 kilos. of lead can store nearly five kilogrammetres of energy, equal to about 11.3 foot-pounds per pound of lead. With a large battery of 800 cells M. Planté has made a number of valuable experiments, which are one day destined to be of great practical utility. Planté's accumulators, accompanied by Daniell cells to provide a constant but feeble current, are

used to excite the electro-magnets in Achard's electric railway brake, and it will be remembered that some time ago M. Trouvé employed a Planté battery to drive a tricycle; in that case, however, the cells were made of thinner lead, in order to reduce weight as much as possible.

Various uses in the arts have been suggested for Planté batteries; but just as they appeared likely to be utilised in a moderately extensive way, M. Camille Faure came forward with his accumulator, in which, whatever may be its ultimate superiority to the Planté, he avoided the tedious, and in a commercial sense, expensive process of "formation." It will be understood from what has been said above that the principal feature of the Planté cell is the production of a coating of peroxide on the lead plates, which can be readily reduced to the loosely crystalline or spongy metallic state. That coating M. Faure happily suggested might be put on at once by mixing red-lead with dilute acid, and applying it as if it were paint. It will be seen on p. 273 that M. Faure is not certain that minium is the best coating, for other oxides may be used; but at present that has given good results, and various arrangements of the coated plates are undergoing trial. On the page just cited we gave an illustration of the arrangement adopted for a large accumulator where weight is of no moment; in the annexed diagram we give a plan view of the form often adopted, in which five sheets are about 24in. by 10in., and doubled as shown; the other is a single plate 12in. by 10in. These are thickly coated with red-lead on both sides, and against each side is pressed a piece of felt which is also coated with red-lead, the total quantity of which may be gathered from the fact that while the lead-plates in a cell such as that shown in the diagram weigh 17lb., altogether there is as much as 25lb. of minium painted on them. With the trough and the dilute acid such a cell weighs 50lb., and does not attain its best condition until after the expiration of several weeks. These cells can be used to a certain extent at once; but to obtain good results they should be formed by passing current through for about a week. As to the power of the cell, calculations differ, but it is probably rather more than a Planté—perhaps 12 foot-pounds to the pound of lead. Other cells are being made up in which the positive electrodes are .08in. thick, and the negatives .04in., which are folded up in parchment paper and then in felt.

As to the applications of the accumulator, it is at present too early to speak; but it is certain that from what is already known it will in the future be extensively utilised, especially where power is at present running to waste, and also where there is a surplus of power which can be used to drive a dynamo-electric machine. An experiment is about to be made on the Brighton line, in which Faure cells, charged by a dynamo, will be used to supply current to Swan's lamps throughout a whole train; but whether or not that works well in practice the public will be anxious to learn what basis of truth there is in the statements of Prof. Thompson. If it is true that the river Avon at Bristol can be utilised by the erection of a few yards of embankment, and would then give twenty billions of foot-pounds of energy per annum, it cannot be long before such a source of power will be utilised, especially as Prof. Thompson says that one-tenth of the tidal energy in the gorge of the Avon would light the whole city of Bristol. He goes even further by expressing the opinion that the tidal energy of the Severn must be practically unlimited, and that one-tenth of it would light every city, and another tenth would drive every machine in Great Britain. Sir W. Thomson, it will be re-

membered, was not so enthusiastic when addressing the British Association at York, and it would be interesting to learn by what means it is proposed to get hold of the tidal energy. The dynamo-machine enables us to transform and transmit the energy, and the secondary battery enables us to store the current and utilise it as required in a steady flow of power; but by what means is the tidal energy to be grasped and compelled to turn the armature of the electrical machine. No doubt, as Prof. Thompson says, the accumulator of to-day may become as large as the gasometers of a city gas-works; but we are afraid he advances too rapidly when he says that "many months will not elapse" before the fetid atmosphere of the underground railways is replaced by a pleasant and salubrious air, rich in fragrant ozone!

THE PROBLEM OF THE SCREW PROPELLER.

THE problem of the screw-propeller is one of the few questions which have taxed the highest intellects without being solved, and though for forty years or so it has been a subject of discussion amongst mechanics and engineers, it is no nearer solution, apparently, than it was years ago. And yet the problem is very simple when stated in words: it is nothing more than, What is the best form of propeller for a ship of given size, and with so much engine power? There are some other conditions—such as draught of water, contour of the ship's counter, and sundry other details,—but the main question is as stated above. With forty years' experience we should be in a position to state definitely what sort of screw—whether quick or slow pitch—should give the best results in a vessel whose dimensions and engine-power are known; but the fact is, that those who are most intimately acquainted with the subject would be the first to acknowledge that they really know very little about it: they have little more than experience or rule of thumb to guide them, and though so far their practice has been fairly successful, they would be the last to say that it was altogether so satisfactory as they could wish. Experiments innumerable have been carried out by the Government, but though so far as the particular ship has been concerned, the best available propeller has ultimately been adopted, no data have been laid down by which a shipbuilder could determine without fear of error, the best possible propeller he could use for a given vessel. In engineering circles, the man who claimed to have discovered the "secret" of the propeller was, and still is, looked upon as scarcely above the perpetual-motion inventor, and it may be that because so little attention has been paid to the views of the enthusiast, nothing, or next to nothing, has been done towards solving the problem. Of late years, however, thanks to severe competition, new ideas have had a chance of being practically tried, and some of them have been so far successful that shipbuilders are not disinclined to get out of the beaten tracks when they see the promise, at least, of improvement. Our pages have contained from time to time brief notes of new ideas in screw propulsion, and, as occasion required, more lengthy descriptions; it is for this reason that we draw a tention to the somewhat remarkable paper recently read by Mr. J. B. Root before the American Society of Mechanical Engineers. That gentleman, in 1879, built a small pleasure boat with the view of demonstrating the value of the two-hull principle of construction, and in the course of his experiments he arrived at some conclusions with regard to screw propulsion which, at least, deserve more than passing notice. His boat consisted of two hulls,

30ft. long, placed 8ft. apart in the clear, and decked over from hull to hull, the propelling machinery being placed in the centre. At first the engine worked in a horizontal plane, and was connected to the horizontal screw-shaft by means of the familiar mitre gearing. The boat answered its designer's expectations, but the noise of the gearing, as will be readily understood, was too much for a pleasure-boat. Mr. Root accordingly determined to incline the shaft and work direct from the engines, and, in carrying out the arrangement he has devised some improvements which are alleged to yield the following advantages:—(1) The same or greater effect upon the vessel by using a smaller angle of blade, or pitch, by which a great part of the loss from slip is avoided, and the propelling power economised; and (2) a diminution of the resistance of the vessel by the lifting action, due to the position in which the screw is placed. In an ordinary screw-propeller, working in a line parallel with the keel of the vessel, we may assume that the propeller sends in a line with its axis a stream of water of the same diameter as the screw, at a velocity equal to its pitch, less the velocity of the vessel; that is, at each revolution the water is moved approximately a distance equal to the difference between the pitch of the screw and the velocity of approach of the water to the screw. It is obvious that as the after side of the screw disc pushes the water back, the water in front follows to take its place, and consequently as the screw revolves each blade impinges on water that has been put in motion by the preceding blade: hence, if the difference between the velocity of approach and the velocity of pitch is 2ft. per second, the actual velocity imparted by the screw may be assumed to be only 1ft. per second, the other foot being due to the momentum acquired before the screw entered. If the screw could be moved sideways so as to enter water that had not been put in motion by the preceding blade, there would be more velocity to be imparted by each blade, and consequently a greater thrust. It is only as it gives or adds motion to the water passing through it that the screw gets the requisite resistance to propel the vessel, and it is consequently necessary that each blade as it revolves should strike far enough ahead of the preceding one to get hold of water that has less than pitch velocity. If, for instance, we change a two-bladed screw for one having a great number of thin narrow blades, the pitch remaining the same, the thrust would be greatly diminished, because the difference in the velocity of the water between entering and leaving the screw would be very slight, although it would leave it at the same velocity as with the two-bladed screw—in other words, the propeller with many blades would exercise less thrust, because each blade would enter water having nearly the velocity due to the pitch of the screw. Mr. Root has found, then, that the best results are obtained with a propeller whose axis is inclined at an angle of 60 degrees to the horizon, or to the line of movement of the vessel, which acts by pushing the water downward and backward. In this arrangement, double the force of thrust is required to produce the same amount of forward movement in the vessel as is necessary when the thrust is exerted in a line with the vessel's movement; and this increase Mr. Root obtains by enlarging the diameter of the screw until its disc area is sufficient to give the required thrust without excessive slip, when it gives the same forward push upon the vessel as the ordinary screw having double the pitch and about one half its disc area. The improvement is found in the fact that such an inclined screw gives equally good results at a much less expenditure of power than is required by the familiar and

well-tried screw propeller working in a line with the direction of the vessel's movement. Mr. Root claims an economy of 30 per cent, and states that in his experiments with the boat above mentioned, it was demonstrated beyond all doubt that the inclined screw gave as great a speed upon the boat with less power. How far an experiment with a boat indicates the probable result with an Atlantic liner remains to be seen, and remembering the contradictory and puzzling results of experiments with different shaped propellers, we are not inclined to attach much importance to Mr. Root's views as worked out upon paper. His cylindrical screw, as he calls it, appears to be an improvement when applied to a boat 30ft. long, for he says that one of only 14in. pitch, having its axis inclined at 60°, propelled the boat 360ft. in 180 revolutions, the travel of the pitch of screw being only 210ft. It will occur to many that the action of the blades of the cycloidal screw will vary at different parts of their revolution, but any disadvantage is avoided by attaching the blades to the shaft by a cross-bearing or hinge, which causes the action of the blades to be automatically equalised. The angle of θ is not put forward as the best—for the greater the angle of incline the greater the theoretical gain; but there is a limit, viz., the angle at which the increase in the sin of the screw would so increase the friction as to offset the gain from the less angle of blade. The experiment can be made at little expense by those having steam-launches, and it is only practical trial that can determine the real value of the "improvement."

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.

By JOHN WATSON WARMAN,

Associate of the College of Organists, London.

ff. **EXAMPLES** of No. 1 Treatment is common in Organs by Willis; the Hodgesdon Instrument (60, r) may again be cited. Of No. 2 with a proper Cambered Key I believe that Bevington makes frequent use. A Specimen occurring in his large Organ at Martin's-in-Fields, London. Of No. 3 I cannot at this moment recall an Instance.

fff. To the foregoing it should be added that as it is very desirable, at all events when Manuals are as many as Four in number, the Key-Noses of the lowermost of such Manuals be well bevelled away (in order to give the Player a better view of the Pedals; see f. n), it will be equally necessary in such cases (4) the Cross-Bead be set at the Angle corresponding to such Bevel. It will not here be necessary to have such Bead of any other than the usual Flat Form.

g. All Cross-Beads which partially enter [under] edge or face of the Key may be termed *Entering Beads*; all which do not so enter, but set in front of some portion of the Key-Nose may be styled *Exterior Beads*.

gg. Whenever there are *Pneumatic Buttons* placed between two Manuals (see *Departments Composition-Actors*) the Cross-Bead existing at such point should, if possible, be made of small Width and Thickness, and be so positioned, that the actual Button itself can and will, on being pressed, recede into the Bead. The object of this is to give, by diminishing the amount of the Projection of the Buttons, more space to the Player's hands upon the Manual next beneath such Buttons. Where, however, it is desired to have the Levels of the Manuals very Contracted (see 92, m), and the latter are at same time as many as Four in number, and *Pneumatic Buttons* between them are numerous and important, it will sometimes be found best to dispense with the Cross-Beads at such points altogether,—giving, instead, a downward extension to the Key-Nosings (see 83, n), in order to hide the Gap as much as is practicable.

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g. Of course the *Merits* or otherwise of the *Form* of [Front] Cross-Bead will or fall, according to the *Merits* or *Demerits* of particular *Forms* of *Key-Voss* with which species of *Bead* corresponds. For this see with the *Keys* themselves (at 88, s).

The *Top* CROSS-BEAD is a rod or Rail of ble wood, running across on the *Top* al only, and at close behind the *Combs* ps) of the latter. This *Bead* also is, how-sometimes dispensed with entirely, the Rail of the *Book-board* or its *Frame* so treated as to serve instead. An ple of this substitution occurs in the oft-d Hoddesdon Organ (60, v). The *Treat-* is to be recommended as both simplifying *Workmanship* and facilitating *Access* to the al *Keys*. In some other cases the *Thumper* de to furnish the *Top* *Bead*; for this see next.

All regular Cross-Beads (that is, all such e not afforded either by the *Book-board* or by the *Thumper*) are, whether of the or the *Top* kinds, usually best Affixed by s of *Screws*. These should in all cases be lid Brass, and have their *Heads* of the tersunk *Form*.

The *Material* of all Cross-Beads, of both and *Top* species, will be exactly the same d] as that of the *Cheeks*. This rule has ception.

See at this point more fully under *Head* ontracted *Levels* (comm. 92, g), already red to.

THE THUMPER is a small bar or rail of wood, some kind of metal, laid on (and, of course, ded with proper lateral guidance and aint, see *kk* next) the *Keys* at as close d their *Combs* as is practicable, its use s to prevent such *Key*, whenever the finger s it suddenly, from rebounding to higher its proper level. The reason why a *Free* ad of a *Fixed* *Thumper* is employed is simply ase, as the amount of the [vertical] motion uch of the *Manual* *Keys* is, from several as (see 117, s) liable to constant variation, a l Rail placed in contact with them would nswer: for, any palpable deepening of the Touch would then be followed by a *Cypher-* i.e. an unbidden sounding of one or more s); while any shallowing of such *Touch* d result in a slackness or space between the and the Rail (*Thumper*),—so causing the Rebound already spoken of. The *Free* nper, being actually placed upon and ed by the *Keys*, must rise and fall along them in their variations; and, although its ht would be quite sufficient to press down r more of them by themselves, yet as their r surfaces at the *Thumper* point are all ed off to an absolutely level and straight it (the *Thumper*) obviously cannot depress *Key* without at the same time taking down he rest (or at least all the rest except any dy pressed down by the *Player*), and this ight is not sufficient to enable it to do.

The under-face of the *Thumper* will always overed with soft Cloth, Baize, or other suit- material, in order to deaden the sound of key in rebounding against it. The *Thumper*, a of metal, has sometimes, to improve its arance, and at same time avoid the harden- of the cloth with any sticking substance, been vered all over: an Instance of this occurs ae Organ by Gern mentioned a little back 15, mm). This whole-covering, however, is a good plan, for not only is there a trifle of tional space required (often valuable verti- z, see 92, n), but there is no plain surface left offer "a Straight-edge against for *Truthing* "esting the straightness of the *Thumper*,— iftly a matter of importance. At all events upper face of the *Thumper*, whether of al or wood, should always be left unclothed.

j. When the *Manual* is a *Sliding* one (see 6), and vertical space is very confined, the mper may sometimes, with advantage, be e to furnish also the *Top* Cross-Bead. In event this *Thumper-Bead* must, of course, suitable material, form, and appearance, be also left Un-Loaded and Un-Scored (see o, next). No Instance of such a *Treatment* Present known to writer, the idea being his The having to leave the *Thumper* Un- d is, however, a manifest drawback.

k. The *Weight* of the *Thumper* will, in one aspect, depend upon the total length of the *Key* which it governs,—the *Thumper* admitting of being made lighter as the *Key* becomes longer, because, the farther off the *Key* *Fulcrum* (see 86, y) is, the less is the amount of [upward] force with which the fore part of the *Key* rebounds against the *Thumper*: but always remember that this consideration is, to a certain extent, counterbalanced by the fact that the total momentum or force with which any *Key* moves, inevitably increases along with the length (weight) of such *Key*. Under all circumstances, however, the weight of the *Thumper* should be as small as is admissible, the reason being to avoid the risk of the *Keys* "dancing" during playing. This risk lies in the obvious fact that whenever a full chord is suddenly played there directly occurs a decrease in the amount of support furnished by the *Keys* to the *Thumper*, and therefore the latter will, if it be heavy, inevitably tend to depress all the *Keys* which remain up. See now further with *l* next, and at the References there given.

kk. The *Thumper* will be retained laterally in its place by means of two shallow Grooves, made in an exactly vertical direction, one across the inner face of each *Manual* *Cheek*: into these grooves either the actual ends of the *Thumper*, or two suitable *Pins* firmly affixed one to each such end, do enter and loosely fit. Thus the *Thumper* can ride up and down with perfect freedom, but cannot move side-wise.

l. When the *Thumper* is of Wood it is usual to Load it, by first boring or sinking (into its under face) a sufficient number of cavities, cut so as to enlarge towards their floors, and then pouring molten lead into these,—the enlargement of the cavity securely retaining the metal when cooled. There is, however, no real necessity for this Loading, provided only that the requisite space exist for containing a *Thumper*—which in such case may perferably be of some rather heavy wood (see next)—of sufficient size (see 91, h), and that the *Manual* *Keys* themselves be not too short. All Wood *Thum-* pers, whether Loaded or not, will be the better for being Scored (see o, next), except when such *Thumper* has also to furnish the *Top* Cross-Bead (see *jjj*, ante), in which latter case neither Loading nor Scoring must be permitted,—as spoiling the appearance of the *Bead*. Further information on the *Weight* of the *Thumper* will be found at *p*, next, and also under its regular *Head* (at 91, i); the *Dimen-* sions commencing just before (at 91, h).

m. As regards *Material*, the wood *Thumper* should generally, if Loaded, be of Pine, but if Un-Loaded, Spanish Mahogany is preferable, as being tolerably heavy, and yet not liable to cast. Whenever the *Thumper* has also to furnish the *Top* *Bead* it will of course be of the same wood—or else veneered with the same—as that of the *Visible* *Frame* *Cheeks*. In all ordinary cases, however, with either two or three *Manuals*, the best *Material* for the *Thumper* will be *Pipe-Metal*, that is, a mixture of Lead and Tin: about 6 parts of the former to 1 of the latter will give cheap and sufficiently heavy bars, occupying a mere fraction of space, and possessing enough but not too much rigidity. Whenever it is desired that the *Thumper* shall demand as little space vertically as is in any way possible (see again at *Contracted Levels*, 92 g), Wrought Iron should be employed (see on).

n. Concerning this matter of vertical room at the point where the *Thumper* lies, it is to be observed that the amount of such room existent will or may depend upon the type of *Key* employed. If the present writer's *Bayonet* form be used (see *ic*, next), there will always exist sufficient space over the *Key* to permit of the *Thumper's* being, if of *Pipe Metal*, made thick enough vertically to be allowed to be narrow laterally; and then it is only the fore part of the *Bed-Rail* of the *Manual* next above that can come over the said *Thumper*: such fore-part, however, can easily be rebated ("Rabeted") away to admit the *Thumper*, leaving the major portion of the *Bed-Rail* unreduced and consequently unweakened; or at all events the (lateral) width of such *Thumper* will never be sufficiently great to interfere with any metallic strengthening slip (see *c*, ante), or a similar one of wood, which may be attached to the rear part of the said *Bed-Rail*. Where, however, the *Manuals* are

not enough Contracted (see 92, i) to demand any departure from the ordinary Straight *Key*, and it is yet desired that some amount of such *Con-* traction sh be secured, then the flat bar of Wrought extending entirely or almost entirely be with the *Bed-Rail* next over it, will be the preferable kind.

nn. Instances of Wood *Thumpers* are, strange to say, still constantly presented in *Organs* by Willis and other skilled Builders; the *Hod-* desdon Instrument (see 60, v) may, yet once again, be cited in connection. Of *Clothed* *Pipe* Metal an instance has already (at *jj*, ante) been given. Of un-Clothed *Pipe Metal* any modern Organ by *Hill* will afford an example. As regards Wrought Iron, no specimen can at present be called to mind, the use of this material being to some extent an idea of the present writer's.

o. As concerns *Flexibility*, the *Thumper*, whether of wood or metal, must always be of such form, dimensions, and treatment as to inevitably bend slightly—say to a deflection of 1-16th in.—by merely its own weight. When- ever the dimensions here given (see 91, h and on) are adopted, such flexibility will be always secured if such materials as *Pipe Metal* and Wrought Iron be employed: with Wood the requisite pliability must be obtained by *Scoring*,—that is, by cutting, with a fine saw, the *Thumper* nearly through, at stated distances. These *Scoring* will always be made into the top surface by the *Thumper*, and they may be at about 6 inches apart; the distance into which the saw-cut enters will vary a little with circumstances, but a very good rule will be to leave just 3-16th in. of land or un-scored wood. The exact proper depth of cut can, however, always be easily found by simply poisoning the (Cut) *Thumper* on its two ends, and then measuring the amount of deflec- tion resultant at its middle. It has already been pointed out (at *l*, ante) that should the *Thumper* have to serve also as a *Cross-Bead* this *Scoring* must be sacrificed. (Such *Flexibility* in the *Thumper* is rendered desirable simply by the facts that it is almost impossible to secure proper unalterability in either the *Bed-Rail* or the line of the *Keys*, and that a very slight space between *Key* and *Thumper* is sufficient to admit of a palpable over-Rebounding.)

(To be continued.)

TOOLS AND MOTIVE POWER FOR AMATEURS.—XV.

LEAVING the main shop for a while, we will turn our attention to the smithy. The outfit for this shop need not be an expensive one. Given a few necessary things, such as forge, anvil, hammers, a strong vice, and a couple of pairs of tongs, it will be within the powers of some amateurs to complete the equip- ment for themselves, or if not, the services of some neighbouring blacksmith might be re- quisitioned, who would soon turn out a good set of tools.

Now for our requirements. In the first place we want a forge, and this may be either portable or fixed; preferably, of course, the latter. As every bricklayer in every neighbourhood knows how to construct these, directions as to their formation would be superfluous. I may suggest that they are often built too nearly the level of the tuyere, not leaving sufficient depth of fire- room; also a narrow shelf should be left above the back plate, which will serve to catch a lot of the smuts or spent coal, which would other- wise fall again upon the fire, necessitating frequent cleansing of the same.

Where continuous forging is carried on, the back plate and tuyere get very hot, and the slag adheres to the latter and chokes the blast: to obviate this, the tuyere is often surrounded with water, which effectually prevents this nuisance. An amateur forge will not require this addition, for two reasons: first, because he will not have the work to demand such a constant fire; and secondly, that if he had he probably would not have the inclination or the physical strength to work at the anvil from morning till night. The usual form of portable forge is also well known, being illustrated weekly in our advertisement columns. To procure the necessary air supply, we may select either a pair of bellows or a fan. I prefer the latter as taking up less room, and giving a more constant blast; but this is very

much a question of individual taste. In any case, have plenty of blast: it is most annoying to have to keep blowing away for half an hour to heat a bit of one-inch rod. The amateur might easily construct a fan for himself out of sheet-iron; the great point to be attended to being to get the blades of the fan to work as near the casing as possible without touching. The speed of the fan cannot be too great, and, of course, multiplying gear must be employed. I think it preferable to have two or more pairs of wheels and pulleys, rather than to drive direct off a large wheel on to the pulley of the fan.

The anvil should not weigh less than 1½ cwt., and do not have a worn-out one at any price. Three hammers will be wanted—one for light work, one as heavy as can be conveniently used with one hand, and a sledge-hammer. The vice should be a heavy one, and very firmly bolted to a strong bench, so as to be capable of withstanding a good side pull. The bench should be firmly braced to the wall of the shop, and ought to be three feet wide if possible; the length is immaterial.

Two or three pairs of tongs must be provided; generally blacksmiths make all their own tools, and if the amateur can secure the services of a smith in his leisure time, not only would he be able to get his tools made on the shop, but he would learn more in a few hours' careful watching of a good workman, than he would by reading a whole bookful of directions. But watching alone will not insure proficiency; nothing but long practice will give that ease and pleasure in working which a good smith exhibits. Personally, I have a very high opinion of a good smith: I always embrace every opportunity of working at the forge myself, because I really like it: I don't often stick at it all day long, though.

The additional tools used in the smithy consist of chisels and top and bottom tools of various shapes. One chisel is made with a square shank to fit into the hole in the anvil; to be used when working alone at the fire to cut off pieces of hot or (small size) cold iron. Another chisel is used for heavier work, which is held in a withe (handle of thin rod-iron, or of osier-stem, and is struck by an assistant with the sledge-hammer. Swages of various forms are used, but those most in demand are half-round ones; the hot iron being laid in the bottom tool which is inserted in the hole of the anvil, whilst the top tool, which is held in a withe, is placed to correspond with the bottom one, and by blows of the sledge-hammer reduces the iron to the smaller section desired. In lieu of a collection of bottom tools, a swage block is often employed, which is an aggregation of tools in one heavy block of cast iron, the four sides of which are filled with depressions of various sections to be used in conjunction with top tools held in wites; whilst the centre part of the block is pierced with holes of different shapes and sizes, useful for heading bolts, making nails, etc. A set of holes, both round and square, must also be made for use by hand at the anvil; but our hypothetical "village blacksmith" will advise on all these matters. The amateur will find that tools, like ill weeds, grow apace.

W. S. BROWN.

PRACTICAL NOTES ON PLUMBING. XX.*

By P. J. DAVIES, H.M.A.S.P., &c.

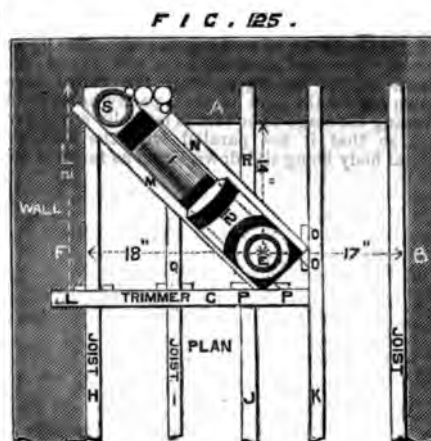
Inside Work, or Sanitary Plumbing.—
Fixing Closet-Traps.

BEFORE fixing the trap for a water-closet you should ascertain the description of apparatus it is advisable to use. For a valve-closet the distance from the wall A, Fig. 125, to the centre of the trap-dip should be 14in. Generally, closets are very narrow, frequently not more than 3ft. wide—5ft. is considered a bare of a closet. When the closet is from 3ft. to 4ft. wide, the trap should be fixed 14in. out of the centre to the right, as shown at L, or between B and E. This is to allow the handle and disk of the closet to come within the lap of the closet seat. This also applies to pan-closets; but for the pan-closet

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the distance from the back wall, A, to the centre of the dip should be only from 12½in. to 13in.

For Jennings' Closet, and some other special makers, you will find it necessary to examine

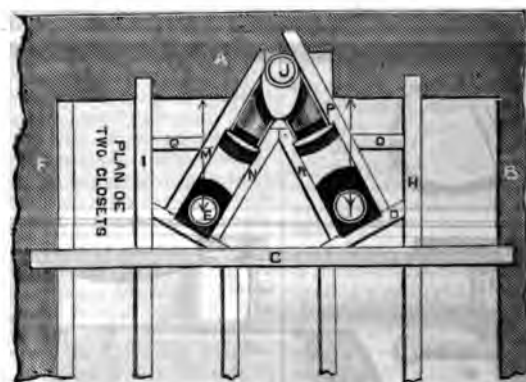


the outgoes and trunks, and so ascertain the proper distances. In a future chapter, I will give the exact distances for those most in the market.

Fig. 125 plainly illustrates the method of trimming the joist for the trap. The trimmer, G, carries the joist, H, I, J. One end of this trimmer, in this case, has a bearing upon the brick wall at L, the other end is trimmed into the joist, K. The trap is supported upon two bearers, M, N; and as can be seen, the ends of these bearers rest upon the brickwork, the other ends are trimmed into the trimmer, or are sometimes made to rest on a fillet, as shown at A, A, P, P. Q and R are two bearers to support the boarding for the floor and closet-seat to rest upon, &c. This trimming is the general method adopted throughout England, and should be well noticed and remembered by all carpenters. The trimmer should always be kept far enough back—say 2ft.—from the back wall, as shown at F.

Twin Closets.

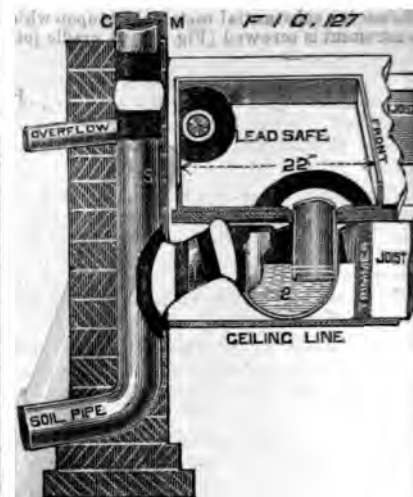
London builders are certainly very much to blame for not, when building houses, providing proper children's closets. I have fitted the whole of the closet and plumbing work for some scores of builders, many of whom were and are in a large way of business, and only one man has consented to have children's closets fixed; and furthermore, to show how much this branch of the trade is neglected, I only know one out of the many dozens of closet-makers



who make a valve-closet for juveniles—viz., Warner and Sons, brassfounders, The Crescent, Cripplegate, London, a drawing of whose trap I shall furnish later on. Fig. 126 illustrates by plan the method of fixing the traps for twin-closets, and also the trimming of joists, &c. In closets having plenty of room, the traps may be fixed at equal distances from the side walls, E, B; but where the closet is narrow, the small closet should be on the left-hand side and nearer to the wall; then the large closet-trap may be fixed the same distance from the back

of the brickwork, as from E to A. The traps are trimmed in much about the same manner as in Fig. 125, excepting the end of the bearer, P, Fig. 126, which I have shown run into the brickwork, and is now in the way of fixing other pipes up the chase, but which may be supported by another shallow trimmer, Q, as fixed that it does not come in the way of the under-side of the soil-pipe, &c.

The elevation of the plan, Fig. 125, is shown at Fig. 127. S, the soil-pipe; (1) the out-go



of the trap to the soil-pipe; (2) the trap. By the side of the soil-pipe are fixed the smaller pipes, that can only be seen at the top near M and C. This also illustrates the lead-safe of the closet and overflow. The overflow should not go into the soil-pipe unless under very special circumstances, and then great care must be taken to insure the trapping being



thoroughly perfect. The safe should be large enough to admit the closet, but not so far in front that it will come in the way of the closet-seat riser. It should never project beyond the front of the basin, which is generally

23in. from the back wall, so that 22in. will be plenty for the bottom of the safe to stand away from the wall, because the top can easily be bent over against the riser, if required.

The safe should be properly soldered to the dip of the trap, and sunk as at A, B, Fig. 128, in order to allow the solder to be wiped level or flat with the bottom of the safe.

The angles of the safe may be soldered, bossed, or dog-eared up; the last-named will not have as neat an appearance as when bossed, but if properly done will answer every purpose.

men who choose to dog-ear the corners be careful not to beat the lead too close ther, as, although the work may look neater, it must be remembered that substantiality is vital, and the close beating will destroy the les.

LENCH "POCKET" MICROSCOPE:

FIGS. 1 and 2 show a compact form of compound microscope (of anonymous French origin) which may be commended for its portability. The base is a substantial metal tablet, upon which the instrument is screwed (Fig. 1). A cradle joint

can either be used in the optic axis as shown *in situ* (1), or an additional elbow-piece (2, Fig. 1), fitting into the hole (2) immediately below the stage, can be made use of for giving some range of obliquity. A condensing lens for opaque illumination, fitted with jointed arms, can be attached to the side of the tube, and a revolving plate of diaphragms beneath the stage.

For convenience of packing, the objective is removed, the draw-tube closed, and the optical body drawn up the sprung-socket; the milled head shown behind the limb is then partly unscrewed, allowing the stage to be turned laterally a quarter-turn, so that it lies parallel with the limb, the optical body being slid down again as far as it will

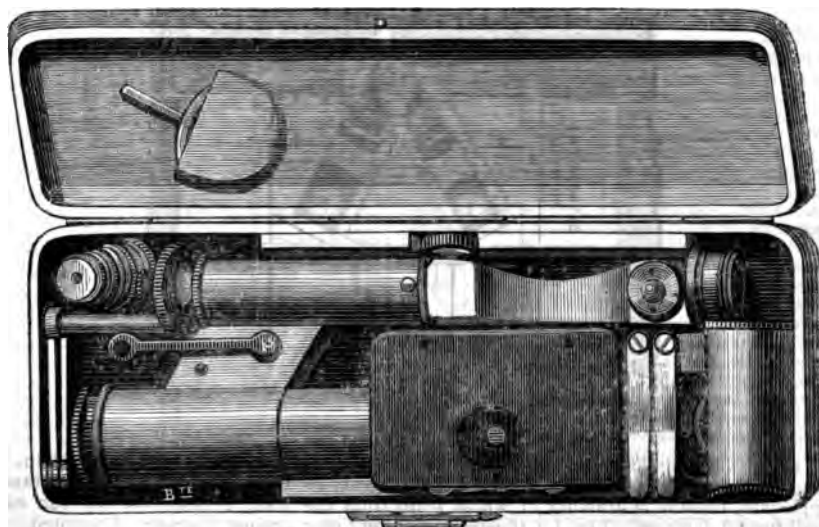
as the foot, the microscope being screwed to the lid instead of the metal base, if it is not desired to be encumbered with the latter on excursions, &c.—*Journal Royal Microscopical Society*.

[By the courtesy of Mr. F. Crisp (Secretary Royal Microscopical Soc.) we are enabled to reproduce the above Figs. and description from the *Journal* of the Society. The query of "B." (No. 45375, p. 290) is thus partly answered. We hope shortly to give Figs. of the other portable microscopes referred to by "B."—Ed.]

FIG. 1.



FIG. 2.



above the base permits inclination, and in all positions the microscope is quite steady. The fine adjustment is effected by sliding the tube the fine adjustment by the usual screw acting on a spiral spring in the hollow limb, as usually adopted in Continental models. The draw-tube is graduated. The mirror (1, Fig. 1)

go. The mirror and condensing lens are also removed, and the base unscrewed, inverted, and placed in the travelling case, the under surface-shaped in the casting—forming a secure packing for the instrument as shown in Fig. 2. The whole is enclosed in a leather-covered box $7\frac{1}{2} \times 3 \times 1\frac{1}{2}$ in. (about the size of a cigar-case), which can be used

THE IDENTIFICATION OF FIXED OILS.*

By ALFRED H. ALLEN, F.I.C., F.C.S.

Lecturer on Chemistry at the Sheffield School of Medicine.

THE recognition of an unmixed animal or vegetable oil may usually be effected by a careful application of the methods of examination already described. Various systematic schemes for the purpose have been devised by different chemists, but no such method can be implicitly relied on, owing to the variable nature of the oils themselves. In particular, any positive recognition based on the colour reactions of an oil is of but little value, unless confirmed by the indications of other tests:

In examining oils for the detection of adulteration, the relative commercial value of the different kinds should never be lost sight of, and it must be remembered that, in addition to the adulteration of the more valuable fatty oils with the cheaper, their sophistication by admixture with the hydrocarbon oils obtained by the distillation of petroleum, shale, coal, rosin, &c., is also extensively practised.†

Practically, it is often of less importance to know whether an oil has the origin attributed to it, than to learn whether its characters are such as will allow it to be safely used as a substitute for the genuine oil. This may be ascertained with tolerable certainty, and in some cases the nature of the adulterants definitely detected.

Although it is not possible to lay down any general scheme which shall be available for the identification of any unmixed fatty oil, the recognition is much facilitated by conducting the examination in a systematic manner. By proceeding in the following manner, positive identification of a particular oil may generally be effected, and so much information gained as to the probable constituents of a mixture that special tests for the oils suspected to be present may then be successfully applied:—

Place a drop of the oil on the back of the tongue by means of a glass rod, and taste it carefully, avoiding too hasty a decision. In this manner fish oils, linseed oil, croton oil, mineral oil, rosin oil, and some others may generally be detected. Rosin oil is remarkable for the nauseous after-taste of rosin produced by it. Rancidity of an oil may easily be recognised by the taste.

Heat a portion of the oil in a porcelain or platinum capsule to about 140° or 150° C., and observe the odour carefully. When sufficiently cool, pour a little of the oil into one hand, rub with the other, and smell again. A little practice will allow of vegetable oils being readily distinguished from animal oils, and the products of fish and marine mammals from those of terrestrial animals. The odour on heating will also frequently permit the recognition of mineral and rosin oils, and, if the remainder of the oil be strongly heated till it ignites, and the flame then blown out, the vapours will often have a highly characteristic odour.

Ascertain the specific gravity of the sample at 15.5° C. ($=60^\circ$ F.) if fluid at that temperature, but at 37.8° C. or 100° C. if solid at the ordinary temperature. This test is a very valuable means of recognising individual oils, but if much free acid be present, or the sample be a mixture of several oils, its indications are less reliable. The following table enables an unmixed oil to be arranged in one of eight groups, according to its specific gravity and physical state at the ordinary temperature.

* From advance-sheets of "Commercial Organic Analysis," Volume II.

† The following tabular arrangement by Messrs. Stodart shows the order of commercial value of the principal fluid oils:—

1. Sperm oil.
2. Seal oil.
3. Olive oil.
4. Lard oil.
5. Rape oil.
6. Seed oils { (a) Cotton-seed.
(b) Linseed.
(c) Niger-seed.
7. Castor oil.
8. Fish oils { (a) Cod.
(b) Pilchard.
(c) Whale.
9. Mineral oils.
10. Rosin oil.

Oils Liquid at 15° C.				Oils Solid at 15° C.			
Specific Gravity at 15.5° C. (59.9° F.)				Sp. gr. at 15.5° C. (59.9° F.)			
881 to 883	883 to 912	912 to 920	920 to 927	927 to 957	957 to 1000	1000 to 1009	1009 to 1014
Vegetable oils. None.	Vegetable and Animal oils. None.	Vegetable oils. Almond, B. n. Rape and Colza Earth-nut. Mustard. Olive.	Vegetable oils. Beech-nut. Cotton-seed. Hazel-nut. Sesam. Sunflower. Niger-seed. Hempseed. Linseed (raw). Poppy-seed. Walnut.	Vegetable oils. Cotton. Boiled linseed. None.	Vegetable oils. Castor. None.	Vegetable fats. Cacao butter. Palm oil.	Vegetable fats. Cocoa-nut oil. Palm-nut oil.
Marine Animal oils. Sperm. Shark.		Marine Animal oils. None.	Marine Animal oils. Cod-fish. Cod-liver. Menhaden. Porpoise. Seal. Whale.	Animal and Mineral oils. None.	Animal oils. None.	Terrestrial Animal fats. Bone fat. Lard. Tallow. Dripping. Butterine. Oleomargarin.	Terrestrial Animal fats. Butter-fat.
	Mineral oils. Shale and petroleum products.	Mineral oils. Heavy Shale and Petroleum products.	Mineral oils. None.		Hydrocarbon oils. Rosin oil.	Sp. gr. above .92 in solid or fluid state.	Bee's wax. Carnauba wax. Japan wax. Sp. unaccl.
						Sp. gr. very variable.	Paraffin and mineral wax.

The sample having been satisfactorily classified by means of the taste, smell, and density, the subsequent means of identification depend on the results of these tests.

(a) Sperm and shark oils are readily distinguished from shale and petroleum products by the products of their saponification.

(b) The non-drying vegetable oils may be distinguished from each other by a careful determination of the density, viscosity, and heating when mixed with sulphuric acid. The colour reactions of Chateau may be employed as confirmatory tests. Lard-, tallow-, bone-, and neat's-foot-oils may be differentiated by the fifth and sixth tests of Chateau, and by their viscosity and heating with sulphuric acid.

(c) The vegetable oils possessing more or less well-defined drying characters may be in a great measure differentiated by an exact determination of their densities, viscosities, and heating with sulphuric acid. When cotton-seed oil is saponified, the fatty acids separated on acidifying the solution of the soap are solid at the ordinary temperature, while those from most other oils of the group are liquid. The elaidin test and colour-reactions will suffice for the positive identification of an unmixed vegetable oil of this group.

The marine animal oils may be distinguished as a class by the brown colour they produce when saponified, and by the darkening that ensues on passing a current of chlorine through the oil. They may be differentiated from each other by Chateau's colour-tests. Liver-oils give a fine violet colour changing to brown, when a drop of sulphuric acid is placed in the centre of 10 or 20 drops of the oil. The following table shows the density of the leading "fish oils" at 37.8° C. (= 100° F.) compared with water at the same temperature taken as unity:—

	Highest Extreme.	Lowest Extreme.	Usual Density.
Cod-liver	0.920	0.914	0.919
Shark	0.925	0.913	0.919
Seal	0.935	0.933	0.930
Whale	0.945	0.938	0.942

(d) and (e) Boiled linseed oil is easily distinguished from cotton oil by the taste and smell. Cotton and castor oils are readily soluble in rectified spirit, but linseed is nearly insoluble. Boiled linseed oil dries very rapidly, but cotton and castor very slowly. The viscosity and heating with sulphuric acid also distinguish these oils without difficulty.

(f) Rosin is unsaponifiable by alkalis, and is readily identified by its strong after-taste and the characteristic odour developed when the sample is heated till it catches fire and the flame then blazes out.

(g) and (h) The oils of these groups are distinguished by their melting and solidifying points, taste, smell, and by the proportions of soluble and insoluble acids yielded on saponification. Cocoa-nut oil and palm-nut oil resemble butter-fat in yielding a notable amount of volatile or soluble fatty acids.

In the case of a sample consisting of a complex

mixture of wholly unknown oils, the identification of the constituents is often a problem of extreme difficulty, but when the leading component is known or can be recognised, the detection of the others becomes more feasible. It must, however, always be borne in mind that in most cases oils cannot be recognised by distinct and specific tests such as exist for the different metals, and that in arriving at a conclusion as to the composition of any sample of mixed oils, the analyst must be content to be guided in a great measure by circumstantial evidence, and a careful consideration of probabilities. (The foregoing methods of examination are of course employed, and in addition such special tests as will be found described under various heads. The sub-articles descriptive of the more important commercial oils contain a list of the admixtures most commonly found in each oil, and special tests suitable for their detection.)

The following facts, which depend on the chemical nature of the oils, are of importance in the examination of complex samples, and to a less extent for the identification of unmixed oils:—

Much information may be obtained by saponifying the oil and determining the products formed by the reaction. Thus most fixed oils are split up into a fatty acid and glycerin; but sperm oil and the waxes yield products differing from glycerin in being insoluble in water but soluble in ether. Sperm oil only yields some 63 per cent. of fatty acids, while most other fixed oils (not the waxes) give about 95 per cent. As stated above, butter-fat and the oils from cocoa-nut and palm-nut yield a notable proportion of acids volatile and soluble in water; but in the case of almost all other oils, practically the whole of the fatty acids are insoluble. Rosin gives 100 per cent. of resin acids and no glycerin, but mineral and rosin oils do not undergo saponification at all, and so can be dissolved out of the solution of soap by agitating with ether.

The saturation-equivalents and the physical properties of the fatty acids afford important information. The acids from rape and castor oils neutralise sensibly less alkali than those from most oils. Lard-, tallow-, and neat's-foot-oils yield fatty acids of much higher melting point than the non-drying vegetable oils which they otherwise resemble. Cotton-seed oil yields fatty acids solid at the ordinary temperatures, while most drying and semi-drying oils yield liquid acids. Any admixture of resin acids tends greatly to increase the density of the fatty acids. When it is intended to examine the characters of the fatty acids, it is highly important that the aqueous and alkaline solution of the soap should be previously agitated with ether until nothing more is removed, as any admixture of wax or hydro-carbon oil would profoundly modify the properties of the fatty acids.

It will be observed that the drying oils are heavier but less viscous than the non-drying oils, apparently in proportion to their drying tendency. The non-drying oils give solid elaidin, the product becoming less and less firm as it is derived from a more strongly-drying oil. Similarly, the heating produced by mixture with sulphuric acid appears to bear a direct relationship to the drying properties of a vegetable oil. By a careful application of these facts an approximate estimate of the proportions of different oils in a mixture can often be made.

NECESSITY OF CLEAR MECHANICAL CONCEPTIONS.—I.*

By WILLIAM D. MARSH,

Whitney Professor of Dynamical Engineering, University of Pennsylvania.

THE nomenclature of mechanical concepts is a matter of common consent, and as it is reduced to approximate uniformity, the majority of writers upon mechanics as painstaking and clear in their use of it would they bear in mind that a clear perception of the meaning of terms used is of greater importance than any subsequent skill and ingenuity in the mathematical solution of the symbolical expressions for them.

Every term used in mechanics should be the mind a distinct physical conception, being expressed in intelligible language with course to symbolic notation; and until it is recognised and acted upon, mechanics will be a dreaded study to those who are forced up, saving that small proportion of thoughtful and patient enough to elaborate own conceptions by careful decomposition of the elements of the symbolical expressions which are taken for the foundation of an elaborate mathematical structure. Those engaged in teaching can have failed to the stupefying effects of a course of reasoning unaccompanied by any materialisation of the meaning of the expression or have not noted the injury of a natural intellect in the attempt to memorise partially apprehended formulae. Great technical requirements do not seem to be a necessity, since discoveries in natural science seem to point out new and appropriate quantitative treatment rather than to render the labours of the pure mathematician knowledge of mathematics does but enweigh and measure our results. A mechanical problem should first be analysed by means of a course of abstract reason being quantitatively analysed with the mathematics, just as a cautious chemist a quantitative analysis by qualitatively ing the nature and ingredients of the under consideration.

Clear ideas of the meanings of mechanical concepts are imperatively required as a first success in a preliminary analysis of any and any attempt at quantitative analysis probably lead to error than truth unless preliminary analysis be complete. That it may not appear to have "set up a man for the pleasure of demolishing him, he will a few cases occurring in the works of writers upon mechanics, passing over notice the two apparent evasions and misuses of a host of writers of so-called "mechanics." Prof. Wm. Whewell, who is the clearest writer in the English language mechanics, constantly uses the terms "force," "pressure," "interchangeably." Pressure is force distributed over a considerable area in the case of water, the atmosphere, or Rankine calls the moment of inertia of a body the weight multiplied by the square radius of gyration; this expression is moment of inertia, but only the mean moment of inertia. Prof. Tyndall defines a "mode of motion"; it is really a form. Possibly this apparent error is a wilful ment, made with a design to convey to an approximate idea of what he did not believe capable of conceiving fully. It certainly an error or a concession to ignorance, done much harm. It is very much easier to defects than to remedy them, and the offering the following verbal definitions, feel that he has made himself as clear as have wished to be. He trusts, however, will serve the purpose of showing more meaning of the usual terms of mechanics, relations to each other, giving in the pre of successive aphorisms a connected view whole field of mechanics. In order to be clear, and establish a complete understanding between our readers and ourselves, we will repeat the most elementary ideas, because having the more complex meanings will the most precise accord as to the most elementary terms to which they will be. We may, then, be pardoned for the repetition definition with which all are assumed to be.

Dynamics may be separated into two: kinematics and statics. When these two considered in conjunction we have dynamics. Careful isolation of these two branches of their separate study, will add much power of apprehension of the student comes to consider them conjointly. It evades all questions of force, and in it we ourselves entirely to the consideration of velocity, and direction of motion. Motion

* From the *Journal* of the Franklin Institute.

a change of position, and in many cases this change is a matter of time, so that the path and direction of motion are our consideration. If velocity is taken as the unit we introduce the element of time. The velocity of a point is the distance which it passes over in the time which is the usual standard. We can then measure the space described in any time to the product of the velocity and the time, if the velocity is not constant it can be measured by the quotient of the space by the time. These quotients will be different for different periods, and in variable velocities we have velocity, at any instant, by the space which has been passed over in the succeeding time, and the velocity being rendered constant. Angular velocity, which is used to measure the speeds of rotation of bodies around a fixed axis, can also be constant or variable; it is the angular distance, in a circular path, of a point which is equal to the distance equal to unity from the axis of any rotating body; or, if the axis does not pass through the body, it is the velocity, in a straight line, of a point situated at a distance from the axis equal to unity, and in an assumed line perpendicular to the axis and the body revolving around it. It can be obtained by dividing the curvilinear distance of any point in a rotating or revolving body by its radial distance from the axis.

with these few fundamental concepts all that are necessary to the study of, this word being used in its most general sense. Statics, on the other hand, evades the question of motion, and in it we confine our study of forces at rest. What force will probably never know until we eliminate nature of matter; we do know, at whatever tends to produce motion, it produces motions in bodies at rest, or tends to bring a moving body to change the direction of a moving body. We measure force by weight, in pounds, and limit it by its point of application. In terrestrial statics which we limit ourselves in this paper, we force which attracts all bodies to the centre of the earth in a vertical line; if allowed a free body in a vacuum it will produce a constant acceleration of about 32-2ft. at the end of one second, the time the body will have fallen a distance of 16-1ft. In order to define the centre of gravity of a body we will have to precede it by the definition of the statical moment of a force which is the product of that force multiplied by its perpendicular distance from the point around which it actually does produce motion. We define the centre of gravity of a body as that point at which, if supported, leaving the body free in any direction, would balance all the forces of the molecules of the body. The force of gravity; the body would have a tendency to turn about this point, at that point the force of gravity acting upon the body is assumed to be concentrated. The theorems of the parallelogram and the triangle of forces form the basis for the development of forces which has received an independent development both analytically and

much matter. The fact is that mass means the intensity of the force of gravity divided by the velocity due to the force of gravity at the end of one second, and is a constant ratio at all points on the surface of the earth. The great convenience of this ratio for the purposes of the mechanic will be seen when we recollect that in dynamics the intensity of a force is measured by the velocity which it will produce in one second, and if we multiply this ratio (which is the mass) by the velocity which is observed, we have the intensity of the acting force in pounds. This leads us at once to the momentum of a body, which is the intensity of a constant force which has been (or should have been to produce the same velocity) acting upon it for one second, it is equal to its mass multiplied by its velocity, in feet per second. If a moving body be brought to rest in one second, the momentum is the intensity of the constant force which must be exerted through a space equal to one-half the velocity of the moving body. In speaking of momentum, unity of time is always assumed as one of the conditions; thus the weight of a body equals its momentum when gravity is the force acting upon it.

(To be continued)

SCIENTIFIC NEWS.

IN the first of his series of Cantor lectures on the industrial uses of the calcium compounds, Mr. Bolas performed the rare experiment of isolating the metal from its fused chloride, by means of an electric current obtained from a machine on Pacinotti's principle driven by a small gas-motor. Although calcium is the most abundant metal in nature, it has such an affinity for oxygen, that it is rarely seen outside the chemist's laboratory, and not often there, so difficult is it to reduce to, and keep in, the metallic state.

Sir Wyville Thomson has resigned his post as professor of natural history at Edinburgh.

Mr. H. N. Moseley has been appointed to the chair of anatomy, at Oxford, vacant by the death of Prof. Rolleston.

With a view of commemorating the services of Father Secchi to astronomy, a committee has been formed at Reggio, to collect funds for the erection of a refractor of 27in. clear aperture.

In a paper recently communicated to the Royal Institution of Cornwall, Mr. J. H. Collins gives reasons for believing that the country southward and westward of the Bodmin granite is composed of no fewer than four distinct rocks of very different ages, not merely of two kinds as indicated by the maps of the Geological Survey.

The experimental works at the Channel tunnel are progressing satisfactorily, the boring averaging 28ft. per day of twenty hours. Mr. J. D. Brunton has recently completed a patent of a machine for excavating tunnels of the kind; but the real difficulty appears to be the ventilation. That might be overcome while the work is in progress; but by what means can a tunnel 20 miles long, be rendered safe for passengers in a train drawn by an engine belching out volumes of carbonic acid?

The Fontaine Engine—the locomotive with the drivers on the top—has been tried on the Pennsylvania railroad and has not given satisfaction, apparently because it has not sufficient tractive power. In Canada the Fontaine is stated to have run a distance of 200 miles at a rate of 60 miles per hour.

With the view of avoiding the bursting of water-pipes by freezing, a method of making them elliptical in section has been recently patented. As the water expands to form ice, it will alter the shape of the pipe, causing it to become circular in section, and therefore giving more room for the ice. It is proposed to squeeze the pipes into their original shape, when, by a succession of frosts they have been rounded.

A private trial trip of the *Phosphor Bronze* steam launch, the property of the Phosphor Bronze Company, Limited, London, took place in the Thames, off Westminster, on Tuesday, 22nd inst. This small vessel is built entirely of Phosphor Bronze, and her length is only 35ft., her beam being about 6ft., and she attained a speed of 12½ miles per hour, which, considering her size, is a remarkable performance. The chief object of the Company in having so small a craft built, was to test the rigidity of the

phosphor bronze sheet and anglepieces used in her construction, prior to having boats built on a larger scale. The results have been beyond the Company's expectation as regards rigidity, absence of vibration, and the speed obtained. The cost of phosphor bronze boats will not much exceed those made of steel, and the metal is not subject to corrosion, like iron or steel.

We learn that the first *conversazione* of the session of the Royal Microscopical Society will be given at King's College on Wednesday Dec. 7th, when the suite of rooms of the library will be placed at the disposal of the Society for the reception of the visitors, and the exhibition of objects and appliances of interest to microscopists. The following exhibits are promised:—By the President (Prof. Martin Duncan, F.R.S.), rare sponge spicules from deep-sea soundings; by C. Stewart (secretary), specimens of double-staining; by F. Crisp (secretary), the collection of microscopical appliances that have been brought before the Society during the past year, including microscope-stands, illuminating devices, microtomes, turn-tables, &c.; by J. W. Stephenson, *Amphipleura pellucida* mounted in solution of phosphorus in bisulphide of carbon; by Dr. John Anthony, Wenham's new microscope-stand; by Powell and Lealand, new formula $\frac{1}{3}$ th homogeneous-immersion objective, and possibly a higher power on the same formula; by Swift and Son, their radial traversing substage in action; by Watson and Son, Crossley's new microscope the illumination passing through the trunnion-bar and by three total reflexions upon the mirror, all degrees of obliquity can thus be obtained by the mere lateral swing of the mirror-arm, the lamp remaining stationary; by T. Curties, foreign microscopes by Prazmowski and Zeiss, and miscellaneous objects. Exhibits are also expected from the following:—Drs. Beale (treasurer), Gray, Milnar, Matthews, &c.; Messrs. Bennett, Déby, Fox, Glaisher, De Souza Guimarães, Ingpen, Ridley, Ward, White, &c. The invitations have been limited to 1,000.

Biological science owes not a little, already, to the marine stations instituted of late years, at Naples and elsewhere, for study of sea-life. An encouraging report was given by M. Lacaze-Duthiers the other day in the Paris Academy of the Zoological Station, at Roscoff on the coast of Finisterre. The number of persons who have worked there this year is 38, as against 27 last year; eight of these have been foreigners. A large fish-pond has been added, and the aquarium and laboratories, which are yet to be made, will be quite near it. The naval minister put a small vessel at the disposal of M. Lacaze-Duthiers, for dredging excursions. A large number of live animals are sent inland. Banyuls-sur-mer, on the Mediterranean, has been chosen for the new winter station, which will be inaugurated in January next. The site is on a promontory at the mouth of a round bay, and is said to be charming. The building (rectangular) will have an aquarium on the ground-floor, and, on the first-floor, nine working cabinets, a hall for conferences, a library, &c. A steam-engine for pumping water has been presented, and set up in a hollowed rock. A total sum of 48,000 francs has hitherto been acquired. The mayor of Banyuls has started a subscription to supply the station with a good vessel. The maintenance of the station, with its personnel, will be at the charge of Government. The laboratory is named after Arago. Another item (which we find in *La Lumière Electrique*) is that the electric light will be used at this station, the pumping engine being utilised for this purpose.

A good deal has been done by the Japanese Government since 1868, to facilitate navigation along the coasts of that country. A list of the lighthouses, lightships, buoys, &c., has lately appeared. There are, at present 45 lighthouses, classed in six divisions. The first lighthouse erected in Japan was that of Kannonosaki, at the entrance of the Bay of Yedo; it is the work of a Frenchman, was begun in 1863, and lit in February, 1869. It rises 187ft., the light is white and fixed, and has a range of about 14 miles. The last constructed is that of Kouchinotsou on the Bay of Simabara; it came into action last year. It belongs to the sixth order. Of the 45 lighthouses, 11 are of the first order, four of the second, four of the third, eight of the fourth, seven of the fifth, three of the sixth, and eight below the sixth. The sixth class contains three

Espin's interesting letter (19436) which I have previously made as to the personal peculiarity, or which causes certain people to exclaim in many stars in which such at all, perceptible to the great rivers. Part of this may be in a sense of its dependence upon the correction of the object-glass, the material of the speculum; but portion of it undoubtedly resides in the observer himself. I have before sent through a long list of so-called in company with the author of valuable works of astronomy (for correcting the list of such objects, volume), and how he and I remember in which a scarcely perceptible formed the only warrant for their catalogue.

Royal Astronomical Society.

A' ANDROMEDÆ.

Order to obviate disappointment, pleasant feeling that one's instrument to one's expectations, it may to amateurs to mention that this as ceased to be available except in apertures and superior defining results, extracted from the observations of Double Stars," for am indebted to the kindness of that noble observatory, will the closing up of this interesting

Angle.	Distance.
.... 97.3	 0.35
.... 101.0	 0.38
.... 104.6	 0.37
.... 103.6	 0.37
.... 103.2	 0.43
.... 99.1	 0.33
.... 95.8	 0.35
.... 103.4	 0.28

101.00° 0.358"

throughout being 888.

For anyone acquainted with this astonished at the perfection alike manipulation which such results

recently, Nov. 15 and 22, when verily steady. I have attacked with my 9in. "With" mirror, it some years ago. I do not old have detected so much as an not been matter of special search; gazing I thought it perceptible deed, last night I imagined that red two minute points), and my affirmed by the circumstance that had no distinct recollection of the beyond the general fact that the vials much from the line directed r. Compared with this, I found 3° and 78°; estimations perhaps a truth, considering the extreme object and the difference of the yed, to warrant a belief that the n was not imaginary. as to magnitudes still remains ry state. OE had rated them aph Hall gives 6 and 7; as far on goes, materially influenced ximity of the principal star, I self that they attain such a

T. W. Webb.

JUPITER.

Evening (November 25) I observed Jupiter's third satellite. It did not change from a one, as I have seen it on at I did not lose sight of it at all. southern limb all the time it that it appeared to be at almost whole time. At the moment of the disc, its shadow entered the spot where it had entered. ed much larger than the satellite's blackness than the shadows usually are. The satellite at the edge of the planet for a certainly 25 minutes, this with a 1in. refractor. At egress it did not for so long a time. Have marked that the red spot is much I first noticed the change on not seen it for some days. I foot of the atmosphere, but it or since with various kinds of I feel sure it must be a change as fiery and red, but lighter ting; not so solid, but more

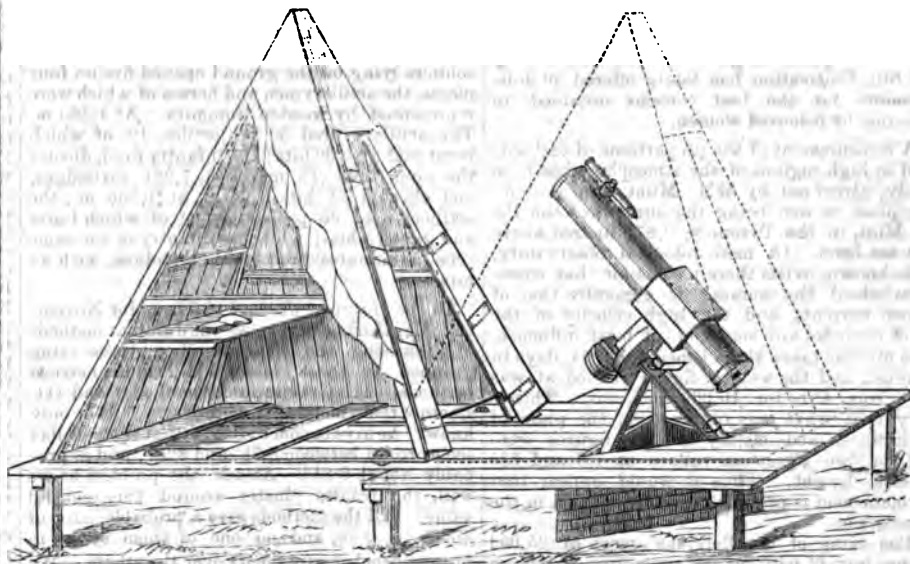
gauzy. When it is near the limb, until it is fairly within the disc, it is hardly distinguishable, while formerly it was a conspicuous dark mass at that time. I believe it is more red this year than it was last year. The belts are perhaps more continuously red than they were, but I see no decided blue shade as last year. The duskiness at both poles is very much more decided than it was. Last night (Nov. 25th, 10h. to 12h.) there appeared to be a sort of penumbra around the southern side and the ends of the red spot—a very slight shading, with no red in it.

No one can observe Jupiter from night to night without being struck by the changes going on in the belts. I have not taken any transits of the red spot this year, because I was under the impression that eye-estimations were not considered sufficiently exact; but now I see Mr. Marth is going on collecting them, I am sorry I have not done so. The difficulty seems to be in getting the true time. I have been drawing Jupiter on every occasion that it was possible, and have a series of twenty sketches since Oct. 9th. I have thought that if I could do five drawings at intervals of two hours I should get a picture of the planet all round. This would allow a little to overlap. Perhaps I might get half one night, and the alternate half another night. If anyone can give me a hint as to arranging the times, I shall be glad.

M. A.

TELESCOPE.

[19460.]—I enclose a drawing of my telescope-house, which may be of use to some of your readers.



It is very convenient for star-gazing, and when rolled back, as in the sketch, forms a comfortable shelter for books, &c. The telescope, a 6in., is a beautiful specimen of Mr. Calver's handiwork, though he would not be proud of the equatorial stand, which is home-made.

The stage is 8ft. by 8ft. at the wide part, and 8ft. by 4ft. at the narrow part, and made of 1in. plank.

The pyramid is made of 3in. by 2in. framing, covered with match-boarding 1in. thick, and over all a coat of painted canvas. Dimensions: base, 8ft. by 4ft.; height, 8ft. There is a table at the back for books, lantern, &c.

I have torn away the canvas and boarding in the sketch to show the interior. The front is open, with two hooks to keep the proper shape, and the whole runs very lightly on four sack-cart wheels 7in. in diameter. The dotted lines show the pyramid when over the telescope.

J. S. L. L.

SATELLITES OF MARS.

[19461.]—THE times of greatest elongation of the satellites of Mars have been kindly sent me by Mr. Marth, and I feel sure he will not mind my asking you to publish them for the use of any of your readers who may wish to try their eye and telescope.

The satellites will only be about one-third as bright as when first seen; but bearing in mind what was then done, it is not quite hopeless to expect to see at least Deimos with any aperture above, say, 10in.

The apparent orbits of the satellites are nearly straight lines, and at elongation the pos. angle of Deimos, when n.f., is from 72° to 69°, and of Phobos from 71° to 69°. The s.p. elongation being, of course + 180°. Deimos will be some two to three

diameters distant at the times given, but Phobos must be looked for very near the planet.

PHOBOS.		PHOBOS.	
Dec.	h.	Dec.	h.
1	11.6 n.f.	14	9.5 s.p.
2	10.6 n.f.		13.4 n.f.
3	9.5 n.f.	15	8.5 s.p.
4	8.5 n.f.		12.3 n.f.
5	12.3 s.p.	16	11.3 n.f.
6	11.3 s.p.		
7	10.2 s.p.		
8	9.2 s.p.		
9	13.0 n.f.		
10	12.0 n.f.		
11	10.9 n.f.		
12	9.9 n.f.		
13	13.7 s.p.		
	8.8 n.f.		
	12.7 s.p.		
	7.8 n.f.		
	11.6 s.p.		
	10.6 s.p.		
	14.4 n.f.		

DEIMOS.	
Dec.	h.
1	11.6 s.p.
2	9.1 n.f.
3	15.3 n.f.
4	12.8 s.p.
5	10.2 n.f.
6	16.4 n.f.
7	7.6 s.p.
8	13.8 s.p.
9	5.0 n.f.
10	11.2 n.f.
11	8.6 s.p.
12	14.9 n.f.

A. A. Common.

Ealing, Nov. 26.

ASTRONOMICAL.

[19462.]—In reply to letter 19410, p. 254, I have examined the following stars out of Mr. Read's list during the last week with my 8in. Calver.

η Cassiopeia.—Wide with 120. The colours I should call yellowish white and livid purple. I

should have estimated the P.A. now not less than 165. Has this been measured since 1878 by Gladhill?

γ Arietis.—Colours to me exactly similar.

ζ Pegasi.—A, white, with slight grey or lilac tinge; B, greyish lilac.

ψ Cassiopeia.—Well seen with 190. B and C very minute, their dark blue colour perhaps making them appear of less mag. than they really are; but comparing them with the 9.5 mag. star between ϵ^1 and ϵ^2 Lyrae, I should have estimated B and C at certainly not over 10 and 10.5 mags. A, yellowish.

Σ 163 Cassiopeia.—Well seen with 120. Two very peculiar stars. A, coppery yellow; B, dark blue. A, very like a small edition of Mars.

Can anyone say if the star 2 Camelopardi has been lately measured? I have tried it several times lately, and it seems to me that it must be very much closer than 1.7"—De's measurement. It is only occasionally that I can see it double with 190; while at the same time I can distinctly divide α Aquila—which is put at about the same distance—with 120. This latter star I found very clear half an hour after sunset, when the full moon had been up for three-quarters of an hour.

I should be much obliged to any of your readers who possess a 5in. or 6in. refractor, by either Dallmeyer or Wray, of modern make, if they would let me know what they can do with them on difficult stars—say, those I have named above.

Nov. 26th. B. M.

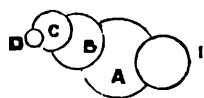
LUNAR RING RANGES AND CRATERS.

[19463.]—I fear that aiming at brevity has obscured my meaning in letter 19086, page 670, and that some small outline diagrams were needed, and Mr. Birt has confused two distinct remarks together in consequence—i.e., A, regarding the de-

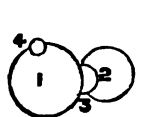
cular ranges or crater rings overlapping and deforming each other, and B, relating to the obliteration of large segments by the plains (or seas).

Regarding the first, A, I said, "there seems to be a steady relation between size and age (of craters): smaller ones cutting into and deforming larger, and few, if any, cases of the reverse." Thus, in the group 1, 2, 3, 4, 1 is obviously the largest, as well as oldest; 2 is the next; then 3; and last, 4. Also that we here see two distinct series coinciding—i.e., the series of size is also the series of age.

In group A, B, C, D again, we see this repeated, both groups re-



duced as diagrams from drawings at the telescope. The great majority, however, of cases where the circles overlap show but two or three in the series, though the result is similar; and the rule seems to be that small overlap larger circles. The energy of formation seems decreasing. So far,



I can see no cases where the larger circles obviously overlap smaller as—Nor do I see cases where the series of age is not a series in size as annexed, where the ages are as 2, 3, 1, 4.

There are many instances where small circles are inclosed in larger and imbedded in the margin or edge, but this only confirms the foregoing. Regarding B, the missing portions of rings or circular ranges adjoining seas, I asked if the phenomena were considered due to subaqueous or to subaerial drift; undoubtedly, as Mr. Birt says, the range or wall has been broken down, and removed, to all appearance, which implies that the sea, or sand-desert's, action was the later phenomenon. But, as Mr. Birt will see now, A and B are two quite distinct matters.

The study of surface modelling is especially applicable to the Moon, the radical difference between her surfacing and that of our Earth being that ours is essentially aqueous, while hers seems subaerial. Ours shows water exits, which is the feature conspicuously absent on the Moon, whereon the modelling of our river systems and mountain sides is absent.

The structure of the circular ranges or rings, also is concentric (A) rather than

radial (B), showing a piled formation acting from a centre (after fountain).



the manner of a These things taken in conjunction with the

generally received notions regarding absence of atmosphere and water, added to the low temperature and occasional presence of mistiness or haze, led me, some years ago, to look on the Lunar ring ranges, or large craters—having a floor—as of similar formation to our ice-caps, and those on Mars, though the formation is in the former centrifugal—i.e., the Lunar rings, and in our case centripetal, converging to a point on each pole. The transport of moisture subsequently condensed and precipitated to form huge areas of solid, is one we are already familiar with. The very conspicuous peculiarity of the Moon's surfacing, seen in these walled plains, ringed ranges, and craters, is evidently to me a last phase of her expiring life—at least, seems so; if true that there is little or no air or water, and that the surface temperature is far below zero.

The last traces of moisture from the warmer interior being expelled now and then through fissures due to shrinkage, expelled under pressure into a comparative vacuum, would not only travel a great distance fountainwise, but on condensation fall in a ring; solid matter carried up during a rush of vapour or gas being piled near the orifices as crater cones in the centre, or eccentric if there were a slight drift in an attenuated atmosphere. Later and slighter exudations would form lumps or hillocks with or without a visible orifice.

It is true that some of the walled plains seem below the general level outside; but this may be due to continuous discharge shielding that area from precipitate falling all around. When quietly thought over, I do not see that there is anything so very extraordinary or unlikely in this idea that the Lunar rings are composed of some condensed precipitate. It is likely to be one of the last phases in her existence, and would account for the peculiarity of her mountain systems, so extremely unlike ours, and which all her conditions seem to favour. I hope that those interested in these matters (and they seem many) will now and then think of the above, especially when at the telescope.

"F.R.A.S." has kindly noted my want of a lunar map; but I cannot understand the surface-temperature on the moon reaching 500° Fah.; such a heat certainly would melt ice of great thickness. I can the less understand it on a globe nearly destitute of atmosphere. I had just started on a largish oil-painting of the three peaks north of Texpur, in Asam, at heights of 21,000ft., 22,000ft., and 23,000ft., and was going to call the group the "Eternal Snows." How is it that the almost unbearable heat of a tropical sun, that I have registered at 172°, and has been known to reach 190°, does not melt this snow all off, or indeed raise the temperature to or over 32°? Temperature of the exposed rock may rise, but snow, *on snow*, should melt in one case if it could in the other, and it does not on our earth above the snow-line.

Sibsagar, Asam.

S. E. Peal.

THE COLLISIONS AND CONSTITUTION OF COMETS.

[19464.]—THE least distance of a comet's orbit from the earth's is the latitude of that point of the comet's orbit at which the radius vector equals the same in the earth's orbit into the radius vector.

If we suppose that upon the average the centres of earth and comet-nucleus must approach one another within 40,000 miles in order that a collision might arise, and that all inclinations are equally possible, and that upon the average n comets per annum come to perihelion, with average dimensions corresponding to the above limits (their perihelion distance being not less than earth's distance from the sun), then the probability that the earth should meet with a collision in any year is $2np^2\sqrt{2}(\pi+2)$, where p is 40,000 divided by the circumference of the earth in miles. In the above the inclinations of the comet's orbit are supposed to be 45° upon the average, the motion indifferently retrograde or direct. We may, perhaps, fairly put $n=2$, whence the earth, upon the above suppositions, may expect a collision upon the average once every seven million years with some comet—not any particular one.

We may, I think, conclude that such collisions have frequently taken place since the existence of organised beings upon the earth's surface, and will do so in the future.

The nature of the phenomena that would be presented upon such an occasion would evidently depend upon what a comet really is.

It was formerly supposed that a comet was entirely composed of gas; but since the discovery of the connection between comets and meteors that idea may, I conceive, be set aside, and the nucleus and coma, at all events, considered as merely an extremely dense portion of a meteor flight. The spectroscopic, however, appears to show that some incandescent vapour is in general present. This has been explained by Prof. Tait as due to collisions between the fragments.

It is natural to suppose that the tail has a similar constitution to that of the coma and nucleus (waiving, for a moment, all consideration of the position in space of the tail). The nucleus, coma, and tail will be ranged in order of density: that is, the tail being the least dense, and therefore having few and feeble collisions.

The spectroscopic phenomena would be as follows:—In the nucleus a continuous and gaseous spectrum, due to collisions; for some collisions might suffice to produce the spectrum of an incandescent solid, but not of an incandescent gas. There would also be the reflected solar spectrum. The coma would present phenomena somewhat similar, but the conspicuous, or tails of large dimensions, except at the portions near the head, would only give the solar spectrum, presenting more or less traces of polarisation. Observation in these respects coincides with this as well as could be expected. Considering a comet as a dense mass of meteors, those aerolites which have fallen to the earth must be considered as specimens of the matter of which comets are composed. It would, then, be interesting to ascertain the spectrum of the incandescent vapour of such meteors, with the view of discovering those bands which are most conspicuous, or which first become visible; and whether these are the same as the bands visible in general to us in the comet-spectra.

I think I have seen somewhere an account of a similar investigation; but, if so, I have forgotten the result. A collision with a fair-sized comet would be a passage through a very dense meteor stream. Imagine the Leonids at their best, enormously increased in number, brightness, and size, so that possibly the greater number of them would apparently be as large or larger than the Sun, bursting frequently with loud explosions, and scattering their fragments upon the earth's surface. Such would probably be the phenomena of a collision; no doubt a terribly magnificent sight, and by no means without danger to organised beings.

As to the *revivata* question of the tail, if it really extends in the line passing through the Sun and comet, as is usually supposed, it is absurd to speak of it

as a mass of meteors. But this direction is, I believe, an illusion of perspective. In a word, the tail is a meteor stream less dense in general than the nucleus or coma following or preceding the comet in the direction of its orbit. I am not sure whether this is the opinion of Prof. Tait and Sir William Thomson, although some of their utterances might seem to imply this. As to their sea-bird theory in explanation of comets' tails, I do not at present see its useful application to that object.

If, to fix our ideas, we suppose the comet moving in or very near the plane of the Ecliptic, the comet's orbit, if it were made visible in the immediate neighbourhood of the comet by a sufficiently dense meteor stream, would undoubtedly be projected on the heavens in a great circle passing through the sun and comet, and it would pass from or towards the sun, according to the position of the comet in relation to the earth, and the position of the meteor stream, whether preceding or following the comet. Again, if we suppose the comet's orbit to have any inclination whatever to the plane of earth's orbit, yet, while the earth was not very distant from the node, the meteor stream would still be visible, approximately in a great circle passing through the comet and sun. In positions very materially deviating from the above, the projection of the meteor stream would also deviate, especially towards its extremity, but not much at its commencement, from the great circle in question. But many or most of the large comets, at the time of their greatest tail-development, have been near the earth, and not far from their node, and the observed direction of the tail is by no means so constant as is sometimes asserted. I have made some rough calculations as to the varying position of the geocentric orbit of the great comet of 1861 in the immediate neighbourhood of the comet, and after perihelion passage, and compared this with a table of observed positions of the tail, and found a very close correspondence. When a comet is near the earth and node, and moving with great rapidity,—that is, has a small perihelion distance,—a great tail may be developed in a very short time.

At one time a spectator at the earth may be looking at the meteor stream in the approximate direction of its length,—that is, of a tangent to the orbit,—when it would be scarcely visible, and a few hours afterwards the line of sight might be perpendicular to the stream, and the tail have a length of almost 180°. Conspicuous tails consist, for the most part, of two bright streaks inclosing a comparatively dark space. Now, if the tail be considered as a cylinder or paraboloid visible by reflected light, the central parts would in general, I presume, be brightest if its surface were continuous; but if it were a paraboloid of discrete fragments at some distance from one another, the edges would, or might, be brightest, as is the case.

If there were a visible meteor stream following or preceding the comet, then whatever tail may be supposed existing due to repulsion, electricity, or any other as complicated hypothesis, there would certainly be another due to the meteor stream. But although I have myself very little doubt that the tail, coma, and nucleus together constitute a dense meteor stream and nothing else, there is one difficulty which I cannot at present see how to explain. The general direction of the tail in a line through the earth and sun is explicable as a meteor stream, but it would seem that it ought to pass from or towards the sun indifferently, and not almost always from that body. This may appear to some decisive against the hypothesis.

I need hardly say that the circumstance that stars can be seen through a comet is no argument against their consisting of a mass of discrete fragments or stones.

The two sets of elements given in the "Scientific News" of Denning's comet give, taking their mean, an aphelion distance of about 7.1. This aphelion distance is sufficiently remote from the mean distance of any of the four larger planets as to make the comet unique amongst all the known periodic comets, which would seem to render it probable that the period is incorrectly determined. But as no theory that we can form of the origin of comets shows why aphelion distances at first should have any particular values, we seem driven to the conclusion that there is some cause which eliminates orbits in which the aphelion distances are not within certain limits. Is it possible, then, that such a cause has not yet had time to produce its usual effect upon Denning's comet? Its perihelion distance is almost exactly equal to the mean distance of Venus, and the inclination is not above 2° 30' upon the orbit of Venus. In fact, the orbits come very close to one another, but not so close that we can attribute the entry of the comet into the system to the recent action of Venus.

The comet would be, theoretically, comet to Venus, and is proceeding to its greatest brilliancy. In estimating the position of the earth and some comet system, I have not thought it worth while to consider the action of the earth in modifying the position of the comet.

near approach to the earth, which would modify the probability.

The signs of fusion which most meteors present can be readily explained, if not by their passage through the earth's atmosphere, yet by the collisions they have experienced while forming a portion of a comet or dense meteor-stream.

Carbo-hydrogens of some kind usually form a portion of a meteor. This, in my opinion, ought to be considered as a proof that carbo-hydrogens can exist without having an organic origin.

These compounds are probably the source of the bands visible in comets by means of the spectroscop.

The collisions among the fragments would necessarily cause a diminution of the total *vis viva* of the comet, which would produce the same effect as a resisting medium. From the nature of comet-orbits a meteor stream would necessarily tend to become concentrated, as its constituent portions approached perihelion, which would probably give a paraboloidal form to the portion of tail nearest to the head. At the same time the attraction of the sun would produce in the nucleus and head a sort of tidal action in opposition to the gravity of the nucleus, and the concentration due to approach to perihelion, which conflict would tend to increase the collisions in number and vigour, and therefore the brightness of the bands as perihelion was approached. Further, the diminution of *vis viva* due to collisions would be mainly about perihelion, as in the case of Encke's comet, according to Von Asten.

W. C. E.

THE APERTURE OF MICROSCOPE OBJECT-GLASSES.

[19465.]—In reply to E. T. Scott (letter 19441, p. 282), the diagrams of the back lenses of object-glasses at p. 173 of Vol. XXXIII. illustrate the case of $\frac{1}{2}$ in. objectives of different apertures, as there stated. With a higher power the back lenses would be smaller, and with lower powers larger for the same apertures.

There is a definite relation between the angle of aperture and the size of the back lens of an objective, which can be determined by the values obtained in the particular cases from the formula, $n \sin u = r/f$, n being the refractive index of the medium in front of the objective, u the half of the angle of aperture, r the semi-diameter of the back lens, and f the focal length. If the objective is given a back lens of larger diameter, the excess will not be utilised; or, if one of smaller, the aperture of the objective will be needlessly contracted, and a portion of the incident-pencil will be prevented from emerging—i.e., its angle will be "cut" down.

Two cases will illustrate the application of the formula—a $\frac{1}{2}$ in. dry objective of 180°, and a $\frac{1}{2}$ in. oil immersion of 120° angle.

In the former case, n and $\sin u$ are both = 1, and the formula becomes $1 = r/f$, or $r = f$ —i.e., the semi-diameter of the back lens is equal to the focal length, and the whole diameter must therefore be half an inch.

In the other case, $n = 1.52$, and $\sin u = .87$, therefore $r/f = 1.32$, and $r = .33$ in., so that to utilise the full aperture, a back lens of two-thirds of an inch is necessary. The 120° oil-immersion has, consequently, an aperture which is a third larger than that of the 180° dry objective.

The Writer of the Articles.

HUYGHENIAN EYEPIECES v. DOUBLE OBJECT-GLASSES—TO "ORDERIC VITAL."

[19466.]—In the first place, it is upwards of 14 years since I was practically connected with camera work; but processes of working are at my finger-ends still, and memory and notes I will bring into use. I do not wish to dishearten any of our amateurs in the optical way, but I think the number of tools required to produce a good $\frac{1}{2}$ plate lens would be a profitless investment. If, however, a whole-plate lens was attempted, there might perhaps be a little profit attached after all cost. I give curves for $\frac{1}{2}$ plate, which will serve as data. The glass used, Chance's light flint and soft crown; front lens, contact cemented with Canada balsam. 1st surface, 4" radius convex; 2nd surface, 2" radius convex, crown; 3rd surface, 2" radius concave; 4th surface, flat, flint; 5th surface, 6.5" radius convex; 6th surface, 4" radius concave, flint; 7th surface, 3.5" radius convex; 8th surface, 6" convex, crown. These surfaces are spherical, with the exception of the 6th surface, which must be elliptic, and is difficult to work; but upon the proper figure of this depends the flatness of lens to a very great extent. The distance between lenses is of considerable importance, and I should advise the amateur to leave the sliding-tube for a $\frac{1}{2}$ plate 2" between inside of lenses, and test and shorten tube until the image on the ground glass is well defined, sufficiently covering the plate.

"O. V." will see the necessity of the ring between the lenses in the back lens, the inside convex

curve being deeper than the concave. It, too, is active in correcting, and is of various widths by different makers. I cannot venture into the mathematics of the Huyghenian eyepiece, but I think it would be impossible to construct a combination on that principle that would serve as an o.g.—natural laws are opposed. And as the Huyghenian eyepiece is giving way to various modern forms, notably the achromatic combination eyepieces by Browning, Cooke, and Wray, and the solid stick combinations of Cooke and Steinheil, each of which is superior to the Huyghenian, and both are superseding it on account of its chromatic and spherical errors. Its unfitness for micrometer purposes, too, leaves it far behind for telescopic work, although for the microscope the only rival the Huyghenian has is the Kellner. As to the best form of lenses for the Huyghenian, "the survival of the fittest" being taken for granted, the plano form of lens, in the proportion of 3 to 1, separated by half their combined focal length, both convex sides towards the o.g. "Orderic Vital's" suggestion (19413) concerning object-glass working has opened up a fresh field of interest; and I must confess that I wish half-hours were hours, so that my little might come in useful. I will promise that if this is gone into, and our courteous Editor can give us leave, I will help a little.

Prismatique.

THE BERLINER VIOLIN.

[19467.]—I AM much obliged to "Essar" for notice of the above. The idea is to take away all end pressure, by stringing the fingerboard by itself, instead of the whole violin as is usual. But this has been done long ago, the object being to reduce the pressure on the middle of soundboard. I have done it by carrying the neck round the back and up the end, and so have connected the tail-piece with strings, leaving the body of the violin free. But I found a downward pressure necessary for the production of tone, the only place that requires to be free are the lips of f -holes, which form the mouth of the instrument. Take this pressure off, and it is like speaking while drawing the air externally, or with the teeth shut; but, put the pressure on the centre—i.e., roof of mouth, and a distinct tone is produced. Now, this pressure can be hardly maintained, even with an iron neck (which would be very heavy to carry, and would absorb most of the force not being in direct contact with the soundboard, but only hinged on as it were), because the lift of the bridge would raise the neck or depress the body, so much as to take off the necessary pressure, and so, would not join the strings to belly as compact as should be. I think it was a naval officer who discovered this some 50 years ago. With respect to my own violin, I have improved the first and fourth strings, 'till I believe it will play with any other, and blow its own trumpet anywhere. I shall advertise it presently.

Fiddler.

FOG SIGNALLING AT SEA.

[19468.]—On opening my "E. M.," No. 863, by to-day's mail, I was pleased to see that the all-vital question to sailors, fog-warning signals, is again being discussed in the pages of "ours." And I beg to refer J. A. Westwood Oliver, and all who have the welfare of sailors, ay, and landmen who may have to sail across the treacherous sea, at heart, to my letter No. 15235, at page 396, Vol. XXVIII., on this very subject. And I again urge that the simple plan (as set forth in my little pamphlet referred to) of signalling the vessel's course by means of three of the Morse letter symbols, which correspond to the three signal letters, as found in the compass table of the International Code of Signals, be adopted at once. No simpler, inexpensive, or more ready-at-hand plan could be devised to meet the loudly-demanded want to safe navigation in fogs, there being only seven or eight blasts of the fog-horn, or steam-whistle, now in use required to make any one of the 64 half-points of the compass on which the vessel's course may lie. And I am sure, in my own mind as a sailor, and from the expressed opinion of the many shipmasters to whom I have shown the pamphlet, that it will, if introduced, be accepted as a great boon.

There are nineteen flags used in the International Code of Signals, and it so happens there are just nineteen symbols in the Morse alphabetical code, consisting of both longs and shorts—dashes and dots; that is, which are made up of them: and as there can be no possibility of even a novice mistaking one symbol for another if these only are used, I have appropriated them, which involves four transpositions; but what matters it to the sailor whether the H of this new code is called the A in the Morse alphabet, so long as he can make his wants known by sounding them on his horn or steam-whistle in fogs, or flashing them from a well-screened lantern by night, another useful adjunct to safe navigation is afforded him.

But, as I have a book in the press, "The Hooghly River Sandheads Sailing Directory," in which the above-mentioned pamphlet is reprinted

with some fresh matter, I hope before long to send you a copy for review if you will do me the favour, and in which I have planned two other modes of signalling, one of which is night signalling by means of the green, the red, and the bright light, which all vessels by law are compelled to carry. If there is any possibility of making intelligible signals by those three lights, why should we not do so, seeing that at the present time we sailors are debarred from making our wants known, except by the solitary "rocket distress signal," from sunset to sunrise.

Like my other plan of night signalling by a light and screen, this, too, embraces every signal message of the international code of signals.

Calcutta, Oct. 28.

S. R. Elson.

SPIRAL APPARATUS.

[19469.]—In answer to the letter of Dr. Skues (p. 284), I beg to inform the Dr. that the spiral apparatus, fitted as he requires it, will be published shortly; in the mean time, I shall be glad to give, personally, every information that may be required.

J. H. Evans.

159, Wardour-street, London, W.

A TRADE SECRET FOR JEWELLERS.

[19470.]—MANY jewellers in the country find it a difficulty to solder common dress rings without discolouring the stones (?) or removing them; but if they would get a raw potato, cut a piece out, and put the ring into the hole, and then replace the piece cut out, so as just to hide the stones (prepare the joint, as explained to "Amateur Silver Smith," 45286), the steam from the potato keeps the stone from changing colour.

A Fellow Workman.

BRAHAM'S EXPERIMENTS WITH METALS IN GLASS TUBES CONTAINING BISULPHIDE OF CARBON.

[19471.]—In your number for Nov. 25, I observe a notice of experiments conducted by sealing up certain metals in glass tubes containing bisulphide of carbon, described by Mr. Braham at a meeting of the Bath Microscopical Society, and from your account it would seem that the crystals obtained after one or two years' rest were supposed to be diamonds. Many years ago, I made experiments of a like kind, and obtained minute, transparent, and very hard crystals, which I thought might be diamonds until they proved fusible into transparent and colourless beads when heated before the blow-pipe on platinum foil. I endeavoured to obtain a sufficient supply of these crystals to admit of at least a qualitative analysis, but time and opportunity failed me. These old experiments had nearly passed out of my recollection until reading the notice referred to reminded me of them, and I thought that possibly it might not be unacceptable to give you a brief account of the results attained. My first experiments consisted in sealing up copper wire with commercial bisulphide of carbon in glass tubes, and keeping the tubes in the dark for one or more years. After such intervals, very minute crystals, not easily visible, except in good light and by aid of a common lens, were found adhering to the wire. Passing over intermediate trials, I may mention that, lastly, I prepared some bisulphide of carbon by digestion with and slow distillation off mercury, quite free from disagreeable odour, placed this in clean glass tubes with a coil of bright copper wire, which had been well rubbed and examined under a glass, to insure freedom from any particles of dirt, and through the coil introduced a platinum-wire, inclosed in an open glass tube; the ends of both the copper and platinum wires were brought into close contact outside the tube, and the arrangement was kept as much as possible in sunlight. After a few weeks, the copper wire darkened in places, and after many months became nearly black, minute colourless crystals being distinctly visible here and there. The internal surface of the glass was also attacked, and a dark deposit formed upon it. After opening, the dark matter on the copper was scraped off, and repeatedly digested in nitric acid until nothing remained but a great number of the crystals, mostly too minute for individual manipulation; but some were large enough to be picked out and experimented on singly. At about the temperature at which a fragment of diamond would burn on platinum foil before the blow-pipe, these crystals melted to transparent glass. I can only suppose that the crystals obtained as described consisted of a silicate, derived from the glass tube employed, which was sensibly attacked. It is certain that the bisulphide in the tubes in some way conveyed a copper compound from the copper to the glass surface, which was coated with a deposit, and therefore, it need not be considered more surprising that some solvent action should have taken place on the glass. Other metals besides copper were experimented upon in tubes with bisulphide, and copper was used in the state of a very finely-divided precipitate.

E. Sonstadt.

For a machine of the sort to have a high and forward seat is new to me, and, I fear, would put undue weight on the steering-wheel.

No. 170.

COAL-GAS, AND HOW TO USE IT.—I.

[19181].—JUDGING from the numerous letters that have from time to time appeared in these columns relative to the economical consumption of gas, there appears to be a want of a little practical information on the subject, which it will be the object of the present papers to supply, without attempting to give full and exhaustive details on every point mentioned, but to give in a small compass such advice as will be most practically useful to the large or small consumer.

Mr. Sprague has commenced a series of articles on Gas-works, so that only a brief description need here be given of the manufacture of gas. Most people are aware that the coal is put into retorts or ovens, made of cast iron (now almost an obsolete material) or of fireclay; sometimes in one piece throughout, sometimes in sections, and sometimes built up out of bricks shaped for the purpose. From the top of the mouthpiece, which is closed with an iron lid carefully faced or else luted with mortar, the gas leaves the retort by an upright pipe, and enters a main which is fitted with contrivances varying in different works for preventing the backward flow of the gas when the lids are opened, and in which the tar is condensed. Not all the tar, however, for this substance often gives considerable trouble by condensing in the other parts of the works; and many methods have been devised for its separation. The gas next passes through pipes exposed to air or water, in order to cool the gas, thereby depositing more tar and ammonia and water. An exhaustor is used in all but the very smallest works for drawing the gas away from the retorts and forcing it through the other apparatus. If this exhaustor works too fast the pressure in the retorts, &c., is reduced below atmospheric pressure, and air enters by any chance leak that may happen to exist in retorts or pipes. One per cent. of air reduces the illuminating power by about 6 per cent., and thus no one will "draw air" willingly or wilfully. If the gas accumulates in the retorts, it is decomposed by the heat and the carbon, which forms its most essential constituent, is deposited in the retorts, the higher and more valuable hydrocarbons thus being reduced to lower and less valuable ones. A governor of great sensitiveness is therefore used to control the exhaustor, and maintain a uniform pressure about equal to atmospheric pressure in the retorts.

A description of an exhaustor was asked for not long since; but it can only be stated here that the principal kinds of exhaustor are the pumping-engine exhaustor, the rotary exhaustor, and the steam-jet exhaustor, sections of which are often given in the advertisement sheets of such publications as the *Journal of Gas Lighting*. The remaining processes are differently arranged in different works, but may be generally stated to comprise washing to get rid of tar and ammonia, and purification. The exhaustor may be placed at almost any stage in the process; but perhaps the best place for it is after the washing and before the purifying apparatus. The working of the latter has been lately ably described by Mr. Lewis Wright, though I am afraid his method is as yet far from being universally adopted. Next to the purifiers come the station-meters, which register all the gas as it is made before going into the gas-holders, which form such a notable feature in the scenery near a gasworks. These immense structures, by their weight being distributed over so great an area, give so slight a pressure on the gas contained in them, that to force air in by blowing with the mouth would be the merest child's play. This pressure is, however, much in excess of that required to force the gas through the mains. And here I had perhaps better say a few words as to what is meant by "pressure," which, although so small, is one of the most important points to be attended to in a gasworks. By observing the pressure we decide whether all is right, and, if not, by trying pressures at various places, what, and where the fault is. "Can't get pressure" is one of the commonest complaints sent in from the town, and always to have the right pressure is one of the principal aims of a gas-manager's existence. If we take a U-shaped tube and partly fill it with water, the water stands at the same height in both limbs. But if we connect one limb by an indiarubber tube with a gas burner, and turn on the gas, the water in that limb will sink and rise in the other limb. Suppose the water sink $\frac{1}{2}$ in. in limb A and rises $\frac{1}{2}$ in. in limb B, then the difference in level is $\frac{1}{2}$ in., and the gas is said to give a pressure in excess of the atmospheric pressure of $\frac{1}{2}$ in. of water, or, briefly the gas is at $\frac{1}{2}$ in. "pressure."

It is to be noted that the atmospheric pressure, plus the pressure of a column of water $\frac{1}{2}$ in. high in limb A, is the pressure of the gas in limb B. Atmospheric pressure is 15 lb. to the square

inch, and this will sustain a column of water 30 ft. high (about); it follows then that a column $\frac{1}{2}$ in. high represents a pressure of 1-24 lb. to the square inch, or $\frac{1}{2}$ of an ounce avoirdupois, tending to force the gas out at the end of the pipe. It will thus be seen that the pressures that we have to do with in considering the gas-supply of towns are very different from those which exist in steam-boilers, or in water-mains.

The simplest form of pressure gauge is made on the principle just described, and in a similar manner; these are sufficiently exact for many purposes, but for more accurate measurements gauges are made in which a float moves a pointer, which traverses a scale divided to represent inches and tenths and hundredths. These can only be used for a small range of pressure, such as that at which gas is supplied to the town, which will be considered in the next article.

Ploni Almoni.

RAILWAY ACCIDENTS, 1881.

[19482].—THE Board of Trade have issued the summary of accidents reported during the nine months of the present year to the 30th September.

The return has been spoken of as a "melancholy document," and it becomes still more disheartening when we remember that a very large proportion of those killed and injured have simply been sacrificed because railway companies neglect to use proper appliances for safety, as I shall be able to prove by the following remarks upon the causes:—

No less than 764 persons were killed, and 3,197 injured in the United Kingdom in the course of public traffic during the nine months, and including those returned under the Act of 1871, the total number of personal accidents amounts to the terrible total of 796 persons killed, and 6,094 injured.

A very few figures will show your readers that the so-called accidents are *preventible*. For instance, 117 collisions between trains or parts of trains are reported.

Very nearly, if not quite all, these collisions would have been avoided by the absolute block system, and the use of efficient continuous brakes. Seventy-three trains, or parts thereof, left the rails, in almost all of which defective permanent way was the cause.

Fifteen trains were turned in the wrong direction through "points," and accidents were caused.

In some of these cases the points ought not to have been allowed to exist, and in others they required to be properly interlocked, and provided with locking-bars and bolts.

Fifteen passengers were killed and 50 injured by falling between carriages and platforms when getting into or out of trains, all of which cases would have been prevented by the use of continuous footboards and platforms of a proper height.

In 44 instances trains ran through gates across the line at level-crossings, and a very large number of persons lost their lives crossing railways at stations or public roads. At very many of these crossings there is considerable traffic, and bridges over or under the railways are very much required for the safety of the public.

I will not occupy your space with further details of the accidents, as I think the instances to which I have called attention prove most clearly that they are undoubtedly "preventible."

All "preventible" accidents are a disgrace to railway companies. Notwithstanding all the reports of the Board of Trade, the opinions expressed in Parliament and the press, and the recurrence of accidents, some lines are doing little, and others absolutely nothing, to render the traffic safe. Under these circumstances we cannot wonder that the public so warmly agree with the opinion of Lord Milntown, "that the time has arrived for the adoption of stronger and sterner remedies."

The subject of railway accidents will come before Parliament next session, and it is to be hoped some steps will be taken to reduce the fearful loss of life which is now annually reported by the railways of this country.

Clement E. Stretton.

Saxe-Coburg-street, Leicester, Nov. 26.

THE ACCIDENTS AT LEEDS—AUTOMATIC AND NON-AUTOMATIC CONTINUOUS BRAKES.

[19483].—It will be remembered that upon the 26th and 29th of September, North-Western passenger trains ran off the line at Leeds, in consequence of a "curve being in its present state clearly unfit for any passenger train to run over."

The trains were fitted with Clark and Webb's chain brake, which, being non-automatic, was useless to mitigate the effects of the accident.

Major Mariudin, at the conclusion of his second report, states:—"Had the train been fitted with an automatic continuous brake, this brake would have been called into action when the coupling between the tender and front carriage was parted,

and the damage to rolling-stock, and the risk to the passengers would, in all probability, have been much reduced—the value of a brake, which would, by coming into action immediately a coupling is broken, prevent the rear part of the train from telescoping into the front part, while gradually stopping the progress of the whole train, must be conceded." The circumstances of these two accidents, and this very clear statement by the Government inspector, will show at a glance the very great advantages possessed by automatic brakes.

I have before pointed out that an efficient brake must not only be a "quick train stopper" under ordinary circumstances, but is required to apply itself in cases of trains leaving the line, breaking loose, or when other casualties occur.

The London and North-Western Company have for several years been considering the question of adopting another brake in place of the Clark-Webb.

It is to be hoped that the recent accidents and reports will cause the directors to see the great necessity which exists for their trains to be fitted with an efficient continuous brake, automatic in action, and fulfilling the Board of Trade conditions. Nov. 26th. Clement E. Stretton.

BLACKING BRASS—ORGAN WITH STEAM-WHISTLE, &c.

[19484].—It appears, from query 44903, that I did not make myself quite clear in giving the process for blackening brass. If your correspondent will put a few fragments of copper wire in a phial, add sufficient nitric acid to dissolve them, and then dilute with water, he will have his solution all complete, and can then proceed as I previously described.

I see you have been having some little inquiry and discussion as to the practicability of making an organ with steam-whistles instead of pipes. This would be no particular novelty. One of the features of the street parade of Barnum's Circus consists of a steam "Calliope," on which a talented artist performs various popular tunes, not requiring too great a range of notes. I have never examined the details of the construction of the machine; but from a cursory view it includes a small boiler, about 2 or 3 octaves of whistles, and a keyboard, and the tone is exceedingly melancholy and monotonous. I merely instance this to show the feasibility of what has been inquired about; but the machine must have cost a good deal, and in a musical point of view is not a particular success.

In a recent number Mr. Wenham describes a steam-whistle formerly used on the Viceroy's yacht. There is a somewhat similar contrivance sold in this country under the style of the "mocking-bird" whistle, and as a tug on the river here possesses one, I have very frequently the pleasure of hearing it. In this whistle the disc which alters the tone, instead of being a fixture, as in that described by Mr. Wenham, is made to slide, so that the operator by one movement opens the steam-valve, and lengthens or shortens the length of the bell. The tone is indescribable, and is never recognised as belonging to a steam-whistle. It is the most diabolical row that was ever produced. I thought a siren was bad enough, but this beats it altogether. I understand that the City of Chicago has prohibited its use within the city limits; but I should think the whistle might be made considerable use of for signalling, as the tone ranges through something like an octave.

H. E. Smith.

East Saginaw, Mich., U.S.A., Nov. 9.

SCREENS FOR MAGIC-LANTERN DISPLAY.

[19485].—A bad lamp or a bad lantern with a good screen is more satisfactory to use than a perfect lantern with a bad screen. Much has been told us of the qualities of the lenses, reflectors, and lamps best suited for fine definition, and too little has been written about the screen, without whose corresponding excellence the best qualities of the apparatus must remain in obscurity and eclipse.

If we have plenty of light to spare, as may happen when we employ the lime-light on a small disc, then it does not greatly matter whether we use a screen of clean, fine linen, or of calico covered with paper, but, with even the best mineral lamp-light, whether with duplex, triplex, or circular burners, it is of great importance to receive the picture on a substance which will reflect it back with vigour and purity; for, with an 8 ft. or 10 ft. disc there is no light to spare, and for effective display a slide cabinet to have this magnification.

A mixture of Spanish white with skim-milk forms a distemper which may be used with good effect on a wide calico sheet, and to correct the yellow of the oil some blue may be mixed with the colour. Glue or size may be used instead of the milk. A good recipe is this:—"Break one or more balls of best whiting, pour on clean water until quite covered; let it remain a few hours, then drain off the water; wash into a cream the soaked whiting, using a piece of wood and adding

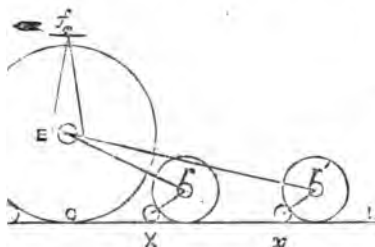
an agreement with H. A. Wassell (19388) less of testing had better be deferred until now, so as to take a suitable position in the process. Prismaticque.

TRICYCLES.

5.]—"D. H. G." has struck a chord which in sympathy with my idea of a smooth-riding tricycle. To have a good and easy running machine, one of two things must exist. 1st, large wheels; and when I say large wheels I do not mean rivers only; 2nd, Considerable length of frame. I need not insult the understanding of others of the "E.M." by penning sentences forth the why and wherefore of the above. Facts must appear axiomatic to most people. Attention now comes to be, Are riders of the tricycle to be content, and to expect high efficiency machines having one or more small wheels on base-line? Machines are not built on purpose that a given machine may stand in a small space. They are built to carry a rider with comfort, safety, along the highways of the country. I find that the length of road from any one place in Scotland to any other place is long enough to accommodate a machine considerably longer than machines now in the market. Coupling this with the fact of length affording easy riding, there has been developed in me an amount of pride equal to the building of a new machine (now far advanced) embodying the features along with others more important. I am I shall produce a machine which will run like that exists.

G. D. Macdougald.

7.]—THE letter of "D. H. G." (19422) is going through; his diagram, page 257, is what is wanted in the present position of the question of the subject. I am not about to do his elegant demonstration; but I venture to his data. In middle column above diagram he says "it follows that the weight necessary for steering purposes may be decreased in proportion to the increase of leverage." This, this can only be true as regards tilting-ward, because length of leverage of back-wheel multiplied by weight upon back wheel is equal to the weight of the front wheel, but it is not the weight of the wheel on the ground to give steering that remains the same with a long tail as with a short one. On this important diagram is next strated at middle of third column, same page 257, that "the angular disturbance of the machine and its rider by any given inequality in ground will be less in proportion as a machine is lengthened, and greater as the tail is shortened." An elegant demonstration by means of the ground line. In my experiments to produce a tricycle at odd times during these last five years I came to use other data in an attempt to do this point. In third column, page 14, "Sunlight" says of a smaller but quicker wheel that "trifling obstacles are not felt to the speed of the wheel." This has been used in letters that followed, but I looked a matter; he is a rider, while I have done



that way, and I accept his experience as fact. To give a diagram with my modifications. The large wheel were running by itself, or if the wheel were running by itself, then the mechanical mechanics put forward would be right enough, but the applied mechanics of the case to me to show that "Sunlight" is right. When I commenced to study a tricycle the machine had suddenly changed from two equal wheels to one large wheel, and a little wheel trailing it. It long puzzled me how the little wheel could rough ground. As it runs past you at the time you see at every turn of the big wheel the little wheel is tugged about an inch back and forth. This shows great resistance to the turn of the rider, nevertheless to emulate a machine is the aim of a tricycle. X, G, L is the line. Each line from the centre of a large wheel to the centre of the small wheel, and is drawn downwards towards the ground-line, and is perpendicular to the perpendicular nearer the wheel is to the large wheel, and as it is the wheel that draws the small wheel, here

comes into action that combined force which makes the great practical difference from the two wheels, each running theoretically alone as I before supposed, and that action is a lifting one, and not a horizontal force, as seems to have been supposed.

In support of this deduction, consider f as the top of the fork and backbone of a bicycle. The dotted line from f down to r shows by inspection that f , moving horizontally, will lift the small wheel over an obstacle X, although it were as high as the axle of the little trailing-wheel. This working property in the bicycle may explain the seemingly anomalous experience of "Sunlight" when riding on a smaller wheel revolving at a proportionately higher velocity.

"Sunlight" talks of running over an extra elevation with ease. If we imagine him running over corrugated plates, these elevations would be regular, and then the larger the circumference the easier. But he finds it easiest when the pedal-shaft revolves quickly, because, "when going slowly, every little stone or obstacle tends to bring it to rest." It seems that the momentum carries the machine over an obstacle, as only one wheel at a time has to mount that obstacle, and then he gets the advantage of the usual length of leverage of pedal to the short leverage of radius in the smaller wheel at the moment of mounting the obstacle.

C. E.

[19478.]—It seems strange to one who has made cyclomotion a study, and noted the comprehensive elucidation of wheel-motions by the ancient Greek mechanicians as well as the more complex and elaborate expositions of modern scientific writers, that some writers on the comparative motions and speeds of large and small wheels should contend they are the same, or that a point on the periphery of a small wheel does not travel faster than a large wheel on a machine having the same axial velocity.

We admit the mental defects of certain organs of the human frame, as deafness, colour-blindness, &c., and from a wide experience with mechanics otherwise skilful, I am convinced there is a defect of the brain-power about wheels and wheel motion, which I long ago termed "circle-draft." Some I have met with have been candid enough to admit the mental defects; others, especially if they dabble in algebra, are hopelessly perverse, and are well left alone if you would not waste time, so that I will now proceed to say something about muscular action requisite for propelling a tricycle. (The quadricycle may be dismissed as the velocipede of old, tried and found too fatiguing for serviceable use). The tricycle I made thirty years ago differs little from those proposed as new ideas, except they weigh twice as much as mine.

One is spoken of as a light tricycle by— as weighing 79lb.; a well proportioned machine should be only half that weight, or even less for a light rider on level roads. I find machines may be made lighter by 10lb. weight, for every two stone less weight of rider.

Now for muscular power to impel a machine with the greatest ease to a rider.

The up and down tread from the hip is feeble and fatiguing compared with the forward thrust of the leg, with a purchase obtained by the back against the back of the seat, with the power of the arms to help the legs, as well as to impel the machine with or without the legs at rest.

Now for the position of the third wheel: the large driving-wheel on one side, and smaller ones on the other side, is very well for ladies riding.

The wheel in front was tried years ago, both for tricycles and carriages, and proved dangerous, and not easily controlled down steep hills, besides being a source of greater weight in the machinery of a tricycle.

I may mention for a carriage, the third wheel behind was applied to a carriage for six riders, and exhibited at the Workman's Exhibition, Agricultural Hall, some years back. Its weight was only 2½ cwt. I believe it is still in constant use.

There is too much frippery, adding weight and cost to bicycles and tricycles. I am about one on the simplest principle possible. The frame, with-out wheels, to be under 20lb. weight, to be wheeled up to the rider's height and weight, the cost, with-out wheels, to be under £5.

As I contemplate patenting a portion of the invention, I preclude myself from details.

J. Charles King.

[19479.]—I SEE in last week's issue, "Paugul" advocates, especially for touring purposes, a two-speed tricycle, and as I have lately had one built for me and ridden it now a few hundred miles to my satisfaction through the worst of weather and varied country (having ridden from Coventry here), with your permission I will describe it.

The speciality of the Dual tricycle is its two speeds—the one to reduce the labour over heavy roads, against head-winds, or up hills; the other to give a good pace on the level. The alteration of speed is made whilst the machine is in motion. The

arrangement gives the least possible friction, and has been adapted to the open-front, rear-steering machine.

The wheels are 42in. On the hub of one wheel is an 8in. cog-wheel, and the crank on the same side is a 6in. The lower parts of the arms of the frame are bent back; at the end of an arm a light lever works, carrying an intermediate 6in. cog-wheel. This lever is so arranged that, whilst disengaging the intermediate wheel on one side, by pulling it back, the intermediate wheel on the other side engages, first, with the cog-wheel on the hub, and deriving motion from this, readily gears with the cog-wheel on the crank, when a small spring catch holds it in its place. This side, from the relative proportions of the cog-wheels, gives power, or, in other words, the 42in. wheel is driven as about a 31in. On the opposite side a 6in. cog-wheel is attached to the hub, and an 8in. to the crank. This speeds the 42in. wheel up to about a 52in. On going down hill the levers are thrown out, and automatically held fast midway, when the pedals form foot-rests. The steering-wheel runs in a very castor-shaped fork, which causes the machine to run straighter, thereby giving the steering-hand a liberty.

Christchurch.

William Jeans.

[19480.]—As none of your contributors have yet replied to Mr. Stacpoole Westropp's question (letter No. 19380, p. 211), I will, with your permission, endeavour to do so.

"Sunlight's" views upon the double-driving mechanism of the Salvo (letter No. 19373, p. 210) are, in my opinion, entirely erroneous and misleading. I will consider his so-called "practical test."

It is quite true that I can easily stop, say, the left-hand wheel; but what does this prove? Nothing but the fact that I can stop it. I now try to stop the right-hand wheel also, but cannot. This shows that the crank drives the right-hand wheel. I now reverse the operation: start both wheels revolving; stop the right-hand one, but find that when I try to stop the left-hand wheel also, I cannot do so any more than I could the right-hand one in the first experiment. This clearly proves that the crank drives both wheels.

Study of the nature of the gear will show that the driving-pinion, operated by the chain-wheel, carries round in its revolution both of the bevel wheels with which it is in gear, and drives both, whether the road traversed is straight or curved. I will now consider the test proposed by "56 Inch" (letter No. 19403, p. 234). It is quite true that under the given circumstances the brick will stop the wheel, and the whole machine will turn round that wheel as a centre. But why use a brick, or dispense with the steering and tail-wheels? All you have to do is to turn the steering-wheel until the centre line of its axle will, if prolonged, pass through the point at which the side-wheel rests on the ground, and the machine will describe a circle round this point as before, on the crank being turned.

Granting this, what does it prove? Simply that the one wheel can be moved independently of the other as often and as long as no motion is required in that other. As soon as motion is needed the person drives as before. If Mr. Stacpoole Westropp would like to know more of the "Salvo" gear, and will advertise his postal address, I will send him sketch and description. Mr. Westropp can then study the principle of the thing at his leisure.

I will now, with your permission, refer to letter 19287, p. 114, in line 33 of which there seems to be an error. If for "when descending hills" we read "when ascending hills," the passage will be correct. When descending hills the steering wheel is pressed to the ground more firmly by the altered position of the weights, hence the superior safety of the front-steered machine. The requirements in the two questions at the end of this letter are exactly met in any good machine of this kind.

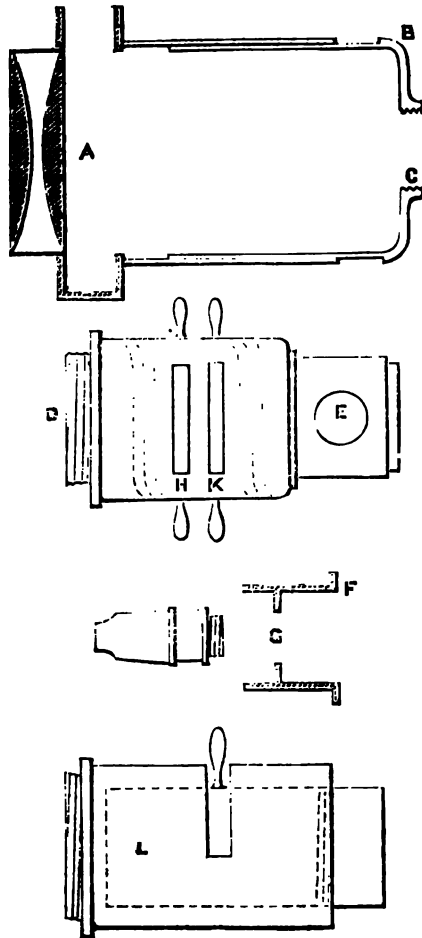
The rear-steering machine has its advantages also. It is, as a rule (not always) lighter, more elegant, and easier to push up hills.

If, as is sometimes done, the chain-wheels are placed vertically under the centres of the main axle, the tendency to pick up the steering-wheel when the rider stands on his pedals will no longer exist. There will, however, be the same tendency when the rider brings his double spoon-brakes into action. Unless it is quietly and cautiously done, up jumps the steering wheel, and out goes the rider. This was the case with the "Salvo," and was the reason why it was reversed.

Let "Treadle" (letter No. 19374, p. 210) beware of the absence of his "Salvo" wheel and gear. He will, perhaps, be caught off his guard some day, and will come a tremendous cropper on the back of his head if he does not restore them.

Will Mr. A. H. Dicksee kindly give, if not too much trouble, the correct weight of his Phoenix? Will he also kindly say what is the horizontal distance from the centre of the main axle to the centre of the rod which carries the seat, and the latter to the centre of pedal-axle.

close together as possible; the Nicol passing up to the face of the selenite, just clearing the hinder spiral spring. No scale accompanies these sketches, for the dimensions of the apparatus would be determined in any similar case by the diameter of the screw *c*, and the size which may be adopted for the polarising Nicol. The size of this prism has been given in the present instance, and the diameter of the carrier, *f*, is 1½ in. Perhaps it may be allowable to add that the whole was constructed for me, with much care and success, by Messrs. Ottway and Son, of 178, St. John's-street-road, E.C. For showing diatoms under a really high magnifying power, to which Mr. Shrubsole refers, I fear neither this nor any other arrangement will be found fully satisfactory, for, after trying all sorts of lenses of half-inch focus and less, I have abandoned the attempt in despair. But for his other desideratum the exhibition of living objects, the method answers perfectly. The "phantom larva" is a capital object, and I have succeeded with *Meliceris ringens* by screening the animalcule through for a short time at intervals; she resents the light (or is it the heat?), and pops down into the tube after a very brief display of her ciliated movement and pounding action. Why Mr. Lan-



caster should have condemned so decisively the use of micro-objectives for projection has puzzled me a good deal. There is nothing new in it, for the pages of the earlier series of the *Micro. M. Journal* contain frequent descriptions of this application, by way of experiment only. And when it is remembered that No. 1's XIXth band was resolved (I think with a Powell and Lealand 1-16th immersion) by Dr. Woodward with photography—which implies projection on a screen—it is evident that there is no *a priori* impracticability in the matter. And Mr. Wenham (July, 1870) speaks in that journal of condensing sunlight on Rhomboides, and showing "delicate markings on a screen 10 ft. distant." What the objective was is not stated, but it was evidently one made for table use, and not for projection specially. If Mr. Lancaster can produce lenses superior to those I have mentioned, and will be good enough to offer them by advertisement, he will not lack buyers—myself among the number. Meanwhile, any amateur can easily experiment with any micro-objectives he may happen to possess, by adapting them in a temporary manner to a lantern-front; and if he does not find them more effective than those usually sold for the special purpose, I shall be much surprised.—ANTARES.

[45053].—Panoramic Eyepiece.—Your eyepiece is evidently wrong; it should give a clear

image when closed, and should open about 3 in., and also be equally clear then. You will have to find its best working distance, then mark it for future guidance. You can use the mixture I spoke of for cap of telescope, although it would be very much better to have the cap made to go on smoothly. Any amateur turner would alter the cap for you; but don't let any one touch the head of telescope.

—W. J. LANCASTER.

[45057].—Speeds for Turning and Boring.—To give one definite speed in feet per minute passing the tool-point for either turning or boring is simply useless, and would be misleading. For any given work of known size, and of a given quality of metal, it would be possible to determine the speed which gives best results; but to pitch upon that for all kinds of odd jobs which come into the hands of the lathe man requires a large amount of trained experience. The order of speed is roughly steel, wrought-iron, cast-iron, brass, and wood as fast as the turner likes; but it is obvious that there are different kinds of steel and iron, and the speed that would suit one would not do so well for another kind. The querist may obtain some useful information by reading the statements on page 236, No. 608, and the criticism and reply elicited on p. 408, No. 615, and page 548, No. 621.—NUN. DOZ.

[45058].—Thimbles.—Iron ones are "raised" by being struck between a punch and die, several being used to bring the metal to the required form; they are annealed between each blow. Common ones are struck up at once from red-hot discs of thin sheet-iron. The ornamenting is done in the lathe, a reeling tool making the fitting; and if gilt, a strip of gold leaf is forced on by means of a mandril.—S. R.

[45063].—Iron Mixture.—"V. R. R.'s" question is one that might be answered in many different ways, according to the tastes and experiences of the respondents. I doubt whether, if you called a parliament of founders and machinists, you would get a three-fourths opinion in favour of any one particular brand. As a matter of fact, any good pig-iron will do, but some brands may give better results than others. And—not a point to be neglected—much will depend on the method of melting and casting.—NUN. DOZ.

[45092].—Slivering Goods by the Electro Process.—The old silver must be removed from articles which are to be replated. If they are small articles, such as brooches or earrings, they can be annealed and pickled in the usual manner, and if it will not injure them they can be dipped in nitric or nitrous acid for an instant, till they are green all over, then remove and wash in hot water, and suspend them in the bath. If they are to be dipped they should be of copper, brass, or German silver. Dipping gives them a nice frosted appearance. Such things as these don't require to remain in the bath long. But that, of course, depends on how much is to be paid for them. They must be pure white in colour, or they will not look well, and should not be scratch-brushed too much. If there is any engraving, the white deposit should be left in it and the edges and high parts can be touched with a burnisher. Some cheap silver jewellery (such as lockets) is fastened together with pewter solder; these cannot be bleached by the method which is usually adopted with silver-work; but a few minutes in the plating-bath will answer equally as well. Take great care with hollow goods: if they are dipped in nitric acid, take care the acid is washed from the inside, and when they are finished, see that all the bath solution is washed out. Dry them in hot boxwood sawdust. The dust can be kept in an old biscuit-tin or saucepan, and warmed over the fire; but don't let it burn, or it will spoil the work. If the goods are left damp inside, the moisture will act on the brass or copper and produce very unsightly green spots. Spoons, forks, &c., require rather different treatment; if these are not very rough, water of Ayr-stone will probably be sufficient; if not, a piece of pumice and plenty of water, and finish with water-of-Ayr; a file will be useful to remove any deep marks, but don't file any hills or hollows: endeavour to leave it without the appearance of having been filed. Always pass a smooth file over the bowl of a spoon (I mean on the front). It removes the roundness produced by wear, and leaves a sharp, new appearance. Examine the lines of a fork; see that they are all the same length, and the points all alike; if not, make them so. See that German silver tea and coffee-pots, mugs, &c., have not been clumsily repaired with pewter. In fact, look carefully at everything before you do it. Take the lids and handles of teapots. The handles of teapots are fastened on with two pieces of ivory, and the rivets can be pushed out. If the ivory is discoloured or broken, it will want a new one; and if expense is an object, you can use a piece of hard wood to join the parts, and file a thin ring of ivory to go round the wood and between the joint: perhaps you can use the old ivory and put a new ring on the outside. All kinds of cement and resinous matters should be

carefully removed; as, being more or less soluble in the cyanide, they may spoil the bath. But I might go on for ever in this fashion. There are so many things of this kind to be thought of. I will look over what I have written and see if anything useful can be added; and I will give another method of making a plating-solution, which will be found useful in some cases.—OS.

[45095].—Shoe-finishers' Ink.—Make a strong decoction of logwood, preferably in soft water, by boiling; then add green vitriol at the rate of 2oz. to the gallon, with bichromate of potash and gum-arabic half-ounce of each. Powder the last three ingredients, and even the logwood if you like, as it will take the colour out quicker; or you can use the prepared extract of logwood at the rate of 1oz. to a gallon of water. You need not be running about looking for scales to weigh the ingredients—it will be near enough to guess them.—CRISPINUS NORTHAMPTONENSIS.

[45099].—Cochineal Colour.—Have you tried adding an antiseptic, such as carbolic acid or salicylic acid?—T. J. M.

[45132].—Change in Pitch of Railway Whistle.—The letters on this subject suggest experiences which the traveller in England never meets with. When tossing about in the bunk of a sleeping-car on our trunk roads, I have frequently noticed the marked change in pitch of the sound of a bell on an approaching train, which has rushed past the train in which I was sleeping, or trying to sleep. It is apparently the custom for the driver to ring his bell on the approach of a train. When the passenger first hears the sound, the pitch is at its highest; gradually it goes down till it is lost to the ear. The phenomenon is strange to the would-be sleeper, who does not know what is the cause for the variation in pitch.—R. M. TUTTLE, Providence, R.I., U.S.A.

[45152].—Repairing Geneva Watch.—To "SECONDS' PRACTICAL WATCHMAKER."—This query has been held over longer than it should have been. I must yet hope for a little further indulgence, because I have been unusually pressed for work lately, added to which I have had two subjects to deal with, which had previously occupied my attention. I will endeavour to treat the two subjects, namely, "Putting pinion in 'escape-wheel,'" and "Hints on turning in a cylinder," as early as I can in the forthcoming year.—SECONDS' PRACTICAL WATCHMAKER.

[45170].—Estimation of Ammonia in Gas Liquor.—Mr. Belcher has saved me the trouble of replying to this query, but I may just note that it would be better for a beginner to have an acid funnel in the cork of flask A, for if the light is accidentally lowered before the tube D is taken out of the beaker, there is a danger of the liquid in C being drawn up into D by the contraction of the air in the flask. It is easier also to add the caustic alkali by means of an acid funnel.—PIONI ALMONI.

[45185].—Foot Valve-Chest.—To "SUNLIGHT."—I now see that naturally the pump does not fill on the upstroke until the air has distended the rubber diaphragm against the dished plate. And I fail to see the real use of such an arrangement. No doubt the idea was that the air in the space between the cover which carries the air-valve would act as a vacuum chamber to equalise the suction of the up-stroke. What I should do would be to make the air-valve act differently. For instance, if the air-valve was secured from opening where the parts were as shown in your sketch, the up-stroke of the piston would just tend to make a vacuum in the valve-chamber, when the air contained behind the rubber disc would expand and force it down. This would go on until the rubber bore against the grated disc. But when the pump-ram begins to descend, the water compresses the air behind the rubber, thereby acting as an air-vessel and preventing shock. An air-vessel would not act the same, except that the air would want to be constantly renewed to supply the place of that which would be absorbed by the water. If you took away the arrangement altogether, the shock would most likely be very bad. Still, there is a loss that must result in the use of it as at present. The only question is whether, if it was removed, the shock would prove sufficiently bad to be dangerous.—SUNLIGHT.

[45208].—Pedals to Harmonium.—In the description on pages 286 and 287 of our present volume, I forgot to mention that the feeder of the pedal-organ should extend to nearly the full length of the instrument. The reservoir should also be made as large as space will allow, in order that the vibrators may be well supplied with wind. In the diagram, the footboards of the harmonium are represented too high. The hinged portion should come on the lower dotted line, instead of the upper, as represented in the diagram. The pan of the pedal-organ should be made to swing back, for convenience of tuning the reeds; and when closed over the wind-chest, should be held

[45310].—**Half-Round Boring-Bits.**—Should be like sketch, the large part turned carefully to

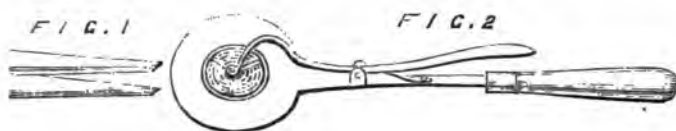


the finished size of cylinder, whilst the front part is cut away to the centre line, as shown; the end must be cut away also as marked, to give a cutting angle to the leading edge. The shank may be of iron even, and should be turned down as sketched, so that, if sent through a long bore, and it should happen to fall off, the cutting part may have room to clear. Such a bit, if well looked after, will make a nice smooth hole.—SUNLIGHT.

[45332].—**Coil to Give $\frac{1}{2}$ in. Spark.**—Many thanks to Mr. Sutcliffe and Mr. Lancaster, and should be glad of any further information from Mr. Lancaster.—ONE PERPLEXED.

[45336].—**Condenser.**—“Novice” is no doubt aware that the atmosphere presses on all bodies with a pressure of nearly 15lb. on the square inch. He will be aware that the boiling-point of water is 212° of Fahrenheit's thermometer, or the pressure of one atmosphere; therefore it just takes the 15lb. of steam that is in the boiler at boiling-point to counteract the pressure of the air. The condenser and air-pump are attached to the engine for the purpose of forming a vacuum or empty space, so that instead of the piston having to force the exhaust steam against the pressure of the atmosphere of 15lb., it has only to force it against the resistance of about 2lb. that is left by the air-pump—that is, if the piston and valves be perfectly tight. Therefore a condensing engine in good order is as strong with 40lb. on the boiler-gauge as a non-condensing engine with about 52lb. on the boiler-gauge. The principal things to be attended to is to keep the piston and valves and air-pump bucket tight, and to keep a proper depth of water in the boiler, so as to keep the engine from priming, as the hot water, passing through the engine into the receiver, spoils the vacuum, and therefore weakens the power of the engine.—SNOWBALL.

[45343].—**Balance-Springs.**—Place the collet, with spring attached, on your skewer, and with your hairspring tweezers (Fig. 1) begin at the



collet to arrange the coils in order. Having done so, you look at it horizontally; you will see some up and some down; now remove the hairspring from the collet, and put your hairspring on the blueing pan (Fig. 2 dotted line is the spring); lay a small piece of bright steel mainspring (soft) as shown, hold it over a lamp, and when the piece of steel turns blue, gently shake the hairspring from the pan, and you will see the result. You can arrange it on the pan. Practice makes perfect. Every beat a Geneva watch makes is a 5th, five beats is one second, 10 beats is two seconds, &c.; but as you only count on one side, you count one for every two beats. Therefore, by the time you have counted five, your pendulum will have gone its journey and returned, which would be equal to two seconds or 10 beats, and when you have counted 10 your pendulum will have returned again, &c.; if you take a Geneva movement in your hand, and hold so as to see the banking pin when it is at the right-hand side, you will soon see what I mean. Much obliged to “Guyot” for his good opinion. I was going to write an article on “pivoting without the use of the graver,” if the Editor thinks it will be any use to his amateur subscribers, and also “How to repair a verge watch.”—A FELLOW WORKMAN.

(Please send.—Ed.)

[45344].—**Enlarging of Photos.**—Many thanks to “Sunlight.” As a lantern is absolutely necessary, I must borrow, beg, or steal one. I propose to render the carte transparent by steeping in paraffin-wax. Is this correct? How shall I proceed for the screen? A very small one will do; indeed if the face were only one inch square instead of about $\frac{1}{2}$ in., I should have experienced no difficulty at all.—ONE WHO MEANS TO DO IT.

[45344].—**Enlarging Photographs.**—The best way for you to do what you wish is to take a negative from present vignette, then from that take a transparency, and with a lantern enlarge to any size you like on Morgan's paper. You can make a

camera to do this kind of work easily. I gave instructions some few months ago how to make a camera, and if you have not back copies I shall be pleased to give you such information as will enable you to make a thoroughly reliable camera. As to the lens, this is not a thing that you could successfully make, and by referring to back advertisements you will find lens mounted for 5s. to take a $\frac{1}{4}$ plate. This is much less than it would be possible for you to make even the brasswork alone, and it is waste of time to attempt to make an article that will cost you double the money for which you can get the thing ready made. Now, as to lantern, this you can build up very cheaply; for instance, taking the cost of lenses to make a lantern, having 4in. condensers, you will find the complete set to be 17s. 6d. Now for 5s. cost more, you will be able to make up a good enlarging lantern. Thus, you being a good carpenter, can readily make a box 12in. high, 8in. deep, and 6in. broad, open top and bottom. One side should be framed to take a door, the other three sides solid; then in the front cut out a hole, say, $\frac{1}{2}$ in. diameter, or large enough simply to take the mounted condensers; then make a box with square taper front, having place to put negatives in, or lantern-slides at will. Then, at the small end of front, glue and sprig a piece of wood, say, 3in. by 3in., having a 2in. hole in centre to take flange carrying front containing object-lenses. This flange should be 4in. from slide-holder. Then for the top you must get a tinker to make a hollow top with a cowl on. This he will do for you for a few shillings, about 2s. to 2s. 6d., and your lantern will be ready to exhibit with or to enlarge with. For lighting you can get an ordinary low paraffin-lamp, costing 1s. to 1s. 6d., or you can buy a duplex burner about 3s. to 4s. 6d., or a Silber burner 4s. 6d. (excellent for enlarging), or you can have a triple-wick lamp complete for 15s., so that with the whole thing complete you will have a first-class lantern.—W. J. LANCASTER.

[45345].—**Enlargements from Quarter-Plate Negatives.**—I should not advise you without seeing your lens, to sell it, and then to purchase Le Merveilleux. The latter needs no recommendation from me, and although “Sunlight” thinks it is too cheap, there are some hundreds of our readers who will, from personal experience, bear me out, when I say that the work it does will stand any amount of enlargement possible. It may (as it has been), be used for any kind of scientific study: geological sections, cut-

tings, fossils, &c., have been photographed, and then enlarged. In the physical laboratory it has obtained a fac-simile of lines of force, and scores of things I need not mention here. I have written this merely to remove the impression so often produced by an article being cheap, and expressed as cheap and nasty; such articles are dear, but when an article is cheap and good, then it deserves to be appreciated, and, thanks to the ENGLISH MECHANIC, Le Merveilleux may now be found as a companion to residents and admirers of our paper in India, Japan, Australia, New Zealand, Egypt, Russia, Germany, Italy, North and South America, &c., &c. It is quite a treat to me to get letters from the most distant and out-of-the-world sort of places, speaking in no mean language of the great boon the ENGLISH MECHANIC is to those who are fortunate enough to get it, and how, in some places, when the mail arrives, there is almost a struggle to get hold of the copy and devour its contents. This is altogether outside the question. Now, you can enlarge with any single lens, but not so successfully as with a doublet. A cheap quarter-plate lens, stopped down to 1in. in the centre, will enlarge beautifully. A pair of 4in. condensers will do for enlarging from vignettes; but when the whole of the plate is to be enlarged, then either 5in. or 6in. condensers are the right things to use. If you will read answer 45344, you may then be able to make up an enlarging lantern; if not, I shall be very pleased to give you all the instruction necessary to enable you to do so.—W. J. LANCASTER.

[45347].—**Boiler Construction.**—“Vulcan” cannot fail to see from the following what he wishes to know. By using same initials as previously given, you can easily turn it into plain figures. Longitudinally, $S = Pd \div t$. Substituting figures you give, we have $S = 40 \times 5 \times 2 \div 3 \times 8 = 150$. Transversely, $SPd \div t$. Again substituting figures— $S = 40 \times 5 \times 3 \div 8 = 75$. From this it is manifest that the longitudinal strain is

double the transverse strain. It is quite likely you may have seen ten or a dozen transverse rents and no longitudinal rents. This may be explained by the fact that boiler-plates of inferior quality often crack with the grain between the rivet holes, especially if the seam is pitched rather close. Or it is more likely to be owing to insufficient lap of plates. Your lap transversely should not be less than 2in., and longitudinally not less than 3in. or 3in. If you are in the habit of working at a pressure exceeding 40lb. per square inch, it is better to have your plates 7-16in. thick, instead of $\frac{1}{2}$ in.—J. F. B. YORK.

[45352].—**Dynamo-Machines.**—I would strongly advise you not to commence a dynamo-machine for at least a month or six weeks. After the exhibition is opened at the Crystal Palace we shall have a much better chance of obtaining really useful data as to best form of machine, &c. In Paris one could not get to the bottom of anything, and there was so much that was unsatisfactory, and so little thoroughly satisfactory, that it will be impossible for the coming exhibition to be so bad, and the probability is it will give us a great deal more information of value on the points you ask for than has been obtained from the Paris Exhibition.—W. J. LANCASTER.

[45352].—**Dynamo-Machines.**—Siemens' machine is one of the best forms of dynamo; the armature has several advantages over those of other makers, as competitive trials have often shown. To give full particulars of construction would occupy more space than our editor could spare, besides requiring many diagrams to make it clear to an amateur. The armature of a 2,000 candle-power machine is wound with about 1,200 of 14's or 15's double cotton-covered wire, and has a resistance of about $\frac{1}{2}$ ohm. The field magnets are wound with four layers of 8's or 9's wire, having a similar resistance to armature coils when coupled to commutator, and are included in the circuit with lamp, not on the shunt principle. The armature revolves at from 950 to 1,000 times per minute, and requires from 2 $\frac{1}{2}$ to 3 horse-power. If “Quæstor” advertises his address I will give him any details of construction he requires, and I would further advise him to carefully inspect a machine if he has opportunity of doing so. If he is in the vicinity of Halifax I shall be glad to show him a 2,000 candle-power machine of the above make.—LUTHER HANSON, Green Mount House, Hanson-lane, Halifax.

[45352].—**Dynamo-Machines.**—In reply to “Quæstor's” inquiry re my dynamo, I can say that I have just finished it, and made a few preliminary trials with it. It seems pretty powerful; but as I am going to test it thoroughly in the course of the winter, I shall defer saying more about it till I know it better. I must say that I did not follow the advice of Mr. Kennedy given in his reply to me, but worked it out on the original lines. My knowledge of light-machines is very limited, and I could not give any advice; but I think if “Quæstor” would search *Engineering* for the last two years he will find very valuable information, and, comparing this with what has appeared in this journal, he ought to be able to design a machine suitable to his purpose. I very much doubt if he will get all the information he asks for, and I for one most certainly agree with the opinion several times expressed by “Sigma,” that there is much more learnt by experiment and self-thinking than when every rule is cut and dried like a recipe in a cookery-book. I can give “Quæstor” some practical hints, which will enable him to avoid certain mishaps which it is not necessary to encounter. They are ready whenever he will ask for them. I am very sorry to see that the electrical element is somewhat subdued in “ours.” Have none of our old friends something to say? Am I the only one who tried his hand at dynamo building? And noticing the all-absorbing interest electricity elicits elsewhere, I should like to see some of the space allotted to tricycles occupied by records of the progress of electrical science.—ANGLO-DANE.

[45353].—**Tricycle Spoke.**—There is not the least difficulty such as you assume. If the spoke is a club-ended one, so that the headed end may be passed through the rim before heading up, then there is but little difficulty. Pass the spoke through the rim, and then hold it with a spoke holder (which is simply a piece of flat iron bent round U-shaped), and if this be in turn held in a hand-vice, if you have the proper steel you will be able to hold the spoke by one hand, with the other rivet up the end. A little care and patience will do all the rest. There is not the least need of heating the wire in a forge, as if you have the right material the end is thoroughly annealed, and as to head up pretty easily. Such a job would not take me ten minutes to do, so that there cannot be much difficulty in it. At any rate, if you can't make one, I will try and help you further.—SUNLIGHT.

[45355].—**Sulphurised Compound.**—Ruhle cannot be hardened without robbing the preparation of its melting powers. That is one of the

reasons why it is vulcanised. If the querist gave some idea of his object, one might be able to help, but "sulphurised compound" hardens by heat and pressure, and then cannot easily be remelted.—T. P.

[45357].—**Harmonograph.**—Anent "Theory's" query with regard to my harmonograph, the principle is the same as that of all instruments of its kind, viz., the combination of two rectangular vibrations. My instrument claims to be the simplest and most compact arrangement. It has no slotted weights. Some machines have slotted weights to load the pendulums. The spiral curve is got when the two pendulums are of exactly equal length; that is, in perfect unison, and started so that one is half an oscillation in advance of the other. Other ornamental spirals are got by turning the table by clockwork or otherwise; but these do not properly belong to the harmonic curves.—A. R. MOLISON.

[45359].—**Tricycle.**—"To SUNLIGHT."—If the question be put with the mere idea of starting a theoretical discussion, I must decline to meddle with it. But if it be restated in practical terms, with actual instance where any practical result is to be gained, then it would have my best attention.—SUNLIGHT.

[45362].—**Sulphate of Ammonia.**—The ammonia in this salt is estimated by heating in iron tube with pure soda-lime; the ammonia gas given off is conducted into a solution of hydrochloric acid, and can be either titrated with standard acid or estimated by forming the double salt of ammonium and platinum. For particulars and details see Sutton's "Volumetric Analysis," Thorpe's or Fresenius's "Qualitative Analysis."—CHEMISTIANA.

[45363].—**Instantaneous Shutter.**—I should advise you, most decidedly to return the shutter you have to the maker, as it is so defective. Much depends on the plan it is made on. The one I use is a modification of "Marion's" pneumatic shutter, with a dodge of my own to set the shutter to fall in any required fraction of a second. If you wrote to Marion and Co., Soho-square, you would, no doubt, hear of something suitable. Or, if you wish to go to work economically, I could give you an address of a smaller London firm who would make it for you cheaper. Anything I could do to help you in the matter, I should be pleased to do.—SUNLIGHT.

[45363].—**Instantaneous Shutter.**—You ask for information that is rather difficult to give. The number of shutters that are advertised as the best is considerable. A shutter to work satisfactorily should have two apertures opening and closing over the centre of the lens; thus two shutters with two holes in the one moving up, and the other down, will, if rightly placed, open exactly in the centre and close there. I am now finishing a shutter on this principle, which, with a single pinion, will enable anyone to regulate the exposure to a fraction of a second. You will understand how to make up the framework of the shutter to carry the two moving pieces; then the two pieces should be connected together, so that exactly as one moves up the other will move down, and for moving them a small spring or elastic will answer well. I will send drawings of my shutter when ready.—W. J. LANCASTER.

[45365].—**Dry Plates.**—You should not keep the plates in a place that is so warm as a kitchen mantelpiece; better keep them in the top of a cupboard, near to the fireplace; still, unless very hot, the plates should not fog or blister; the latter may be arrested by putting the plates in a solution of Epsom salts before developing. You will find that the plates will not blister after being left in this solution for a couple of minutes, and then put into developing solution.—W. J. LANCASTER.

[45367].—**Protioxide of Nitrogen.**—This gas ought never to be taken without being purified.—CHEMISTIANA.

[45368].—**Screw-Shaft of Launch.**—Most decidedly have the play of the shaft in the after-bearing seen to at once. You can't do any real good at the stuffing-box. But your best way is either to have the present gun-metal bush bored out a little larger, and then rebushed again to fit the journal of the shaft, this being a remedy that is only for a time, as the grit in the water quickly sets up wear. Or to apply a really effectual plan which is to fit a set of Penn's wood bearings, which will run for a very long time, if properly put on in the first instance, and can always be renewed at the cost of a few shillings. These are simply strips of hard wood carried in dovetail grooves cast in the stern tube, cut so that a film of water revolves with the shaft. By this means the shaft and the wood surfaces never come in contact sufficiently to wear for a long time. And the bottom segments can always be renewed in a few hours. But have them fitted properly if at all. But for this invention the screw-steamers of the present day would be

terrible jobs to engineers. I speak from actual experience of these bearings.—SUNLIGHT.

[45370].—**Model Locomotive.**—If J. Huntley works his cylinders with steam at the same pressure as is used in real locomotives, he will get the beats. Of course he turns the exhaust into the chimney. Fill the tubes with rosin, not lead. For long lengths it is quite as good.—S. R.

[45370].—**Model Locomotive.**—To obtain the puffing sound in a model, it is necessary that the cylinders should be the ordinary slide-valve type, and well protected from condensation. The exhaust steam must be carried into a blast-pipe, the nozzle of which is contracted, the pressure of steam in boiler which ought to be maintained when engine is running, and then the model should have a good load to take to make it exert itself. If Mr. J. Huntley will give a description of his models, with dimensions, pressure of steam, and what they can do in the way of hauling and speed, I will endeavour to advise him further. I don't know of any other way for filling brass tube with lead than by pouring the lead in from the ladle into a small tin funnel to fit into end of tube. If this will not answer, and the bends are not very sharp, I should make the parts red-hot that have to be bent, and cool them in water. In this way I have bent 3-16in. tubing to a spiral of about 1in. diameter with very slight signs of flattening.—E. L. P.

[45371].—**Carbonated Soda or Refined Alkali.**—"F. E. T." may learn how to test these by reading the chapter on Alkalimetry in any book on Quantitative Chemical Analysis. Sutton's "Volumetric Analysis"—or, better, Thorpe's, because of the cheapness—will give all the information required.—CHEMISTIANA.

[45372].—**Lathe-Engine.**—Depends on the work you do and the size turned. A 4-horse, if of the high-speed class, would be ample—that is, if calculated on any rule for manual power.—SUNLIGHT.

[45373].—**Non-actinic Lamp.**—See page 573, No. 830, where you will find a woodcut and description of an efficient lantern that you can make for a few pence. The chief thing is to see that the ruby glass is the right kind, and does not allow the light to fog the plates.—SUNLIGHT.

[45373].—**Non-actinic Lamps.**—Buy a cigar box, cut a hole in the bottom of it, say, 4in. by 2in., then put it on end, and over the long aperture put a piece of dark ruby glass to cover at least 1in. all round aperture; then buy a penny candle-holder from an ironmonger, and fasten it to bottom of box inside to hold a wax candle; next make half a dozen 1in. to 3in. holes in the bottom of door (formerly lid), and put a piece of thin tin blackened, slanting over the holes so that plenty of air can go in to lamp, and no light come out, next cut a 1 1/2in. hole in top of lamp, and inside bend a piece of tin, —, something like one of the brackets inclosing number of query, with a flange on each side to be screwed inside top of lamp, and to be at least 3in. square; black this bottom and top, then screw it in box, and you will have an excellent lamp quite light-tight and well ventilated. You can make a similar lamp in tin, but it would be more difficult to make than the cigar-box lamp.—W. J. LANCASTER.

[45374].—**Crystals for Microscope.**—It all depends upon the crystals you wish to mount. You should begin with simple substances, and then go on to compounds containing salicine, &c. To begin with, make a saturated solution of a salt, for instance, chlorate of potash, then mark the centre of a 3in. by 1in. slide with a small spot of ink on the under surface; now take a drop of the solution on the end of a glass rod, and allow it to fall on to the top of 3in. by 1in. glass; then put it carefully away out of dust to crystallise. You should do three or four of each sort, then you can pick out the best of them to finish; having obtained a good specimen, put the slide on to a turntable, and put on it a ring of asphalt or marine glue, and put glass on to this; allow to dry, and finish to please your own taste. There are lots of magnificent crystals which can be mounted with ease, but nothing but experience will teach you how to get best possible results.—W. J. LANCASTER.

[45375].—**Microscopical.**—A reply to part of this query will be found among the articles under the heading of "French Pocket Microscope."—EN.

[45376].—**"Singer's" Sewing-Machine.**—Not much the matter with your machine; probably wants cleaning. A few weeks ago I had several machines of different makers brought me, suffering, but in a worse form, from the same complaint as "Tom Taylor's." I took them to pieces, well cleaned them, put them together, and sent them home cured.—H.

[45377].—**Straightening Steel Wire.**—"G. M." will find an illustration of a simple appliance in No. 850, p. 431. It is just what he requires.—S. R.

[45378].—**Fret-saw.**—A simple plan of adding a fret-saw to lathe, and sundry other accessories, appears on p. 33, No. 834—last volume, that is.—T. P.

[45378].—**Fret-saw.**—The Britannia Company, of Colechester, make a fret-arm to fit any lathe, and if you send stamp to them they will forward engraving.—G. T. B.

[45382].—**Cotton Belting.**—When once thoroughly stretched, it answers very well. If the right kind be used, it is as good and economical as stated. I much prefer it to the rubber or leather belt, as it holds to the pulleys splendidly.—SUNLIGHT.

[45382].—**Cotton Belting.**—I have charge of works where we use about twenty American cotton belts, from 10in. down to 2in. wide. They wear very well, and, we think, are more economical than leather; but it will not do to have them endless, as they stretch and require to be tightened up a number of times. They should be kept free from moisture or damp. For this reason I would not recommend them for steam-thrashing purposes, as in such work they would be much exposed to the weather, which would cause them to contract and expand, and give you extra trouble to keep them in good working order.—HYPO.

[45383].—**Church's Slide-Valve.**—I regret I am unable to afford Mr. Scutt the information he desires, or I would with pleasure do so. I presume that it is a similar valve to the Webb circular valve, tried some years since as a balanced valve, and which is fairly successful.—SUNLIGHT.

[45385].—**Prevention of Slip in Belts.**—The usual way is to take a piece of leather about the same thickness as the belt, and say half the width, and bevel off the edges well on the outside. Then drill holes through rim of pulley and rivet leather on with copper rivets. You would get the same effect if the pulley were turned to a proper shape instead of being flat.—LABOR OMNIA VINCIT.

[45386].—**Lemonade Bottles.**—The best is that known as Codd's, which contains a simple glass marble. It was first illustrated in this paper several years ago.—F. S. H.

[45388].—**Tinned Iron.**—The sheets of iron are scoured with sand, pickled in acid, dipped in oil, and then plunged into a bath of melted tin. As they are taken out they are wiped with a wisp of greasy tow. There are one or two minor details; but I do not suppose the "Inquirer" wishes to know them. If so, they are given in most cyclopedias, or such a work as "Ure's Dictionary."—NUN. DON.

[45388].—**Tinned Iron.**—You should get permission to go over a tinworks, and see the processes carried on in tinning an iron plate. You would find that the various qualities of iron to be tinned had to undergo a cleaning, often being immersed in a dilute solution of sulphuric acid, then packed and heated, and subjected to other processes for getting a chemically clean surface; then the plates are placed in a frame, and the frame is lowered into a bath of melted tin, and left in for from 15 minutes upwards, according to the kind of plate wanted; sometimes they remain in the bath for an hour; they are then drawn out slowly, generally by boys pulling a rope over a pulley, and boys will be boys everywhere, and some of these boys pull for a few seconds and then they let them rest; this causes a line across the plate. I once made a train of wheels, with a fly to bring the plates out steadily, but the workmen could not get paid for the lad when they had the clockwork, so by dropping pieces of iron between the wheels, and knocking a tooth out of a cog, and such like, they soon spoiled the movements.—W. J. LANCASTER.

[45391].—**Boiler Composition.**—Why not precipitate the carbonate of lime before pumping the feed into the boiler. It can be done by adding cream lime to the cold water, or by simply heating in a feed-water heater, whence the deposit could be easily removed.—ESSAR.

[45391].—**Boiler Composition.**—I don't like soda fed in at random. I should prefer to use either "Taylor's" or "Bailey's" (of Manchester) new composition, which is giving me, so far, satisfaction. Prevention being better than cure, could you not use a lime-catcher and heater in one, and so prevent the lime getting into the boiler at all?—SUNLIGHT.

[45391].—**Boiler Composition.**—I was troubled just the same as you are, and tried soda and frequent blowing out, but without much effect, except having a lot more trouble with the brass boiler fittings. I am now using a fluid which effectually prevents scale forming, and, contrary to the usual kinds of boiler compositions, I have not found any sign of injury to any part of the boilers. The cost is only about 10d. per week for a boiler 28ft. by 7ft. As it would be gratuitously advertising the makers, I will send you their circular if you will put your address in the "Sale Column."—LABOR OMNIA VINCIT.

[45393].—**Grinding-in Cocks.**—The best plan is to grind them in with sharp sea-sand and water, and is expedited by the judicious use of a fine file on the prominent parts and rings that form. Do not in any case use emery.—SUNLIGHT.

[45394].—**Electric Water-Basin.**—If the basin be a copper one, as most exhibitors use, carry one wire from the coil to a binding-screw on the basin and hand the other one to the person who is to take out the coin—that is, if they can. If the basin be of earthenware or glass, then carry the one wire to a piece of chain, one end of which should be placed in the water in the basin whilst the other handle is held by the person who "fishes" for the coin. In either case the moment contact is made by dipping the hand the explorer gets the shock. A little salt should be added to the water.—SUNLIGHT.

[45394].—**Electric Water-Basin.**—Use a metal basin—zinc is best, and have a wire soldered to the bottom of basin; connect this wire to the coil, and let the person hold the handle from other side of coil; then put water into basin, and coin, and if the current is strong, no one will get the coin out.—W. J. LANCASTER.

[45395].—**Gas Instantaneous Water-Heater.**—The length of pipe will regulate the quantity of water heated. If you want only a small continuous supply, a few coils of $\frac{1}{2}$ in. pipe will answer; but if you want a large supply then a number of coils will be requisite. I have several times thought that a series of coils, forming a spiral over an ordinary Bunsen burner connected to a half-inch gas supply, would be very effectual in producing warm water quickly. I would have the bottom coil only a little larger than diameter of burner, and then the coils getting smaller and smaller until the supply end should close the top in, then the bottom of the tube should be led right through the frame and out to tap. An apparatus of this kind could be simply made, and would work well.—W. J. LANCASTER.

[45396].—**Capacity of Tank.**—Assuming that your tank is part of a true cone, then you can easily get at its cubical capacity. Thus if 10ft. diameter at the bottom, and 9ft. at the top, this would be equivalent to 9ft. 6in. all the way; then 9ft. 6in. by 9ft. 6in. by .7854, and multiplied by height will give you contents equal to 709.21 cubic feet.—W. J. LANCASTER.

[45396].—**Capacity of Tank.**—This is a frustum of a cone, for which the formula is: Vol. = $\frac{1}{3} (A_1 + \sqrt{A_1 A_2} + A_2) h$. Where A_1 and A_2 are areas of two ends, and h is distance between them. Therefore, cap. of tank = $\frac{1}{3} (78.5 + \sqrt{78.5 \times 63.5} + 63.5) 10 = 1642.3 = 544$ cub. ft.—R. M. A.

[45396].—**Capacity of Tank.**—10ft. diam. at base, 9ft. at top; take mean diam. as 9ft. 6in. To obtain the capacity of a cylinder multiply the area of base by height of cylinder; to obtain area of base multiply square of diam. by 0.7856 thus: $9.5 \times 9.5 \times 0.7856 = 70.90$ diam. $\times$ diam. $\times$ 0.7856 = area. Multiply by height, that is 10ft., and you have 709 cubic feet; multiply by 6.23 and you have 4,417 gallons. Or the following is a rough and simple method of obtaining the capacity of cylinder:—Multiply the square of the diam. in feet by 4.9, and you have the number of gallon-per foot section thus:—9ft. 6in. $\times$ 9ft. 6in. $\times$ 4.9 = 442 gallons per foot section, multiply by 10 you have 4,420 gallons.—CHEMISTIANA.

[45397].—**Pressure of Sea-Water.**—The weight of a cubic foot of sea water being 64lb., you have only to multiply that by the depth of water, and the product would be the weight per square foot.—SUNLIGHT.

[45397].—**Pressure of Sea-Water.**—The pressure at any given depth is equal to the weight of a column of water of that depth, and having a base equal to a unit of area + the pressure of the atmosphere. Taking 1 sq. ft. as unit of area, pressure = $50 \times 1000.16 \times 1.025 + 14.73$ lb. = $50 \times 1025.16 + 2121.12$ lb. = 5324.24 lb. N.B.—1.025 is the density of sea-water.—R. M. A.

[45397].—**Pressure of Sea-water.**—The pressure of water on any immersed horizontal surface is equal to the weight of a column of water, whose height equals the given depth of the water, and area equals area of immersed surface; thus the pressure on one square foot at a depth of 50ft. would equal the weight of a column of water 50ft. high and 1ft. square, that is the weight of 50 cubic feet of water. Cubic foot of water equals 62.3lb. $50 \times 62.3 = 3,115$ lb. = the pressure of pure water on one square foot of surface at a depth of 50ft. I do not remember the exact density of seawater, but suppose it to be 1.03; then a gallon would weigh 10.3lb., and a cubic foot would weigh 64.1lb., thus the column of seawater, supposing the density to be 1.03, would weigh 50 cubic foot $\times$ 64.1 = 3,205 lb.—CHEMISTIANA.

[45399].—**Celestial Globe.**—The flat frame of wood which surrounds the globe, called the horizon, is divided into a number of circles; these show the degrees of the signs of Zodiac, 30° each,

in one circle; the next circle shows that these degrees correspond with the days of the months. Thus, "Beginner" looks for the "First Point of Aries," and finds it in the month of March; so for every day named in any problem. Take, say, today, 25th Nov.; find this on the wooden horizon, and the degree of the sign which corresponds with it. Then, look upon the globe itself, on the ecliptic circle, for that degree of that sign (it is south of the Equator), bring this degree under the brass meridian. The "index" is at the North Pole of the globe.—H. O'B.

[45404].—**Varnish.**—It was mentioned in this paper a few weeks ago that the addition of a little bichromate of potash to the Indian ink prevents running after the drawing has been exposed to the sunlight. Glue is rendered insoluble by the same salt when submitted to light.—NUN. DON.

[45404].—**Varnish.**—To "SUNLIGHT" and Others. —I should not have tried the plan you did. After the drawing is made and coloured, I should have floated the back only on a weak solution of white shellac and spirit. This would have penetrated far enough to hold the colour. When again quite dry you could apply any ordinary paper-varnish without fear, so long as you were reasonably careful.—SUNLIGHT.

[45407].—**Relacquering Telescope.**—My candid advice to you is not to attempt the job. If you do, and as you say that you know nothing about lacquering, you will simply make a botch of it. I fear you do not see that first the old lacquer must be thoroughly cleaned off, then the metal carefully got up bright again (in the lathe I prefer), and then relacquered. You will find the last operation not so easy as it seems. And it will cost you far more in time and trouble, with an unsatisfactory result at the end, than to send to a working optician in the first place. Lacquering is a branch that requires very considerable practice and skill, and is only learned by everyday use.—SUNLIGHT.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last W. O. T. has replied to 44609; Firth, 44725; Plouf Almon, 45004.

44774. Dynamo-Machine Magnets, p. 75.
44797. Lathe-Making. To Mr. J. H. Evans, 75.
44 12. Claudet's Method, 76.
44816. Electric Gas-Lighting, 76.
44818. Dynamo-Electric Machine, 76.
44822. Comets, 76.
44827. Water-Wheel, '78.

45049. Carmine Paste, p. 170.
45060. Papermaking, 170.
45062. Watch Finishing, 170.
45070. S up Frame, 171.
45071. East Anglian Passenger Engines, 171.
45073. Guitar Construction, 171.
45075. Armstrong's Combination Lathe, 171.

QUERIES.

[45408].—**Easel.**—Will some kind correspondent give instructions, with drawings, for making a painter's easel, and oblige I—JUPITER.

[45409].—**Piston Lubricant.**—Has any of our readers used castor-oil as a lubricant for cylinders? If so, I hope they will give their experience of it, or any other lubricant for cylinders. Also, what they use on wood or iron teeth-wheels, and oblige I—J. C.

[45410].—**Focus of Spectacle Lenses.**—To Mr. LANCASTER, or "SUNLIGHT."—Please give the correct method of finding the exact focus of plus and minus lenses used in spectacles.—NIL SINE CAUSA.

[45411].—**Bending Over Edges of Tin.**—How can I turn over the edges of tin round iron wire? I am good at soldering where there are no edges to turn over.—AMATEUR TINKER.

[45412].—**Photography.**—Can gelatine dry plates be made into lantern transparencies? I understand there is some process for making wet negatives so by nitric acid. Will someone explain details? Also, explain how to use swing-back camera and rising front?—PILLO-Photo.

[45413].—**Tonnage of Yacht.**—Will some of your numerous readers give me the tonnage of my steam-launch? She is 30ft. long, 7ft. beam, and 4ft. deep; no counter, most unusual proportions, but she was built for a powerful whale-boat.—TOM.

[45414].—**Sizing Heddles.**—For my own use I lately made a number of cambs, but have failed to get that skin on the heddles that I have seen on those made by professional makers—these are hard and glossy—and must, I am sure, be easier on the yarn than such as I make. I used boiled linseed oil and beeswax. Could any of my fellow-readers help me to a better?—WEAVER.

[45415].—**Cement for Bicycle Tires.**—May I ask some of your correspondents if they know whether Sinclair's cement is made now? And, if they have tried it? I have tried two or three makers, but find they do not hold. I have, also, heard of Rockhill's as being good. I am sure some better plan might be devised of securing the tires. There was a tire with a waist made, I believe.—McC. T.

[45416].—**Fitting up Lathe.**—Would some competent authority give a few hints as to how to begin to set up a lathe? What pattern, headstock, &c. It must be 5in. or 6in. centre, and of such construction that back-gear and overhead-motion, and all other modern improvements, can be built into it.—SARNIA.

[45417].—**Glazing Stained Glass in Lead.**—Will anyone give me full particulars how to go about getting the glass and lead (cheapest) for stained-glass windows and blinds? And, how to solder and work them together? What tools are required?—BURNHAM.

[45418].—**Small Medical Coil.**—To Mr. LANCASTER.—Although not the querist of No. 44916, I should like Mr. L. to say what is the simplest and best contact-breaker he recommends for the small coils, as I have finished it as far as he mentions in his reply to "Hard Up," and shall be glad to go on further!—LONDON.

[45419].—**To Produce Smoke and Soot.**—I want to burn some dry granulated material, and obtain as much smoke or soot as possible from it, which I shall collect by means of steam in a flue. How should the oven or retort be constructed? Should it be closed or open? And, should the material be spread over a large surface or, be burnt in a mass? Quantities: a few pounds at a time.—O.

[45420].—**Electric Bell.**—I have got a bell in my house, and I want to use it in connection with a water-tank to let me know when the tank is full or empty. The distance from house to tank is 30 yards; the water rise and fall 25ft. What warning arrangements will I require? Will it require two wires? I propose taking wire under garden walk, as the tank is level with ground. What kind of wire will it require? Also, the price of same? A sketch of warning arrangements will oblige J. C.

[45421].—**Phosphorus in Iron Ores, &c.**—To Mr. ALLEN.—(1) In reducing Fe_2O_3 to FeO by sodium sulphite, is the latter used in the solid state or in solution? I have tried an aqueous solution, but it makes the bulk to be treated inconvenient. (2) How much ammonium acetate would be required for, say, 75 grains of a pig-iron containing about 1.5 per cent. of phosphorus? (3) Bell says, acid ammonium acetate; so I have added acetic acid to my solution. Is this right?—FERREUS.

[45422].—**Clock-Cleaning.**—To "FELLOW WORKMAN," or "SECOND'S PRACTICAL WATCHMAKER."—I have been trying my hand at clock-cleaning, but do not get on to my liking. Two thirty-hours case-clocks that I cleaned go all right, but do not strike right; they commence to strike, but do not strike the number out. In one the chain slips and clicks in the shew, the horns being worn well that prevents it striking right. Also, an eight-day case-clock I have cleaned goes all right for an hour or two, but stops suddenly, although the pendulum still keeps going for a while after.—WORLD-EX CLOCK CLEANER.

[45423].—**Omni-cycle.**—Will "D. H. G." Mr. Westropp, or "Fagul," or "Sunlight," give us their opinion on the omni-cycle? The absence of chain and gearing, with the consequent loss of power by friction, and power to the rider to alter his speed without stoppage, to gain power up a hill, or speed beyond the top of it, are enormous advantages. And, if the weight of the machine could be reduced to that of the "Motor" or "Express," the advantage would be undeniable. Would it suit a 15-stone man of fair horsepower? Would "Sunlight" advise a 40in. wheel for him?—G. BROOKE PACHELL.

[45424].—**Problem.**—I should be glad of a solution to the following seemingly-simple problem (I have given it to half a dozen men, and have received six different replies):—A. purchases a lease, for which he pays £1,050; the term is for 14 years; the rent for the first ten years is to be £250, and for the last four £300. At the end of the first ten years he agrees to sell the lease to B. at a proportional price to what he paid. What is the exact sum that B. must pay?—COCKEN.

[45425].—**Electricity.**—Will Mr. Lancaster, or some other correspondent, help me in the following contrivance?—I want to know at each week-end the number of revolutions an engine has made during the week. This I want to be taken from the line-shaft at the other end of the mill to where the engine stands; and, also, to be done by means of electricity. Would the dial from off a gas-meter be of any service, or the inside works of a clock? However, by giving me the best means by which the above can be done, you will greatly oblige—B. T. B.

[45426].—**Slow and Quick-Speed Governor.**—I wish to know where the difference commences between a slow-speed and a quick-speed sensitive governor. I have seen several engines at mills and workshops, and, also, at Agricultural shows, and, if the full power of steam is put on, and no weight to drive (only shafting and gearing), the engine will run away. In these cases the governors must be improperly made. I have read of a certain mill, in a certain town, that the engine will not vary more than 1½ stroke per minute if all the machinery was stopped off, and this by an ordinary Watt governor. Also another case of a quick-speed sensitive governor, will run to 2 strokes per minute, although the whole of the machinery is stopped throughout the mill. If this is correct, why do many of them have rods and catches to knock off and stop the engine? If the governors are so sensitive as some of our leading engineers say, why do they introduce that complication of rods, catches, and levers?—A. LEARNER.

[45427].—**Fossils.**—Will "T. G. F." kindly give me the names of the small encrinurids found in the granite? I have found a good many single plates of the stalk, but

none of the perfect heads. Are they to be found at all? Most of those I have are about an eighth or fourth of an inch in diameter, with a transparent quartz-like substance inside. What are the small tubes, of a whitish-grey colour, found in this stratum? I mean small things which look like the old boring cases of the Terebratulidæ; they are about an eighth of an inch in diameter, and an inch long; very fragile. What is the name of the spiral shell about an inch long, something like the *Turritella costatus* found in the chalk, only smoother and with more distinct spirals?—JOHN HALL.

[45438.]—**Faure Accumulator.**—I should be much obliged if "H. B. T. S." will kindly answer my queries! What would be about the cost of making a Faure accumulator as described by him? Would a bichromate battery with two carbons, each 4 in. by 3 in., and one size of same area, be strong enough to charge it? If not, how many of such batteries would be necessary? When the Faure battery was fully charged with electricity, would it be strong enough to light one of Swan's small incandescent lamps? And, for how long?—JOHN HALL.

[45439.]—**Geology.**—To "T. G. F."—I should be much obliged if "T. G. F." or some other geologist, would kindly answer my queries, if possible. In the gault at the brickfields near here, I have lately found, among ammonites, belemnites, &c., a large quantity of a kind of small nut-like balls of greyish clay; they are exceedingly hard to break. Size: from a pea to a walnut. When cracked in half, they have the appearance of metal in the middle generally, and small veins radiating from the centre to the circumference of the same; the larger part of them is made of what looks like hardened blue gault clay. In one of them I found a small speck, which, examined under a microscope, disclosed most beautiful green and red metallic crystals. Can these balls be coprolites? Some of them have whitish-grey streaks inside. They are certainly not the ordinary metallic balls of pyrites, sometimes called "moteorites," "thunder-balls," &c. If they are coprolites, of what can they be?—JOHN HALL, Sevenoaks.

[45440.]—**Driving-Clock for 4 in. "Cooke"** Equatorial.—I intend to make a clock of the above size, and would be obliged to any of your mechanical readers, through your valued journal, for a description or drawing of a proper train of wheel-pinions, governor, and all particulars, to be driven with a weight as usual. I have been a subscriber to the "E. M." from the beginning, and have it bound in yearly volumes, and is now really a library, and, so far as I have observed, there has not been any drawing or description of a really useful mechanical driving-clock been given by your correspondents. True, there has been a deal said and written about sand and water-clocks, and other useless devices.—T. G. F.

[45441.]—**Electro-Magnets.**—To Mr. LANCASTER.—It would be a great boon to several of us if you would kindly furnish a scale of core and wire for making these, as the questions are frequently asked, and it would be very good for reference. Magnets to lift from 10 lb. up to 300 lb. I hope I am not asking too much, and, when silk-covered wire is not used, would it be better, if after the magnet is wound, to steep it in paraffin, or steep every layer as it is wound?—

To lift lb.	Diameter of iron core.	Length of poles, or length of iron be- fore bent.	No. of wire and quantity.
10			
20			
40			
60			
80			
100			
140			
180			
180			
200			

—M. R.

[45442.]—**Bluing Watch-Screws.**—Will "Fellow Workman" kindly inform me how to finish watch-screws from the rough?—W. MOORE.

[45443.]—**Diminishing Strength of Hair-Springs.**—Will "Fellow Workman" kindly inform me how to diminish strength of hair-springs by the use of acid?—W. MOORE.

[45444.]—**Varnishing Ink.**—I have been told that an aqueous solution of iodide of starch forms an ink which fades away in a few weeks. How is the solution prepared? I cannot persuade my iodide of starch that it ought to dissolve in water.—GLATTON.

[45445.]—**Japan for Iron.**—How is the black lacquer or japan on the poppet-head and other parts of a lathe produced? If the goods have to be fired, is there any risk of warping or twisting the mandril-head?—M. H.

[45446.]—**Meal Elevators.**—I shall be obliged to anyone in the milling trade who will tell me the best or maximum speed in feet per minute at which meal elevators or horizontal conveyors should be driven?—MONSTER.

[45447.]—**Incandescent Light.**—Will "Sigma," or Mr. Lancaster, kindly say what light I may expect to get from a foot of platinum wire, 0.1 in. diameter raised to 3000° F. I, like many others, wish to try my hand; but, before going to expense of putting a battery together, I shall be glad to learn if the above would be of practical utility.—E. C. F.

[45448.]—**Berliner's Violin.**—I read with interest "Esar's" communication respecting Berliner's new violin, and am inclined to try the effect of the alteration advocated; but I am "foggy" about the arrangement of the bridge. Will "Esar" say through which hole, in the diagram he showed last week, is the bridge intended to be placed? If in the small one, it must, of necessity, have to stand on one leg, and that would be detrimental to both the instrument and the tone.—MAX-OSWALD.

[45449.]—**Cleaning or Restoring Indian Brass Articles.**—Can any of your readers inform me how to restore the brilliancy of the articles of Indian brass manufacture when they have become tarnished? The

articles I mean are salvers, vases, cups, &c., which, when first imported, look like engraved gold of a bright rich yellow tint. It is stated that the natives clean these things with lemon juice, but, if so, they must apply it in some special way. Perhaps the effects of gas in the rooms have not to be overcome by the natives in India.—GAMMA SIGMA.

[45450.]—**Intensity Coil.**—To Mr. LANCASTER.—I made a coil from Dyer's book. Reel, 10 in. long; primary, about 1 lb. No. 16; secondary, about 1000. No. 38, or a little stouter; condenser, 75 sheets 5 by 5; and I can get a good fat [in. spark. I think, with what primary wire I have on, it would do with considerably more secondary wire and produce a better spark. Would you please instruct me? How much more would it do with 1 and, what number, 36 or 38? And, should I have it cotton or silk-covered?—LEARNER.

[45451.]—**Bunsen Battery.**—To Mr. LANCASTER.—In making a Bunsen battery, how should the brass terminal be fixed to the carbon? I made some with lead tops and fastened the brasses thereon, but, after being in use some time, a white substance appeared between the carbon and lead and stopped contact. Would it do if a hole was drilled into the carbon and a copper wire fastened in with lead? Also, how should the terminals be fastened on the carbons in making a bichromate battery?—H. C.

[45452.]—**Casting Flywheels with Wrought-iron Arms.**—Would "Working Tom," "Oakland," or some other of our practical readers, kindly give me their experience as to casting above? My difficulty is to get a thoroughly sound casting at the junction of the wrought-iron and cast iron. I have tried fling the wrought-iron bright, and also chalking it, before casting, and have cast them with hot iron, and with metal just hot enough to run them, but have never got a casting to please myself. I have experienced the same difficulty (but not to so great an extent) in casting pipes and using pipe nails for supporting cores.—LEON.

[45453.]—**Foundry Drying-Stoves.**—I will require a stove built for drying engine cylinders, retorts, &c., and would feel obliged if someone would advise me as to the best construction, both as to quick heating and economy in fuel! All those I have seen simply have a furnace at one end and flue at the other.—LEON.

[45454.]—**Staining Salmon Flies.**—I have a small bottle of Judson's dye (canary), I find it about one-third full of crystals. How should it be used in this case, as the directions are to use a teaspoonful of the dye to four quarts of water? Also, will the dye be more effective and lasting if some alum is put in the water? Or, will this do harm? I require the dye to stain feathers for salmon flies. Can any reader say from experience whether Judson's dye answers well for this? Or, does it wear off in the water when the fly is used?—B. M.

[45455.]—**Repairing a Compass.**—I have a floating-card pocket-compass which has lately lost its sensitiveness, owing, apparently, to the suspending point having become blunted. The glass is fixed by burnishing the brass edges of the case over it. Will Mr. Lancaster, or some other reader who is "up" in these matters, tell me how to take the glass out, sharpen the point, and replace the glass? I have another job which requires some burnishing in—viz., one of the lenses of a pocket-telescope. I am aware that it would probably cost less to have these things done by a professional hand; but I wish, if possible, to acquire the knack myself.—GLATTON.

[45456.]—**Microscope Magic-Lantern.**—I find it very inconvenient to exhibit physiological slides to a class of students by allowing each in turn to look through the microscope, and shall be glad to hear from any of our readers if it is possible to get a sufficiently powerful lamp, either of oil or of common gas, to project an image through the microscope on to a screen. An oxy-hydrogen microscope is out of the question for such a simple purpose; but as, I think, for a class of two or three dozen, a disc of 2 ft. or 3 ft. would be quite sufficient, probably, an oil lamp would succeed. If this were possible, it would be a great addition to my teaching resources, and the assistance of Mr. Lancaster, or other experienced correspondent, in suggesting the lamp and arrangement of lenses for such a purpose will greatly oblige. Of course, if my microscope lenses can be included in the arrangement, it would be better.—ST. GABRIEL.

[45457.]—**Repairing Oil Painting.**—I have lately rescued from total destruction a fine portrait of my grandmother as a girl. It was cut out of the frame 50 years ago and doubled up anyhow. Result: cuts and tears everywhere, so that except on some parts of the face, there is hardly a piece 2 in. square intact; but, luckily, very little absolutely missing. I propose to paste a thick sheet of paper over face of painting, procure a properly-stretched canvas, glue on to this, soak off first paper, and then carefully make good defects. Is this right? Any hints of procedure will be highly appreciated in any branch of the undertaking.—ONE WHO MEANS TO DO IT.

[45458.]—**Watch-Cleaning.**—I wish to clean a full plate lever-watch, and should be glad of a few hints from "Alfoje," or "A Fellow Workman." Are the brushes softer than those used for clocks? How many turns must I give barrel-arbor before setting click in its place?—H.

[45459.]—**Artificial Light.**—Will some kind reader inform me of the best artificial light to use in a room for photography to take portraits by on dry-plates? I have tried a white fire composed of nitre 30 parts, sulphur 10, and black sulphide of antimony 5; but the fumes are overpowering. I may say that I am very handy at metal-work, and have a lathe and all the tools; therefore, I should be glad of a hint as to how I could construct an apparatus giving a powerful actinic light. Would two magnesium ribbons do? or, a lamp constructed to burn the white fire in? or, would it be best to have the electric light? If so, what batteries would be the cheapest to use? And, how many cells? Also, the size of them? I have heard that the carbon battery is the strongest and cheapest, as Grove's are expensive to keep

going. Could I make the lamp? Or, should I have to buy it? As money is a great object with me, I should prefer to make the apparatus. Now that the weather is getting so bad for portraiture out of doors, I feel certain that many readers of the *ENGLISH MECHANIC* who "go in" for photography, and, like myself, have not got a studio, will be interested in answers to this query.—PYRO.

[45460.]—**Varying Watches.**—Will "Fellow Workman" say what are the causes of watches varying that have expansion balances? Also, I have a watch, the lever of which occasionally goes to either of the banking-pins and there sticks, and, by touching side of lever, the watch goes again. What is the cause and remedy?—PIVOTER.

[45461.]—**Clockwork Trains.**—Will some of "ours" kindly inform me where I can obtain small clockwork trains for moving small models, such as sand toys? I believe such can be obtained for a very small cost. I want them to go for five to ten minutes. I am making up some French models for a bazaar, and find sand so tedious. As I have seen some models moved by clockwork instead of sand, shall be glad of any subscriber who will help me.—J. H. L., Norwich.

[45462.]—**To "Clerkenwell Clockmaker."**—Kindly tell me through the columns of "ours" the number of teeth of the wheels and pinions of the four-legged gravity escapement regulator described in Volume XXXI. I shall be glad to see your most interesting papers on a chime clock coming forth.—A NOVICE.

[45463.]—**Caoutchouc Tubing.**—The caoutchouc tubing which I use for a table gas-lamp has become so impregnated with gas as to taint the air of the room. Is there any effective method of rendering caoutchouc impervious to coal-gas?—PARALYSED ONE.

[45464.]—**Model Steamboat.**—I have a small boat 3 ft. 6 in. long, 8 in. beam, and 7 in. deep; engine, a vertical slide-valve cylinder, 1 in. bore, 1 1/2 in. stroke. Could any brother-reader kindly give me the size and shape of a boiler to drive it? A sketch would greatly oblige.—YOUNG AMATEUR.

[45465.]—**Refuse from Sugar-Mills.**—As, even in Egypt, we derive much useful information through your columns, I should like to know, through their medium, who are the consumers of the refuse "trash" or "bagasse" from sugar-mills, as I might be able to open a trade with this article? I believe it is used by papermakers. If any idea could be given of its use and value per ton at Liverpool or London, I should feel obliged.—EGYPTIAN.

[45466.]—**Condenser.**—One of my engines (horizontal) has been standing for two months, and, after starting it again, I find I just get 28 in. vacuum before I stopped. I had 27 in. I can find nothing wrong—plenty of water to condense steam, and I cannot stop any length of time, as my other engine has broken down. Could any of our readers assist, and oblige?—CONDENSER.

[45467.]—**Injector.**—My injector fails to work unless it is put full on; then it takes the steam out of boiler too fast. How can I regulate it to feed slower? It has got no name on it; it looks like Giffard's.—C.

[45468.]—**Pumps.**—I have a pair of plunger-pumps driven by spur gearing with air-vessel on main, and, at each stroke of pump, they give a thump, which is felt all round the building. There was no noise for two years after the pumps were fixed. I have tried to find the cause, but failed to do so.—ONE IN TROUBLE.

[45469.]—**Mirror.**—Can anyone explain and remedy the following?—I allowed a candle to drop out of the candlestick, and, for a few minutes, it lay against the face of a large mirror. When removed, it was seen that a mark was made on the glass in the shape of the candle-flame, which cannot be removed. The silver is not injured, as the mark can be seen reflected behind, it feels rough to the finger.—JOHN T. LAWRENCE.

[45470.]—**Spasms.**—Would Dr. Edmunds kindly give a poor female sufferer some help for spasms? She is 44 years old, a widow with one daughter. She has liver complaint and indigestion, with spasms about once a week.—SUFFERER.

[45471.]—**To Mr. Lancaster.**—Many thanks for your kind and prompt replies to my queries. The so-called zinc sulphate cell was a little ebullient though about 2 in. long by 1 1/2 in. deep, breadth 1 in. In the bottom was a plate of carbon, above it and situated on a little ledge rested a piece of metallic zinc—this was said to be charged with above salt. I have four "Gaffie" cells, which I use in the surgery for medical galvanism to work two small coils. Please let me know how to recharge them.—A. M. D.

[45472.]—**Stiff Lathe.**—My lathe works very stiffly. It is a 4 in. centre bar-lathe, 4 ft. bed, made by Evans, with a traversing mandril, and has a four-speed wheel. Will some kind reader of "ours" tell me how to make it work more easily? Would a flywheel mend matters? If so, what weight should it be?—A. N. J.

[45473.]—**Electric Light.**—I wish to employ the electric light sometimes for about six hours at a stretch, and am thinking of employing a Faure's battery. How large a surface of lead should I require for one powerful light? Could I charge it with a small hand dynamo-machine? And, if not, how large a Bunsen battery should I require?—ZU.

[45474.]—**To Mr. Lancaster.**—Would he kindly explain how to make an instantaneous shutter for a {plate camera?—ZU.

[45475.]—**Double Stars.**—In Mr. Crossley's work upon the Double Stars, there is a plate showing the remarkable motions of the components of γ Cancri. The cycloidal path of C is obviously that which it would describe were it, with a non-luminous companion revolving round their common centre of gravity in a period of sixteen years. No such suggestion, however, is made, and I should be glad if any of your astronomical readers would state what objections there may be to so palpable a theory? Supposing the observations to be accurate,

the change from a looped to a sinuous path might be explained by an eccentric orbit and the rapid rotation of the line of nodes.—H. K.

[45498].—Boiler Pressure. Will "Sunlight," or some obliging correspondent, kindly tell me the bursting and safe working pressures of a boiler 24in. long, 12in. diameter, in plate (steel, I think), seam riveted and brazed, hemispherical ends brazed only. It has the following on a brass label: Proved for the London Portable Gas Company.—W. W. E.

CHESS.

ALL Communications for this department must be addressed Chess Editor, 22, Chancery-lane, W.C.

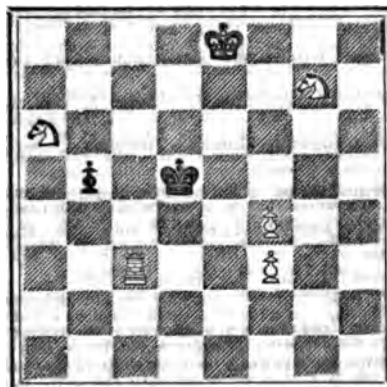
PROBLEM DCCXVIII.—By J. PIERCE, M.A.
Black.



White.

White to play and mate in two moves.

PROBLEM DCCXIX.—By C. PLANCK.
Black.



White.

White to play and mate in three moves.

SOLUTION TO 714.

- | | |
|---------------|--------------|
| White. | Black. |
| 2. Q to Kt 8. | 2. Anything. |
| 3. Mates acc. | |

SOLUTION TO 715.

- | | |
|---------------|--------------|
| White. | Black. |
| 1. Kt to B 3. | 1. Anything. |
| 2. Mates acc. | |

NOTICES TO CORRESPONDENTS.

CORRECT SOLUTIONS TO 711 by W. J. Jubb (conception good, the moves being well hidden), S. L. (a capital problem), H. Planck (an excellent problem: the mate with Q at Kt 8 is very fine), "Tri," W. W. (beautiful; I should be pleased if you can give us a few more of Mr. Planck's elegant compositions), A. Schumcke, and J. W. P. (two of the variations are very neat); to 712 by W. J. Jubb (a sacrifice well rewarded), S. L., H. Planck, "Tri," W. W., A. Schumcke, and J. W. P.; to 713 by W. J. Jubb, S. L., H. Planck (elegant and pleasing, but no great difficulty after the first move), and W. W.; to 714 by W. J. Jubb, S. L., H. Planck, W. W., and J. W. P.; to 715 by W. J. Jubb, S. L., H. Planck, W. W., and J. W. P.; to 709 by "Tri" and A. Schumcke; to 710 by "Tri."

"Tri."—In problem 712 the reply to 1. Q to Kt 8 is 1. Kt takes P. In problem 713 black defends himself against 1. Q to Q 8 by 1. R to R 5.

G. F. (Stroud).—The matter has been attended to.

A. S. (Stockton-on-Tees).—Very pleased to receive your solution. A little practice will soon bring it reward. Problem 713 cannot be solved by 1. Q to Q 8. Black

has just one reply, which guards the threatened mate 1. R to R 5.

J. N. D. (Tuxford).—Rosenbaum's Chess Picture is intended for a particular club. It is the representation of London Chess Players contending three games by telegraph.

H. HALL (Walworth).—Many thanks for the trouble you have taken in forwarding the game. We are sorry that it is unsuitable for publication. The moves played by your opponent were extremely weak, and the game in its entirety is but a variation which often evolves from more elaborate games.

J. P.—Will you kindly forward your present address?

ANSWERS TO CORRESPONDENTS.

* * * All communications should be addressed to the Editor of the ENGLISH MECHANIC, 21, Tavistock-street, Covent Garden, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

* * * Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Miscellaneous Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 30, and unacknowledged elsewhere:—

E. B. B. KELLY.—J. W. Queen and Co.—W. G. Penny.—J. P. Strangman.—Capt. Lister Kaye.—R. Lederer.—H. H. Holt.—F. W. Reynolds and Co.—W. H. Smith and Son.—W. Coleman.—H. Holt.—H. G. Cheesman.—E. A. Litton.—W. J. Bradshaw.—Ch. Benson.—E. K. Jones.—Westinghouse Brake Co.—Stratthay.—R. Gough.—Bojce.—Telescope.—Gluth.—D. H. G.—The Village Philosopher.—P. T. D.—Young Turner.—Edinburgh.—W. H. H.—Afrikanus.—W. J. C.—S.—W. U.—L. S. S.—Capax.—Feesee.—Filter.—Yosemite.—Rev. J. Bone.—A Steam Boiler.—Glatton.—Sergeant Sharpe.—Tau Sigma.—W. G. Dorcott.—A Three Years' Subscriber.—C. S. B.—Genius.—Anatomist.—J. C. L.—A. Tavernier.—Zares.—Oldhallian.—Amateur.—H. Mills.—Anglo Dane.—Trying to Learn.—W. T. Bashford.—A. A.—G. Keilly.—Brewer's Chemist.—Wishful.—G. W. L.—Meteor.—Carstairs.—Peter.—C. W. Clifford.—Lockitch.—E. L. P.—Norman.—Dix.—Lewis Arundel.—Gabbri.—Dorothy.—E. B. Fennemy.

JUPITER.—Two letters containing sketches of Jupiter are to hand from the Rev. W. Cunybeare Bruce and Mr. J. L. Stothart; but, unfortunately, too late to engrave the drawings. We will, if possible, find space for the first next week.

H. STOMAN. (The major portion of your letter refers to matters which we cannot discuss. As regards the elements of Tolles' 1-10, calculation gave the "bal-sam" angle 110° 35' 10", whilst by actual measurement the angle was 87°, which proved that the full diameter of the back lens was not utilised. As to the elements of your own 1-10, in which you state the diameter of the back lens to be 4, we have no doubt whatever that a properly-conducted examination would prove that you do not utilise so much as 3 of linear diameter of back lens.)—ELECTRON. (You should have sent the title of the book and something of the context. As it stands, only the author can explain.)—YOUNG ENGINEER. (The plates should certainly be amalgamated. Clean with strong solution of soda and a brush. Stand in solution of sulphuric acid (1 to 10) until the zinc is vigorously attacked, then transfer to a tray, and pour mercury over them, rubbing it on with a wisp of tow. See that you get pure mercury. There is no work of the kind, but you must study a good textbook, and then read Fontaine's "Electric Lighting," published by Spon.)—A PLASTER ENGRAVER. (Mix thoroughly and rather thinly, and if the plaster be good there should not be any holes.)—W. CLAPSON. (We believe lime polish is the best. A piece of silk-laced sifted through fine muslin, but it will need plenty of elbow-grease. Jewellers' rouge would be quicker, and it would also wear the plating off rapidly.)—ONE ANXIOUS TO KNOW. (Sealing-wax is made by melting shellac in a bright copper pan. Venice turpentine is then added, and a few drops of the colouring matter—cinnabar for red, ivory black for black. When thoroughly mixed the pan is removed from the heat, and as the wax cools it is cut out in pieces and rolled on a warm marble slab with a polished block of wood, or it is poured into moulds directly it is taken off the fire. For common qualities, rosin replaces a good deal of the shellac, and red-lead is used instead of vermilion, lamp-black instead of ivory black. Scent with balsam of Peru, and a little camphor makes it burn better. You will find a number of recipes in Vol. XVI., p. 365, No. 401. There are proportions for nearly all kinds and colours. It is "out of print," however.)—EOLIAN. (Olibanum 7 parts, gum benzoin 2, cascarilla 1. The last may be omitted by increasing the proportion of oil.)—TAVO. (See answer above to "Young and several recent replies—pp. 141, 145, for answers battery answers your first question.)—(Dolbear's book on the Telephone

can be had, we believe, of Sampson Low, Fleet-street, or Trubner, Ludgate-hill, E.C. It is published by Lee and Shepard, Boston, Mass.—C. E. COOPER. (You will find information on the subject in nearly every volume; but refer especially to pp. 361, 363, Vol. XXVIII. See also the indices to Vols. XXI, XXII. They require nothing more than a few small worms occasionally.)—H. MOR THOMAS. (See the indices, commencing with Vol. XIV. You appear to have taken up Ferguson's centrifugal theory, which was described on p. 60, Vol. XIV. At present we have no space for a controversy on a very abstruse subject, one, in fact, which puzzles the greatest mathematicians.)—TAVO. (The sketch you send represents a kind of boiler that is in extensive use. The bends do not burn. See a Davy-Paxman boiler, if you can. 2. Taking the exhaust out by a patent ports underneath a horizontal cylinder is adopted to drain the cylinder. Taking exhaust through steam ports cools the metal at every exhaust, and consequently helps to condense the live steam.)—A BRASS-MAKER. (Get the rules of the Apothecaries' Society. We should think not; but if you had passed the advanced, the certificates would, doubtless, be accepted.)—BRASS-MAKER. (Procure No. 820 of the Journal of Gas Lighting, and Dr. E. J. Mill's "Destructive Distillation," published by Van Nostrand. For the other matter, consult the "Gas Manager in the Laboratory," published by Hastings, Buckingham-street, Strand.)—PHYSICIAN-BRICKER. (Three or four inches, but much depends on the state of the atmosphere as well as on the machine. If we understand the second question, the answer is simply because it is more refractive.)—A RIDDLER. (If by "small" you mean a child's coach, they would; steel would be not only better, but cheaper.)—EQUICMAN. (See answer to "One Anxious to Know," above.)—G. FAYNE. (Your second query answers the first. See indices under head of "Bracing." "Spelter" is the solder, and "borax" the flux.)—BRICKMA. (It is, as we said, about the size of a feeder, 14in. by 18in., with two large holes and two small. The standard reed is fixed by clips over one hole, and the one to be used held by fingers over the other. The large holes for large reeds; the other two for small. It is not furnished with keys and pallets, but is some of the reed factories they have a standard set mounted over a suction bellows, with apertures closed by pallets, over which the reed to be tried is placed.)—E. J. (If the secretary is not justified in so doing, you must appeal to the directors of the Unity. He ought certainly to assign some reason for his refusal.)—C. H. (Try a little washing soda in the water.)—S. L. K. (If you mean copying-inks, a little sugar; if you mean the chromograph or halograph, aniline violet is the best. Dissolve in alcohol and thin with water. They must be inferior inks or peculiar paper. Get a chemist to dissolve some of the aniline colours for you.)—W. H. G. (On p. 243 we not only referred you to the recipe wanted, but gave the quantities of the ingredients. See p. 243, near the bottom of third col.)—H. E. K. (Try benzoline and the hot iron and blotting-paper.)—H. E. C. J. (You should obtain some elementary work on electro-metallurgy. You will find much instruction in the last few numbers—reply 45092.)—X. Y. Z. (Probably Jupiter, though it may be Mars.)—F. YERVOY. (You should obtain a considerable instrument for about 25, and you could add a better object-glass afterwards; but that and your other questions have been fully answered many times. 2. Procure "Practical Photography" from 170, Strand, W.C. 3. It entirely depends on the quality. Consult the catalogues of the dealers. 4. It is necessary to become expert, but how long that would take you we cannot say.)—GRAHAM PORTER. (We do not know of any such paper. It is difficult to recommend books without knowing the object of the would-be student; but you may profitably read Prof. Emerson Reynolds's "Experimental Chemistry," published by Longmans.)—VAS ZOSSENBAACH. (You need not have said you are "quite a beginner." Procure some elementary work on electricity, and then ask questions. Full instructions for making batteries in many back numbers. See pp. 63, 137, 312, 362, Vol. XXIX., and pp. 313, 372, 365, 418, 464, 530, 585, 630, Vol. XXVIII. For telephones and microphones, consult the indices of the last four volumes. You will find plenty to choose from.)—J. W. C. (It explains itself, if you read the question. It is for drawing gas or liquids out of a vessel by the "suction" or vacuum created by the jet of steam.)—GLATTON. (There is nothing much to explain. The two tubes are simply a sliding fit and the other is spread to a cup form at the top, which is filled with water, or, preferably, glycerine. 2. It means the first night of May, and is synonymous with witches' night. Nothing to do with Druidical festivals, as St. Walpurgis was canonised. There is a short account in "Chambers's Encyclopedia," but it is very obscure.)—L. E. MCNAB. (See p. 306, Vol. XXXII., and p. 326, Vol. XXXIII. You have simply to arrange a magnet in such a manner that it will attract an armature, which is attached to the connecting-rod of the crank. For illustrations, see pp. 41, 483, 533, Vol. XXI.; p. 634, Vol. XXII.; and p. 254, Vol. XXIII. They are, as a rule, mere toys.)—C. H. D. (Specification of Crystal Palace organ on p. 129, Vol. XXII. It is known as the Handel Festival Organ. We do not know other, but all replies are indexed.)—RAMON ESTRADA. (We illustrated the compass on p. 472, Vol. XXIV.; but if the papers have appeared in the Journal your name, write to the secretary of the Institution, Whitehall, S.W.)—W. O. TOLCOT. (Yes; at least it was a month or two back.)—J. SKINNER. (We cannot engrave coins.)—F. HARRIS. (Such questions must be asked of Mr. Evans privately, or else through the medium of the "Address Column.")—ENQUIRER. (We have long ago described the gas-engine referred to, but you would, in our opinion, do far better to get the "Otto.")—J. MARSHALL. (Yes; there is an association which devotes itself to the profitable but not very creditable work of recovering penalties in such cases, so you had better be careful.)—W. A. (There is no other chance but an operation. Do not risk the saving her life by recourse to quacks, who will risk empty your pocket without doing you or wife the slightest good.)—T. W. M. (Full instructions are sent with the apparatus you name, and you cannot buy anything simpler or more easy to manage.)—A. SCOTT. (We noticed the chart months since, and it has been advertised at intervals since in our pages—last week, for instance.)—PETER THOMAS. (We believe at John Brown-

ing's, 63, Strand, London, W.C.)—A. SEN. (1. We really cannot spare space to answer this: it would take a whole number; consult Ure's Dictionary, under the various heads. 2. A pyrometer. W. H. Bailey and Co., of Salford, make a good one. 3. Must appear in the "Address Column," if at all. 4. Crossley Brothers, of Manchester, are the best, and will doubtless answer your questions if written to. 5. The action is mechanical. 6. Bisulphide of carbon. 7. Same reply as 3. 8. Practice only, and instruction from a good workman. 9. See indices to back vols.)—A. DEVONSHIRE DUXFORD. (We have subjected the small cube of stone sent to intense heat for twenty minutes, and it certainly does not melt. If, however, the material does not melt in larger quantities, a furnace like an ordinary blast-furnace would do; but unless when fused and moulded the products are of closer texture than the small sample sent, we question their suitability for building purposes.)—OWEN A. FOO. (We do not think you would be interfered with, but do not take our opinion as worth anything. Much more search and careful thought than we are disposed to give to the matter are necessary to arrive at a reliable opinion.)—LOCO. (We do not understand you at all. The gases would have no "result" as far as the draught of the furnace was concerned. If we fail to grasp your meaning, which is exceedingly probable, write and explain.)—J. A. WRIGHT. (See replies 33232, on pp. 403 and 427, Vol. XXVII.)—STENO. (The latest discussion about Freemasonry, with which we are familiar, appeared in the *Building News* of Oct. 7, 14, and 21.)—POOR AMATEUR. (No one could say without personal inspection; but you would, in all probability, buy cheaper of Mr. Lancaster than would better suit your purpose.)—H. H. (A forger, in all probability.)—HEATHKIT. (We do not think registration would protect you; but we cannot say certainly, as you do not tell us what the article is. Provisional protection—the first step towards a patent—costs, including a respectable agent's fees, about £8 to £10, and will give you protection for six months, during which time you could seek aid from a capitalist in safety.)—FIRM. (Your story would furnish all the elements for a sensational novel, and no lawyer could advise you without minute inquiry into the facts. If you can really prove what you say, the purchaser of the property will have to restore it, and, in turn, have his remedy against the representatives of your former solicitor; but how either of the solicitors could have allowed the alleged personation and consequent forgery is to us a mystery.)—MARK TAYSON. (We have not received it.)

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Parrot Cage, new. What offers cash or exchange?—MARIN, Cupola, Sheffield.

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"**English Mechanic.**" 700 to date, four indices good condition; will exchange for Model Boiler or anything useful.—W. J. STEVENS, 8, Greendale-road, Upper Holloway, N.

Microscope, by Smith and Beck, list price £75, for American organ or other.—JOHN CHURCHILL, Junr., Newton Abbot.

What offers, cash or exchange, for 45 sixpenny boxes of Blakely's Patent Hot P-tractors, each box guaranteed to save at least 10s. in repairs. No post-cards answered.—C. BICKLE, Stoke, Devonport.

From 200 to 250 early numbers of "**English Mechanic**" in exchange for pair of scales suitable for butcher, machine, or beam, in good order.—JENNINGS, 20, Sidney-street, City Road, London.

Fine Sin. Astronomical Object-Glass, cost £5; in exchange for Microscope Objective.—E. B. FENNERTY, Palladium, Limerick.

Magic Lantern and Slides, cost £9. What offers?—E. B. FENNERTY, Palladium, Limerick.

Microscope Objective, new, wide angle, 1-3th, by Smith, cost 35s., 6s., exchange.—E. B. FENNERTY, Palladium, Limerick.

Sciopticon, cost £6 6s., given in exchange for Lathe heads, youth bicycle, or other.—E. J. EVANS, Walton, Ipswich.

Wanted, brass, or brass-mounted **Parrot's Cage,** or exchange Parakeet's Cage.—Full particulars, 10, Cambridge-terrace, S.W.

Electrical Apparatus, &c., given in exchange for chucks for a fine centre lathe.—Address, W. E. K., 70, Belvidere-road, Upper Norwood.

Wanted, any Proctor's **Astronomical Works.** Plate or cylinder for electric machine and chemical apparatus exchange.—Glynedw-villa, Harriet-street, Cardiff.

Punching Bear, value 12s. 6d., weight 54lb., with extra punch, for steam-pressure gauge in working order.—W. W. EVANS, Waltham, Rotherham.

Magic Lantern, 31 condenser, worth £2 5s., for 30s., with lamp complete, in box stand. One do. with Newton's 3-1/2 x lamp, with photo. objective lens; good exchanges.—S. EBENEZER street, Cardigan.

Wanted, **Carpenter's and Joiner's Tools.** cheap will give first-class exchange. Furniture, clothing boots, jewellery.—FARDE, C. MAY, 22A, Eastward-street, Dale-street, Devons-road, Stanley-by-How, London, E.

Splendid model of water-tube **Steam Boiler,** cost £26 making. Recently on view Royal Polytechnic. What offers?—ALPHA, 50, Quay-lane, Exeter.

Microscope (3 power); will exchange for Gold Albert, 46in. Bicycle, or L-ver Watch, or offers.—F. DENTON, Market-20w, Great Yarmouth.

"**Scientific American**" and "Supplement," 69 consecutive numbers, for "Gannet's Physics," or offers.—ALPHA, 50, Quay-lane, Exeter.

Wanted, 10-cell **Bunsen Battery**, quart size, in case, and few yards gutta-percha covered wire, in exchange for new 24 in. Lockstitch Sewing Machine.—W. H. JOHNSON, King's Lynn.

Opheleide, twelve keys, one broken. What offers?—T. WATSON, Muggers Lodge, Whitby, Yorks.

Bunsen Cells, 25 quart size, 10 new lines for ditto, 2 Daniell's copper cells, 12 by 4, suitable for electro-plating. Exchange for small black geared Lathe.—4, Belmont-terrace, Stapleton-road, Bristol.

Good 4-plate **Walnut-wood Camera**, two dark slides, hardly used. Also good tuned old violin. Will exchange one or both for good portrait lens about 5in. focus, any maker. Will last week's *Liverpool Correspondent* send legible address?—KOSTON, Photographer, 36, Caroline-street, Cardiff.

Geology.—I should be glad to exchange Palaeozoic fossils for other specimens, or anything useful to a geologist.—T. G. F., 106, Finch-road, Handsworth, Birmingham.

Exchange.—Offers requested for a lot of Bicycle fittings and sundries, a 50in. bicycle, and two lathe-chucks.—ROBERT VANNEA, Flood-street, Chelsea.

Grubb's View Lens, 3in. diameter, for pictures 12 by 10, cost £3; pocket folding camera. A harmonium wanted, value adjusted.—B., 11, Athol-road, Sunderland.

1,530 Whipping Tops, 4d. per gross, in exchange for a set drawing tools.—ROBINSON, 2, Bedford-road, Hitchin, Herts.

Lathe (Gentleman Amateur's), valuable, 3ft. bed, overhead motion, divided head, oval, eccentric, and variety of other chucks, slide-rests, and set of tools numerous to mention, recently offered in "E. M." for sale for £40. Will exchange for first-class microscope, astronomical telescope, modern dissolving view apparatus and photographic slides, for electric or limelight. Must be by known maker. Can be seen by written appointment, W. RICK, 10, Farringdon-street, E.C.

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Advertisements are inserted in this column at the rate of d. for the first 16 words, and 6d. for every succeeding 8 words.

For Sale.

Electrical Wires: silk, cotton, indiarubber, and gutta-percha covered. Bell and handle cords.—W. RICKARD, Derby.

"**The Night-light Clock.**" Illustrated and described on page 370, No. 345. Price, carriage free, 6s. 6d.—F. ROBERTSON, 13, Greek-street, Soho, W.

Photographic Apparatus. Cheap complete sets for amateurs. Instructions free.—HUNTER and SANDS, 20, Cranbourne-street, London.

Astronomical Telescopes.—The Complete Equatorial, 4 1/2 in. aperture, 4ft. focus, first quality divided 1" doublet, iron stand, finder, 3 powers, screw motion, £14 13s. Send 4d. for "Use and Adjustment of Reflecting Telescopes," with Photo.—F. E. FARRIS and Co., Opticians and Electricians, Southampton.

Band Primo.—A Tutor for all Band Instruments. "A Book which every Bandman should have." Price 5s., F.O.O. T. RAWSON, 114, Heaton-lane, Stockport.

Fret Saws, 2s. 2d. per gross.—LA RICHE, Smithford-street, Coventry.

Fretwork Designs for new miniatures and Illustrated Catalogues of Machines, Tools, and Wood, and all required by the fret-worker. Send stamp.—HARRIS, HAAS, settle, Yorks.

Harmonium, £5; 7 stops, walnut case, full compass, ivory keyboard; bargain.—55, Collier-street, King's-cross.

Lantern Photographs, 10,000, with readings, from 6d. plain, 1s. coloured.—A. PUMPHREY, Emily-street, Birmingham.

Lantern Photographs for Hire. List and sample picture for 3d. in stamps.—A. PUMPHREY, Emily-street, Birmingham.

Triplex Lantern, Achromatic Lenses, full size, best light, limelight excepted, 12s.—PUMPHREY, Emily-street, Birmingham.

Complete Limelight Apparatus, equal to 200 candles, 90s. List of Apparatus 3d.—A. PUMPHREY, Birmingham.

Chromatrope, with 5 designs and Eidotrope, complete from the manufacturer, 10s.—A. PUMPHREY, Emily-street, Birmingham.

Ironmongery, Clocks, Timepieces, Jewellery, Furniture, &c. Agents wanted. Wholesale catalogues, 300 illustrations, free.—Apply, HENRY MAY (34), Birmingham.

Harmoniums, second-hand; returned from hire. All prices.—VENABLES and Co., 157 and 159, Essex-road, Islington.

Pianos, second-hand; returned from hire. Extensive showrooms.—VENABLES and Co., 157 and 159, Essex-road, Islington.

Hunter's Piston Lubricant, and for heavy machinery; a trial solicited.—JOHN HUNTER, Bathgate, Linlithgow.

Silver Cream rubbed on will renovate perfectly old electro. Genuine silver; 13 stamps.—Assay Office, Liverpool.

Meliceria Rings, with other interesting Microscopic Life; tube, 3d., post-free.—S., Fish View, Ayr, Scotland.

Excellent **Magneto-Electric Machine**, in mahogany lock-up box, complete, 17s. 6d.—WILLIAM WRIGHT, Electrician, Fairfield-road, Chesterfield.

Magnesium Ribbon, burns like the electric light, 4d. per foot, forwarded free.—L. ROWLAND, South John-street, Liverpool.

Elastic Stockings. No makers in London. Made in Liverpool only by SMITH and SONS, Green-road.

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Drawings Made, copied to any scale. Every description of machinery designed for engineers, manufacturers, amateurs, &c. Inventor's assisted (mechanically). Terms, 1s. per hour for drawings.—DELY, 6, Albion-hill, Leicester.

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Incrustation in steam boilers removed and prevented. 50 years' recipe £1.—JAMES BIRLIS, 171, Grey Mare-lane, Bradford, Manchester.

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Case of Stanley's brass double-jointed instruments (cost £3 15s.), 30s.—F. 16, North-street, Swindon, Wilts.

Large silver repeater Watch, 80s. cash; perfect condition.—THOS. BURGESS, Hatfield, Herts.

Molson's Patent Harmonograph, complete, in polished teak case, 21s.; stamp for specimen curves.—MOLSON, Swansea.

A small Weston Dynamo-Plating Machine, cost £50; has done very little work, and is now in good condition.—Offers to J. T. MATTHEW, 41, Queen Victoria-street, London, E.C.

Union Wire for scratch brusher and wire brusher; flexible and durable.—See Address Column.

Electric Bells from 5s. Leclanche Batteries 3s., pushes 1s., telephones 2s.—MILLAR, 125, Chapel-street, Salford.

Artificial Teeth by experienced dentist; exchange to value; letter at first.—S. 24, Fulham-road, London.

Gentleman's superior gold Demi-Hunter, by Le Roy; highly finished movement; compensated condition; perfect; cost £15 15s. take £3 cash; week's trial.—"Beta," 30, Ovington-street, Brompton.

Floor Cramps, 8s. 6d.; Bench Cramps, 8s.; Stocks and dies, 1s. 6d.—COTTRELL, Townwell Fold, Wolverhampton. Send stamp.

Sh-p-v horizontal Engine and Boiler for sale, on view at Lister Works, Holloway-road.

Three-stop Organ Soundboard, with sliders, pallets, backfalls, bellows, roller board, keyboard, 108 wood pipes, mahogany case; cash £2 10s.; package free.—M. HERRERT, 121, St. Andrew's-road, Folkestone, Kent.

"English Mechanic," nineteen vols., ten complete, unbound, 20s. or offers.—T. WATSON, Mulgrave Lodge, Whitby.

Bench Lathe, £6, 24in. centre, with back-gear slide-rest, four-speed driving-wheel, made by Bateman, London; nearly new.—EDW. LEANOR, Beal.

Microscope, London made, with tank and Beale's pocket ditto. C. eyepiece, all 1 1/2 tubes, spot-lens, polariser, case, all new, cost £15, bought binocular, sacrifice for £3.—G. JOHNSON, Whitechurch, Salford.

First-class Launch Engine and Boiler, 1 1/2 horse-power, steel boiler and fittings, complete, shaft and propeller; good as new.—E. W. H., 43, Newland-street, Barrow-in-Furness.

Telephones.—A splendid pair of walnut telephones, in perfect order, almost new, worth 21s.; 10s.—F. MITCHELL, Hydenham, S.E.

Mineralogical and Geological Specimens. Amateurs and the trade can be supplied with the above on exceptional terms. Large assortment.—Geo. G. BLACKWELL.

Crystallography.—A few splendid specimens of Hemimorphic (Octahedron Crystals of Antimony Oxide) for disposal cheap.—Geo. G. BLACKWELL.

Bunsen Battery, new designs; square cells; great power; unequalled for electric light experiments; cheap. Quart size, 4s.—Geo. G. BLACKWELL.

Leclanche's Batteries. Specialties in glass cells, storage cells, porous pots, &c.; very cheap.—Geo. G. BLACKWELL, 25, Chapel-street, Liverpool.

Glass Circles and Squares, 3 1/2in. wanted.—EXENT, PACTO, Walton, near Ipswich.

Stylographic Pens.—Vulcanite, complete, with pneumatic filler, warranted; free, 15 stamps.—JOHN FULFRA, 127, Sussex-road, N.

Photograph Scraps, including portraits of celebrities and secular subjects; parcel sent to choose from.—C. BICKLE, Stoke, Devonport.

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Your Photograph Copied, equalling original, six for 1s. 6d., twelve 2s. 6d.—Address, C. BICKLE, Stoke, Devonport.

Indiarubber Stamps.—All stamps warranted for five years. Two-letter monograms 1s. 6d. post-free. For other stamps are specimens sheets, post-free 1 stamp. Agents wanted.—H. SANDOBY, 2, Wood-street-square, London, E.C.

Moustache raised in a few days.—Send 14 stamps to HARGRAY and RANNEY, Newtown, Waterford.

Organ Pipes, Oboe, 44, voiced; new, £3 10s.—W. WRIGHT, 25, Balcombe-street, South Hackney, London.

Wheatstone Bridge set of Resistance Coils, Post-office pattern, £18 quite new. Also Portable Electrometer, Mr W. Thomson's pattern, £11.—A. S. T. E. M., Leverton-street, N.W.

Microscope Object Glasses, good 1in. and 1 1/2in. cheap.—J. L. 7, North-place, St. George's-road, S.W.

All kinds of Turning and Fitting done cheap.—A. H. 4, Sudeley-road, Lavender-hill.

Lathe, 8ft. and 4ft. back gear, by best makers (Britannia Co.).—Apply, SANDROD, 5, Duke-street, Little Britain.

Lathe.—Very strong Bench Lathe, back gear, with good bed, best make (Britannia Co.), 2ft. 6in.; price £4.—GAGE, 110, E-square, London.

Lathe.—Several Lathes, suit gasfitters or amateurs, nearly new; Sandford, Little Britain. Price from £2 5s.

Fret Saws.—A new and very effective Fret Saw, 1 1/2in. on any table, and turn by hand; price 15s.—MAKERS, BRITANNIA COMPANY, Colchester.

Fret Saws.—Strong iron tripod stand with turned stave, 1 1/2 6d. Best value.—BRITANNIA COMPANY, Tool Makers, Colchester.

Lathes of every description. Circular one stamp. BRITANNIA COMPANY, Lathe Makers by appointment to the British Government.—Address, Tool Department, Britannia Works, Colchester. See advertisement. See ENGLISH MECHANIC, April 24, 1891.

Tricycle for sale, rotary action, ball bearings; price £2. 6d., Westbourne-street, Finsbury, S.W.

8 horse-power Portable Steam Engine (by Ransomes, Sims and Co.), just been thoroughly overhauled, and in good repair, suitable for farmers, contractors, and others; also 4ft. 6in. double-blast threshing machine, by Robey and Co., Lincoln; price together £25; a bargain seldom met with.—THOMAS LLOYD, Hareleigh, Essex.

Grove's Battery, 5 half-pints, in tray, 28s.; 4-quart Bunsen, round, in case, 12s.—PATRICK.

Intensity Coils, 1in., 5s.; Vacuum Tubes from 1s. 6d.—PATRICK, 15, White Lion-street, Chelsea, S.W.

Eight horse Vertical Engine, cylinder 8in. by 12in., feed-pump, governors, all complete; price £25; taken out to make room for a larger one. 2 h-p. horizontal, price £7 10s.—A. VONDEL STUE WORKS, Bristol.

The latest Lantern Novelty.—I will send for 1s. 6d. a beautifully defined transparency of whale, taken direct from nature, showing it stranded on sea-beach; valuable to private and public exhibitors. Entered at Stationers' Hall.—W. COVLEY, 2, Villiers-road, Stapleton-road, Bristol.

Two Cruikshank Batteries, each 2ft. long, and containing 60 cells, 12s.—C. J. LARSEN, 4, Chester-road, Dublin.

Lathe Crank-Shaft, 2ft. 6in. long by 1in., with iron for treads; price 3s. 6d.—M. A. INGRAM, Kettlebrook road, Tamworth.

Jeweller's Rolls, in good condition, with handle complete, 27s., carriage paid.—H. BALL, 41, Severn-street, Wolverhampton.

Excellent pair nickel-plated "Austria" Skates for sale, 10/11n., 12s. 6d.—W. WITTON, Farnfield, Wolverhampton.

Gas Holder (portable), 3ft. by 2ft., new, cheap.—A. L. 12, Essex-terrace, Lee, S.E.

The Bell Punch.—For instantaneously centring any round, square, oval, triangular, hexagon, or octagonal article for the purpose of drilling or turning. Invaluable to mechanics and amateur makers, 2s. 6d. post free.—E. K. JONES, 6, Ridley street, Birkenhead. Stamp for reply.

Lantern Slides (about 40), 25 comic, half-price.—W. BASS, 14, Uxbridge-street, Notting-hill, W.

Screw-cutting, Self-acting Lathe, 7 1/2in. centres, 8ft. gap bed, new, £25.—JOHN MIDDLETON, Hope-street, Glasgow.

Compound Slide-rest, for 4 1/2in. lathe, long slide, price 50s.—JOHN MIDDLETON, 16, Hope-street, Glasgow.

Several Launch Engines, different sizes, cheap.—State requirements, JOHN MIDDLETON, 16, Hope-street, Glasgow.

Engineer's 4-independent Jawed Chuck, 8in. dia., good as new, 48s.—JOHN MIDDLETON, Hope-street, Glasgow.

Rubber Stamps. Make your own. Plain instructions, 4d.—Box No. 1, Post Office, Richmond, Yorks.

Drosera Rotundifolia, Leaf, insect in situ, and list of other objects, 10d. free.—BLACKBURN, Cross-street south, Wolverhampton.

Double-acting Horizontal Steam Engine, nearly finished, on bed, cylinders 1 1/2in. bore, 2 1/2in. stroke, 6in. fly, all bright; also handsome set of boiler mountings. What offers?—W. THOMPSON, Railway-road, Ormskirk, Lancashire.

Lantern Photographs: Scripture, Temperance, Comic, and other Tales. 6s. per dozen; sample slide and list, 8 stamps.—THOS. A. and J. JOHNSON, Hulton Liverpool.

Lantern Slides, beautifully coloured, 11s. 6d. per dozen, carriage paid; sample slide and list, 8 stamps.—THOS. A. and J. JOHNSON, Hulton Liverpool.

Lantern Manipulation, giving instructions for the use of the oil-lamp, and limelight, &c., 6 stamps.—THOS. A. and J. JOHNSON, Hulton Liverpool.

Good, powerful-toned Violin, Bow, Case; sacrifice; 30s.; cost £1.—WILLIAMS, 78, Byrom-street, Altrincham.

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Cheap Easy Way to Ornament Sheet Metal before or after making up, giving same elegant appearance; 13 stamps.—H. BLACK, 3, Paradise-place, The Grove, Ealing.

Microscope (by Pilscher), two eyepieces, in h and 1/2in. objectives, polarising forceps, condensing lens, live box in mahogany cabinet, with drawer, all first quality; nine guineas.—THOMAS HODGSON, 8, Clapton-avenue, N. tingham.

Make Your Own Scent.—Musk and Essence of violets, the two twelve stamps.—BOX 211, Spagat, Gloucester.

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Instruments, Fittings, and Materials of all sorts made, bought, sold, and exchanged.—CAPLATZ.

All finished Parts and Instruction for making small Dynamo machines, 24; Motors, 12 to 20, Coils and Belts, 6s. to 10s.—CAPLATZ.

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Great Speciality.—Coils, Batteries, and Materials of all sorts. Fuses, F. ante's, Grove's, &c. Cheapest in the trade.—CAPLATZ.

Dynamo Machine, 4 lights, £30; half-horse Motor, £20; quarter £10; 5-hp. organ, £20; best, £10.—CAPLATZ.

Lanterns and Pelongings, best second-hand, two-thirds price; lantern prisms, microscopes, bags, and thousands of slides.—CAPLATZ.

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Splendid set of Vertical Engine Castings, 6in. by 1 1/2in. cylinder, valve face and flanges planed, only 40s. Design free.—A. DORRINGTON, West Gorton, Manchester.

Half horse-power Horizontal or Vertical Engine Castings, 12s. 6d. per set. 200 unsolicited testimonials. Design free.—A. DORRINGTON, West Gorton, Manchester.

Working Drawings of Model Feed Pump and water-gauge; three stamps.—A. DORRINGTON, West Gorton, Manchester.

The Amateur's Gas Engine, in course of construction. Castings will be supplied at the lowest possible price.—Particulars, A. DORRINGTON, West Gorton, Manchester.

Amateur's Workshop Engine Castings, 6in. by 1 1/2in. cylinder, on four ornamental columns, flywheel included, only 25s. Design free.—A. DORRINGTON, West Gorton, Manchester.

Electro-motors for working models, &c., 10s. 6d., 1/2s., 30s. each.—J. STURTEVANT, 51, Cedar-street, Hulme, Manchester.

Electric Boat, with Bichromate Battery, 12s. 6d., by rail.—J. STURTEVANT, 51, Cedar-street, Hulme, Manchester.

Telephone Transmitters and Receivers; articulation loud, clear, and constant, and very cheap.—NEWTON and Co., Birmingham.

For cheap Electric Bells, Batteries, &c., send to NEWTON and Co., 30, Bath-row, Birmingham.

To be Safe from Burglars and Fire, fit your houses with NEWTON and Co.'s ELECTRIC ALARMS.

Wanted.

Wanted, during winter evenings, lessons in turning from practical man. Moderate terms.—A. D. 32, Christchurch-road, Streatham-hill, S.W.

Wanted, fast headstock for 3 1/2 back-gear lathe.—Particulars to FRED GANDY, 15, Dornley-street, Wigan.

Wanted, good back-gear lathe, about 3in. centres, for cash. No rubbish.—A. C. FEMBERTON, 41a, Abbey-road, N.W. London.

Wanted, genuine Tourte Violin Bow, or other good maker. Light, strong, cheap.—W. WITTON, Farnfield, Wolverhampton.

Wanted, Reliable Houses to introduce Morgan's well-known Improved Scale Preventing Compound for Boilers. Guaranteed harmless to metal. Patented 1874.—W. H. MOSS, Engineer, Gloucester.

Addresses.

Will "Sunlight" send his address to JOHN DAVY, 5, Vicarage-road, Plumstead, S.E.?

The "Rock" Skate can be obtained of the manufacturers, EVANST, Adams and Co., Limited, 52, Queen Victoria-street, London, E.C., and of all ironmongers.

Will "Sunlight" kindly send address of "Small Circular Fan" makers to—A. N. JAMESON, Eastlea, Hall?

Tricycle.—I have just completed a tricycle, with latest improvements in all points, and will show it to callers.—C. LAM, 1, Salisbury-terrace, Birch-road, West Kensington.

To "Fal".—Will you kindly send your address to—W. BAYNES, 3, Albert-terrace, Notting-hill?

Will Mr. Lewis Wright (on "Optics in the Lantern") forward his address to A. H. K., 23, Alma-street, Gorton, by Glasgow.

To "On".—Would he kindly communicate with W. Storey, 51, Mary's-gate, Rochdale?

Wanted, address of a professional painter of magic-lantern slides.—S. POTTEN, 1, East Parade, Hastings.

Wanted, add. res of brushmakers and others using union wire, by F. and E. STANTON, Lewisham, London, S.E.

Would "Sunlight" send his address to—G. MORAN, Partridge-green, Stirling?

Wanted, address of Cigarette Machine Makers.—T. W., 12, Frestage-street, Poplar, E.

Situations.

To Fitters.—Sewing Machine Trade.—Wanted, three fitters accustomed to the "Inger" System. Also several improvers.—Apply, SEWING MACHINE DEPARTMENT, BRITANNIA WORKS, Colchester.

Wanted, one or two men used to Light Mechanical Work. State wages.—BLACK, EMMOTT and Co., Halifax.

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NATIONAL BICYCLE COMPANY, National Works, Coventry. The Original Makers (Infringers Prosecuted).

Illustrated Lists Free on application.



ELECTRIC LIGHTING.—Incandescent and Arc Lamps to work by Battery or Dynamo Machine. Wire Cable, and all accessories. Plans submitted by utilizing water or other power.—F. M. ROGERS, 21, Flinsbury-pavement.

PATENT LAW AMENDMENT.

A MEETING of the Society of Arts will be held on FRIDAY, the 2nd December, to consider and discuss the Bill for the Amendment of the Patent Law prepared by the Council of the Society.

Non-Members of the Society who desire to attend should apply to the secretary for a card of admission. H. TRUMAN WOOD, Secretary. Society's House, John-street, Adelphi.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, DECEMBER 9, 1881.

DU MONCEL ON INCANDESCENT ELECTRIC LIGHTING.

THE fact that the Electric Lighting Company of which Mr. Edison is the soul are about to instal their system on the Holborn Viaduct, is an item of news which demands more than passing notice. Count du Moncel, the distinguished French electrician and unsparing critic of the announcements which, from time to time, have been made in the United States with regard to Edison's inventions, having had an opportunity of studying the system, at the Paris Electrical Exhibition, has pronounced it complete in all particulars, and worthy of trial on an extensive scale. He does not, as might be expected, endorse all the visionary ideas of the newspaper reporters; but he thinks that sufficient has been done to establish electric lighting on the incandescent plan as a system, leaving its permanence to be decided by the results of a practical trial that we are about to have on a tolerably large scale before the present month runs its course, for, in addition to the public lamps on the Holborn Viaduct, which the company have agreed to supply gratis for two months, no fewer than 150 incandescent lights are to be fitted up in the City Temple, while the Hotel at the Holborn Viaduct Station is also to be illuminated, at least, in part, by means of electricity. Many of the shops, showrooms, and offices on the Viaduct will, doubtless, be illuminated by the Edison light, as there are special facilities for "laying on" the current, and the site is admirably adapted to the purposes of the promoters of the scheme. As we have already mentioned, a section of New York has been handed over to the Edison Company, and the works will shortly be completed, when no fewer than 16,000 lamps will be supplied with current from a central station, the area over which the experiment is to be tried being a little short of three-quarters of a mile. The work of putting down the conductors is being done in a thorough and substantial manner, showing that the company, at least, is sanguine as to the permanence of their plant, and their action in the City of London shows that they are confident of success in the future. In New York the conductors are of half-round section approximately, and are firmly imbedded in iron pipes by means of insulating material, the connections at the corners of streets being made by junction pieces and bridges, as we may term them, which are accessible from the pavement for the purposes of testing, &c. To give some idea of the magnitude of the experiment in New York, it is sufficient to mention that the central station will have twelve large dynamo-machines, requiring 2,200 horse-power to drive them, and we believe it is intended to supply "current" for small machines, requiring motive power, as well as for electric lighting. Probably before details of the New York experiment reach us we shall be able to form an opinion of the future of incandescent lighting from the trial to be made on the Holborn Viaduct, which, if no unforeseen hitch occurs, will be commenced on the 15th inst. Of the systems of incandescent lighting, those of Swan and Edison are best known; but, according to Du Moncel, there are about fifteen different inven-

tions of the kind besides those just mentioned and the systems of Lane-Fox, Maxim, and Sawyer, all of which seem equally as well adapted to the purpose as those which have been brought prominently before the public. The earlier experiments in incandescent lighting were made with platinum wire or alloys of platinum; but owing to the dis-aggregation and partial fusion of the metal—in spite of the improvements introduced by Edison—the use of metal had to be rejected absolutely, at least for ordinary purposes. The use of threads of carbon had been suggested for some time—a natural development to a mind accustomed to the carbon rods of the ordinary electric lamp—and efforts had been made to utilise them by inclosing them in exhausted globes or in globes filled with an inert gas, or a gas capable to a certain extent of recuperating the waste of carbon. In 1879 the incandescent carbon lamp of Edison was announced, and, without entering into the question of prior invention between him and Mr. Swan, of Newcastle, we may say that it undoubtedly gave an entirely new view of electric lighting. The fate of the paper "horseshoe" we all know, and we also appreciate the perseverance of Edison, who, undismayed by one or a dozen failures, steadily pursued his course until he succeeded in his object. Du Moncel, as he acknowledges, doubted the exactness of the allegations which reached him from America concerning the incandescent carbon; but, since he has seen the lamps at the Exhibition, he has nothing but praise for them. Of the many inventions for preparing the carbon-threads we have given full particulars from time to time; but practical experience alone can prove which method yields the best results. Instead of carbonised paper, or parchment paper, Edison now uses fibres of bamboo, little larger than a horse-hair, which are sealed up in a vacuum while in a state of incandescence. The difficulties attending the expansion of the platinum conducting-wires have been overcome, and though the duration of the lamps may be, as Du Moncel has been assured, "long enough," he is careful to mention that they "must wear out." Some of Edison's, it is said, have served for 1,200 hours, and, taking into consideration that new ones are supplied at, according to Du Moncel, 15d., and that the fitting could not be easier or simpler, it would seem that nothing better could be expected. The fact remains, however, that, perfect as the lamps shown at Paris may have appeared to the Count du Moncel, patents for improvements have been taken out, and the price quoted by him, though it may be "cost," is not the cost to the public. It is not, however, the lamp alone which has won from Count du Moncel his high appreciation of the Edison system of electric lighting; but the completeness of the installation from the motor through the current-generating machine to the lamp itself, every detail being worked out so completely that, "henceforth nothing remains to be desired in practice." Such an expression is, of course, as much above the mark as some of Count du Moncel's strictures were below it, for, though in the matters of generator, distribution of circuits, installation, indicating and regulating apparatus, meters, &c., Edison's system may be thoroughly complete, it is not altogether so super-excellent that "nothing remains to be desired." As to the generator, the armature is arranged on the Siemens principle, bars of copper being employed instead of wire. These bars lie close to each other around the cylinder which forms the armature, and they are secured to discs of copper in such a way that they form a single circuit. The centre of the cylinder outside the axis is made of wood, which is surrounded by a thick tube built up of very thin discs of iron, separated by pieces of tissue-paper. These thin discs are held together

by thick clamping discs, and outside at each end are the copper discs to which the copper bars are secured. This arrangement is said to facilitate the rapid changes of polarity in the plates, to keep the resistance small, and to permit of great sub-division of the current in multiple arc. There is no insulating material to be destroyed by heat, and the copper bars are easily renewed if necessary, as they are simply screwed to the discs. The generator is, no doubt, well adapted to its purpose; but it is questionable whether it is the best of its kind, although Count du Moncel thinks "nothing more remains to be done" but to try it.

The other details of the installation have been worked out with that thoroughness which is characteristic of the real inventor; that is to say, each part is complete and appropriate to its purpose, but is not adopted as final or the best that could possibly be devised, for, in that respect, Mr. Edison is far wiser than his eulogist and former critic. He, at least, has had experience enough to know that nothing is final or altogether perfect. The lamps and the lamp supports have been carefully designed for simplicity and effectiveness. The glass envelopes are cemented into copper sleeves which screw into the supports, and the latter are provided with joints or articulations, in which commutations are made by two plates of the hinges, which are insulated, and fitted with springs in such a manner that the circuit can be broken without causing anything more than the slightest spark. Connections of conductors with lamps are made by short pieces of lead wire, which will melt and interrupt the circuit if the current should become of such intensity as to endanger the lamp. According to the Count du Moncel, Edison's system of electric lighting is as perfect as that now used for gas. It can be laid on to any house, and is controlled and regulated by the simple turning of taps. To make the system thoroughly complete, Mr. Edison has constructed portable chandeliers and a current-regulator, which permits of the light being reduced or increased as required. This regulator is, in reality, a rheostat, made up of pencils of carbon of different section, and the current, being made to pass through one or the other, its intensity can be regulated within the limits possible to the carbon rods. The apparatus is inclosed in a cylindrical cover perforated with holes, or in an ornamental manner with fretwork, to allow the escape of heat, and it is worked by turning a disc at the bottom which brings a spring into contact with any of the rods of carbon, or rather into contact with the metal blocks in which they are mounted. Edison has also invented a "meter" to measure the quantity of current passing through any branch of the system, which is identical in principle with the meter patented by Mr. J. T. Sprague; but he has also devised another method, and it remains to be seen which will answer best in practical work. It is obvious that if electric light is to be laid on as gas is now, some method of measuring the quantity used must be employed, and, apparently, Du Moncel thinks that Edison has satisfactorily solved that part of the problem also. The French electrician says that a combination of arc and incandescent lights is not to be recommended, for the former destroy the effect of the latter, which give an agreeable light free from the "ghastly" hue, as it has been called, of the arc. The light given by the incandescent lamps is really whiter than that of gas-burners, and it can be made as dazzling as that of the arc, but that is not the object of Mr. Edison, or of his rivals, Messrs. Swan, Lane-Fox, and Maxim. It may interest some to know that in the dynamo, which is worked by a steam-engine on the same bed-plate, the

speed is about 350 revolutions per minute. Du Moncel naively says, that "this is not a very great speed, but the armature is very heavy, weighing over three tons and a half." The advantage of driving the armature direct from the engine is not apparent when an ordinary reciprocating piston is employed, but in the case of a three-cylinder or a rotary engine steady running is, no doubt, insured, especially when the available power is in excess of the requirement. From what has been said, then, it will be understood that the Edison system is, according to the opinion of Count du Moncel, calculated to do the work of electric lighting in private houses; and the experiment about to be made in London will no doubt be watched with interest, for, if it succeeds, it will not be long before the shops and warehouses in the City will be illuminated by electricity.

THE MAGNETIC STORM OF LAST AUGUST.

AFTER a long interval of comparative rest, corresponding to the minimum epoch of sunspots and auroras, the introduction of the present period of increase of those phenomena was accompanied by a notable disturbance of the magnetic elements on 11-14 August last. Instruments seem to have been simultaneously affected on different parts of the globe widely apart, and the opportunity has been taken by Herr Wild, of the Pawlowsk Observatory, near St. Petersburg, to compare the records (curves, magnetographs, &c.) at that place with those at Kew, at Zikawei in China, and at Melbourne.

On the days referred to there were three distinct disturbances of the magnetic declination (these second and third somewhat blending); and it appears that the beginnings and ends of these, especially the beginnings, were simultaneous at all four places. With regard to the individual waves of each disturbance, those in Zikawei and Melbourne are quite different from those in the two other places (where the waves are pretty similar). In the case of the first two disturbances, one finds (as normally) a decrease of the amount of variation in the direction of lower latitudes; but it is the reverse with the third.

In the curves of horizontal and vertical intensity, the same three disturbances can be distinguished, and the beginnings and ends correspond accurately with those in the case of declination. Thus, Herr Wild remarks, it would appear that, if it be not a single force that causes these disturbances of all three elements of magnetism, they must be due to forces that simultaneously begin to act and disappear.

Analysing the phenomena further, and comparing the components of intensity, the author finds certain marked differences between the places; but into these we will not here follow him in detail. Two facts appear from a comparison of the curves of normal August values, and of the disturbed values for Pawlowsk and Kew. (1) While the disturbances of declination in Pawlowsk and Kew reach nearly the same amount, those of inclination in Pawlowsk are double those at Kew, and those of the whole intensity nearly five times as great. (2) On all three days the amount of disturbance of the three elements, and especially intensity, presented a wave which essentially agreed with the normal daily variation of those elements.

To us, says the author, partly new and partly old, their precision seem to throw new light on the electrical nature of the disturbing force. From the second fact, especially, we may infer that those forces are to be conceived mainly as sudden, and very sudden, simultaneous intensifications of the forces which produce the normal vari-

ations of the magnetic elements, while the strong and rapid variations of those disturbances indicate, as occurring along with the mean intensifications, quick and violent pendulations of the forces about their mean value.

The known laws of daily and yearly variations of those elements of earth-magnetism point to the Sun as the prime cause of these periodic variations. The only question is, in what way we are to represent this action at a distance of the Sun. If we assumed that the Sun is a magnetised body like the earth, whose magnetic axis does not coincide with its axis of rotation, the daily and yearly variations would seem to be easily intelligible, and we should then merely have to suppose, for explanation of remaining facts, that, at a time of numerous spots, or increased eruptive activity, the magnetism of the Sun is also strongly increased, in connection with these eruptions, with which it suddenly and repeatedly grows or diminishes.

Now, there is indeed no difficulty, considering the colossal eruptions on the Sun, in supposing that such developments and discharges of electricity accompany these as intermittently modify the Sun's magnetism. But whether the absolute amount of the latter, and its variations, be actually so considerable as it must be in order to bring about the observed variations of the magnetic elements on the earth, seems doubtful. According to the known laws of magnetic action at a distance, it is easy to arrive at a lower limit of the assumed magnetism of the Sun.

With an equal degree of magnetisation—corresponding to mass—to that of the earth, the Sun would, with the most favourable relative position, deflect the declination needle on the earth's surface about $0.018''$. Thus, to produce in mean latitudes a deflection corresponding to the half-daily variation of declination, i.e., about $4''$, the Sun must be about 13,000 more strongly magnetised than the earth; and this magnetism must, in the case of great disturbances, where deflections up to $2''$ are observed, temporarily increase and decrease about thirty-fold.

Now, since the Sun, even if it represented (according to our ideas) a steel magnet magnetised to saturation, could, at the most, be only about 2,000 times more strongly magnetic than the earth per unit of mass, it does not seem probable, on this estimate, that the normal earth-magnetic variations and disturbances are simply to be referred to such a direct magnetic action at a distance on the part of the Sun.

Another fact given above is also against the view in question—viz., the dissimilarity of the disturbances, especially in places far apart, and their unequal working on the different elements of the magnetic force. These facts, on the contrary, point to some other disturbing force, having its seat in the earth itself, and for which distances on the earth's surface are not insignificant, as in the case of a force going out from the Sun. Such a force we may consider the electric currents in the earth, especially occurring at the time of auroras, and which, according to the view advocated chiefly by A. de la Rive, are to be regarded as discharge-currents of the earth-condenser. The phenomena of atmospheric electricity warrant the inference (after him), that the earth, with its air-envelope, forms, in some measure, a large Leyden jar, one coat of which, charged with negative electricity, is the conducting earth itself, and the other positive coat the higher layers of the atmosphere (also conducting because much rarefied), while the denser air between is the separating insulator. The discharges of this condenser in the neighbourhood of the poles cause the Northern and Southern lights, and give rise at the same time to compensating currents in the earth's crust, which,

when they go from the Poles to and then return to the upper atmosphere, cause deflections of the pole of the declination-needle. Northern hemisphere, westward; Southern, eastward; but may have some action when they go in the pole to pole. Such electric currents, usually weak, but continuous, and of polar light changing to sudden strong discharges, are, according to the intensity of the observed earth-currents, any case sufficient to cause both the normal variations of the magnetic elements, and afford an explanation of their differences in direction.

We have only further to suppose discharges of the atmospheric electricity do not in general occur erratically, but are regulated by these two factors will so be a common action, that all the chief in explanation of the variations of magnetism may be considered as such. If, that is to say, the Sun by his action and the electric processes during action, act rather by way of liberating charges of accumulated air-electricity on our globe, we do not conceive these solar forces as so distant as in the case of a direct magnetic action. The complete agreement of periodicity made out between the lights and the solar spots affords a satisfactory basis of actual fact for our hypothesis.

According to this theory of the origin of terrestrial magnetism, which rather designates as supplementing (zusammenfassende) than as getting new, an important part is to earth currents. Before following the theory in details, therefore, it seems able, in view of the partial indefiniteness of the present data of observation of earth currents, to first make an experiment of them myself. Opportunity for this will be afforded through arrangement to be made next summer at the meteorological and magnetic observatory of Pawlowsk, may hope that, considering the very distinct disturbances of the magnetic elements at our latitudes, these observations will throw new light, especially on the connection between earth-currents and the intensity of terrestrial magnetism.

ON THE IRRATIONALITY OF THE SPECTRUM IN ITS RELATION TO THE ACHROMATISM OF OPTICAL INSTRUMENTS.—III.

By "ORDERIC VITAL."

(Continued from page 224.)

IN the previous remarks, I have endeavoured to explain why two media cannot be so constructed as to transmit a colourless ray, and I have shown that the appearance of the wine-coloured fringes marks the point at which the dispersion is practically too great to allow us now proceed to consider Sir D. Brewster's experiments, made for the purpose of determining the secondary spectra produced by various combinations; and first, it must be shown how to obtain the refractive and dispersive powers of a given substance, by means of a standard prism, whose refractive and refractive and dispersive powers are known. He shows that the refracting angle of a prism may be diminished, with reference to a given direction, by rotating the prism in a direction parallel to one of its refracting sides. Four lines, A B, C D, E F, and G H, intersecting in the point O, and making angles with each other. If these lines be viewed by a prism, whose vertex point is in the direction F E, and the intersection of the refracting sides parallel to A D; the light fraction is in the direction E F, and will be tinged with colour, violet on its inner edge and red on the right. G H will be colourless, while F E will be tinged with red. Rotate the prism till its edge is parallel

Eqn. (2). $\sin. x = R' r \cdot \sin. A$
 $\log. \sin. 24^\circ - 39' = 9.6202139$
 $\log. 1.336 = 0.1258065$
 $\text{comp. log. } 1.616 = 9.7915586$

$\log. \sin. 20^\circ - 10' = 9.5375783$

And since $x = 20^\circ - 10'$, $(a - x) = (8^\circ - 34') - (20^\circ - 10') = - (11^\circ - 36')$.

Eqn. (3). $dR = dr \cdot R/r \cdot [\tan. (a - x) \cot. x + 1]$.

For the part within the brackets we have—

$\log. \cot. x = 10.4350169$
 $\log. \tan. (a - x) = 9.8123266$
 $\log. .55891 = 9.7473435$

This quantity being subtracted from unity, we obtain .44109, whose log. is 9.6445272.

$\log. 1.336 = 0.1258065$
 $\log. .032 = 8.5051500$
 $\text{comp. log. } 1.616 = 9.7915586$

9.6445272
 $\log. .01167 = 8.0670423$

This is the dispersion dR of the first prism, and by dividing it by $(R - 1)$, we obtain the dispersive power—

$\log. .01167 = 8.0670423$
 $\log. .336 = 9.5263393$
 $\log. .03473 = 8.5407030$

For the flint prism, the dispersive power is .0519.

(To be continued.)

THE WATCH AND HOW TO REPAIR IT.

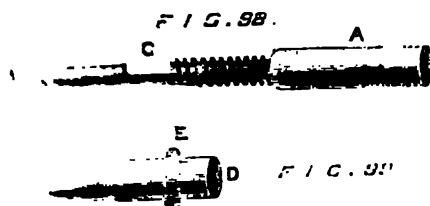
By SECONDS' PRACTICAL WATCHMAKER.

(Continued from page 54).

How to Put New Pivot to a Pinion-Arbor.

WATCH repairers who reside in the Provinces are occasionally compelled to put a new pivot to pinion-arbor, instead of having a new pinion, although many workmen who are accustomed to follow such occupation in large towns and cities where watch manufacturing is carried on, consider "putting a new pivot" an unprofitable and unsound procedure. In some instances such may be true, but frequent instances are exceptional, such as when the arbor of such is very small, and when the pinion-end of it has a deep hollow and the "undercut" of the shoulder has been very much reduced. I therefore intend in the present remarks to introduce to general jobbers the manner of putting a new pivot to a pinion or its arbor.

The first point to determine should be to test the hardness of the pinion-arbor which has to be drilled for the reception of a new pivot. If it be very highly tempered it should be softened; and when the upper pivot to a third or fourth pinion is required, to reduce the hardness of such is a very simple operation, for, by holding such arbor in a pair of pliers and exposing them to gas or spirit-lamp flame, when a light blue colour is produced in most instances, a good drill will form a hole for the intended new pivot. The next process would be to form a mark or "dot," whereby a hole may be drilled for the reception of the intended new pivot. I have found more than one method adopted by which the centre of the pivot-hole may be formed on the end of the arbor. Fig. 98 may be familiar to most "job-



A represents the handle in which is a piece of round steel wire, projecting one inch and a half; it must be highly tempered, and its extreme end formed as a trident-shaped, sharp-pointed cutting-tool, B. Just before such point B, a small portion of the body of the wire must be filed away about half its diameter, as C, which will presently be described. C represents a brass tube, which passes

freely over the steel chamferer, BC, having a coiled spring passed over it in order that, when the tube D is passed over the chamfering piece CB, the pin E, when secured in its tube, such spring will by its pressure force the tube and its pin E against the slot C near its pointed end, thereby keeping the cutting-point B always projecting a trifle through the cup-shaped hollow F, so that the end of the pinion-arbor, when pressed into it, will have its end central with the point of the cutter, CB; then, by holding this tool in the left hand, the pinion-arbor being put in motion by means of a screw ferrule and hair-bow, a small chamfer will be formed on its end, by which means it is kept steady during the next operation, which will be drilling the hole for the intended new pivot.

There are other methods of obtaining a "dot" for drilling, though I have selected an example which I have thought safe, and at moderate cost, though some workmen adopt the following:—Secure a screw-ferrule upon the arbor of the pinion to be drilled, placing the same in the "turns" and securing the chamfered shoulder of the upper pivot in a hole of a "rounding-up" centre; when secure in centres, by using the point of a good graver steadied by the "rest," the centre—or dot—may be formed, which is termed "catching" it. Again, "catching the centre" for a back pivot, say a third-wheel pinion, involves a little more trouble, to affect which, should the pinion require softening, I have found the following method advantageous: Possess a piece of brass wire about the size of a tobacco-pipe, drill a hole in its end such size and depth that the pinion fits so that it will not fall from it; its length should be about 1½ in., such brass-piece being placed upon the pinion, holding the wheel with pliers, and by means of a blow-pipe direct a flame to the upper part of the aforesaid brass punch-like tool, and watching carefully, the "punch" should be removed so soon as the required colour appears. It may be asked for a ready method by which the blue colour of the pinion may be removed without the trouble of polishing. Have ready a little "elixir of vitriol" in a bottle which will be firm on the work-bench, then, by having a good pointed watch-peg and charging it with spirit, by slightly rubbing the discoloured portion of it, the blue colour will disappear; then, as quickly as possible, brush the whole of the pinion and wheel with warm water and soap, after which, dry it in a soft cloth, and then place it in slaked lime; when brushed clean, should it appear not quite so bright as it should be—a little dry redstuff and a peg, by motion similar to polishing it, the wheel and pinion will be ready for further procedure.

Our next portion of this subject will be to become acquainted with the method of drilling a hole in a pinion-arbor for the reception of a new pivot.

Our next inquiry must be to know how to make the required "drills." The "drill" is a very important item in drilling steel—that is to say, it should be light but rigid, in order to endure a moderate amount of pressure, because many failures in drilling steel occur from the fact that insufficient pressure is given, arising—in most instances—from the body of the drill being too thin, and then, when the part to be drilled is pressed towards it, instead of "cutting" being the result, the drill bends, and the steel becomes "glazed." The drill of usefulness (especially for steel) should be short—in the present instance, say, about half an inch long, and when used—with the bow—a trifle longer. Its ferrule should be about a quarter of an inch in diameter; but in the present instance the drill is firmly fixed in a "centre," which passes into the "drilling-tool" B, in a similar manner as a centre of ordinary turns. Fig. 100 A, BB, &c., will illustrate such. Figs. 101, 102, 103, represent three kinds of drill blades. 101 is suitable to pierce the steel, in order that the shape, No. 102, may commence the hole with more certainty; for, in some instances, the curved-pointed drill will not enter so readily as might be wished, in consequence of the "dot" for centre not being sufficiently definite. After the drills have been shaped and fitted into their "stocks," they should be hardened and tempered. A convenient way to do such is to twist a piece of very small binding wire round three or four of such drills, putting a small piece of ordinary soap upon the bundle, holding the same in a flame—gas or spirit-lamp—gas preferable—and when blue-red dip quickly into a

cup of oil. Upon removal, the drills will be quite hard—hence, a drill in such condition is unfit to use; therefore, a slight reduction of its hardness should be attained. The end of the drill, which is secured in the "stock," should be held in a flame until a very slight change of

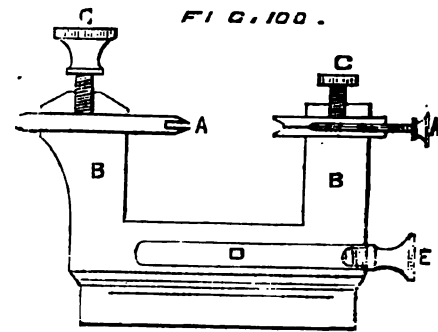


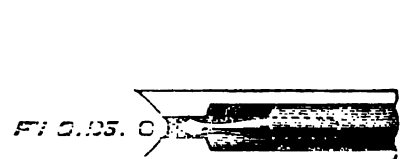
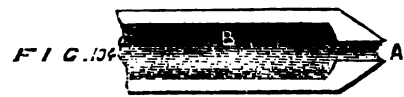
FIG. 100.



colour appears behind the blade of it, at which instant of time it should be dipped into cold oil. Drills thus hardened and tempered are very rough and useful. The drill blade, No. 103, is one termed "chisel shaped," which I have found very useful in breaking through a glazed bottom of hole, after which, proceeding with the drill-blade marked 102. Such drill-blades should be sharpened upon an "oilstone," not "Arkansas." The drill being formed, our attention has now to be directed to the operation of drilling the hole in the arbor-end. Again, we have recourse to an illustration (Fig. 100) which places before us a little tool in section, its actual size, which is used only for the purpose of drilling holes for new pivots. It is very solid and useful, BB being the body of it; CC the clamping-screws, by which the centres are fixed (as in ordinary "turns"); D, a hole drilled in the lower part of the "body" of it for the purpose of containing a few drill-blades, which are secured by a knurled thumbscrew E. Independently of the body of the tool, there are eight other pieces turned "centres," which I place before our readers somewhat in their successive order.

Secondly, the centres require explanation to those who are uninitiated in connection with the tool.

Figures 104 and 105 represent cylindrical centres in section, which I think may be placed before readers with the following explanations. The first of these illustrations is



a short "centre" (Fig. 100) placed in the left-hand portion of the tool, and secured by the clamp-screw C: such being formed to receive the pivot and shoulder of an arbor, so that the shoulder only is acting in the concave point A, and the pivot perfectly free of the passage-hole B. Fig. 105 represents another centre, also concave at its point, for the reception of the shoulder of the arbor requiring a new pivot. By comparing the two figures (100 and 105) it may be readily traced that, while the pinion requiring the new pivot is secured in the tool (100), the drill pressed into the "hollow" centre 105, that, by constant pressure of the drill A

toward the pinion, which being kept in motion by means of a hair-bow, the pinion arbor would be pierced and a hole formed for a plug, out of which another pivot may be formed. The correspondence of the Fig. 105 with that of A, Fig. 100, I hope will be sufficiently clear to avoid further explanation necessary. As I have previously stated, this tool is required *only* for drilling a hole for new pivot, the final completion of it remains with the workman and *other* tools, such as "Jacot," or otherwise.

It may be necessary to further remark that, when *steel* arbors have to be drilled, a *rapid* motion of the pinion, frequently causes failure in producing a hole, which not unfrequently necessitates making the arbor softer than it should be. A moderately slow motion of the pinion, combined with firm pressure of the drill, such pressure being at the time, when the "bow" is in its *downward* action, is most generally more productive of success in drilling a well tempered arbor than a quick motion of it.

The eight pieces of the drilling tool to which I have previously referred are as following:—Two drill-stocks, as A Fig. 100; three coned centres to receive such drills. A, Fig. 104 and 105; one similar centre, with enlarged, hollow pointed opening as O, Fig. 100 and O, 105: one long centre suited to receive a "seconds" pivot, and another double end centre for very small shoulders. I think that the few items I have placed before our readers may enable many jobbers to overcome a somewhat difficult task—putting a new pivot to a pinion arbor; but, I strongly urge workman to select steel of good quality for the *new* pivot, for many workmen take for granted that an ordinary sewing needle will suffice. Such is a mistake, because such are produced generally from steel of coarse quality, and are totally unfit for the purpose. Steel suitable for the object before us is "*staff steel*," and may be tested as following. When a length of steel is *broken across* the grain it should be close and grey; if the "break" indicates coarseness, or sparkling granules, such steel is quite unfit for the purpose. Again, steel for our purpose must be hardened and tempered, in the same manner as described for hardening drills suitable to form holes in pinion arbors, the *temper* of which should be *straw colour* or dark blue. The drill blades should be so secured in the drill-stock A, Fig. 100, that they are true with it, else the hole formed would prevent the intended pivot plug fitting properly. There is an item yet to be introduced, namely: should there be any difficulty of fitting the piece of steel firmly into the hole drilled for it, I have found that, by introducing into it a little thinly-mixed oilstone-dust and oil assist in securing it by placing the face of the pinion upon a rivetting-stake and striking the plug with a light hammer. A plug of steel well fitted, there will be little difficulty, I apprehend, in forming a pivot after the usual procedure of doing such.

Back Setting Arbor of Three-quarter-plate Movement Fitting too Easily, or Otherwise.

Many instances come before watch-repairers in connection with the hands, "back-setting" arbor of three-quarter plate watches. In some instances its fitting so easily that the hands are not carried round; and again, when fitted tightly into the centre-wheel pinion-arbor, the teeth of a centre-wheel (especially of small size and fine number), occasionally are broken by the act of "setting" the watch to time. Two remarks, I think, are necessary in this instance—namely, in watches of small size, the hands arbor should fit the centre-wheel pinion so easy that, when the "hands" are set back, the watch should not "stop"; and that the pin which secures the "setting-square" should be *brass* instead of *steel*, because some wearers have a tendency to keep their watch-cases clean and bright; hence, after having "wound it up," breathe upon the inner portion of the case in order to brighten it before closing. When *steel* pins are used instead of *brass* ones to secure the "setting-square," workmen occasionally discover that difficulty is before them to remove such pins; but when *brass* pins secure the "squares," to remove them is other than difficult.

Lever Watch-Stop, by Fusee Intermediate—Wheel being Untrue—not Circular.

A lever watch, having had a new pinion put to the centre-wheel, was a constant trouble to

"The Master and his Man"; it would stop. After many attempts—on the part of the journeyman—to discover the cause, the detection resulted in favour of the employer, who discovered that, having had a new pinion, it was worked-in too high—i.e., its pinion-face was nearer to the upper-plate than the old one, and as the progress of the fusee carried with it the steel intermediate wheel of the "maintaining power," when that wheel advanced so far as the centre-wheel pinion, instead of passing under the "steel" wheel, the pinion "leaf" and the teeth of the wheel came in contact. The pinion was reduced in length, so that it passed onward, being level with the upper side of the fusee-wheel, and under the under side of the "maintaining" wheel. The alteration was effective.

Making a New Eye to Mainspring.

In making a new eye to mainspring the steel should be softened in such manner that its soundness be fully retained; therefore, always soften such steel with a *small* flame, for by such means the steel becomes *gradually* softened, although the flame should be of such intensity that the steel should be decidedly "red-hot." When the softened portion of the spring has become cool, it should be formed in such a manner that the barrel arbor fits it closely, then, when a piece of hard wood has been placed in the vice, so that its end passes into the "eye," the eye can be formed with a narrow file with a square edge. I have found that, after the "eye" has been completed, by making it hot in a flame, the form of it is retained. It should be remembered that the "eye" referred to should be somewhat broader than the hook of its arbor, by which, the mainspring is kept free from pressing against the bottom or cover of the barrel.

Never force up Third-wheel Bar to give end-shake to its Pinion-Arbor.

A watch, not long since, came under the notice of a workman of fair experience; the complaint attached to it being,—"It stopped, and occasionally started again without being moved." It occupied some time to detect the cause, which was that, some person had given end-shake to its third wheel by raising its bar by some such tool as a screw-driver, by which act a burr had been formed in the hollow of the pillar-plate; the teeth of the wheel acted so closely to such hollow that (the third wheel being much out of flat) occasionally the points of the teeth caught against the burr. Such was the cause of the watch stopping.

Flap of "Stop" projecting beyond its "Stud" and Upper Plate.

A watch that has a cap—whether it be "ring" or "full cap"—occasionally gives trouble to "jobbers," inasmuch as instances have come before the trade something as following: A watch complained of as "stopping"; the instrument being placed under the watchmaker's care, he "winds" it, and places it where his eye will frequently notice it. In about seven to eight hours he discovers it has ceased "ticking." The watch is removed to detect the cause; when opened and its "cap" removed, the watch starts off brilliantly, and nothing detected. It is again submitted to another test, and after hanging a few hours, another "stop" is observed. After a little thought, the watchmaker resets the instrument and replaces it for another test, but without putting the "cap" on. In such condition the watch goes well. The cause then had to be traced, the result being that when the "cap" was properly secured upon the watch, the "flap" of the "stop," which without the cap projected beyond the "frame," was pressed back, so that when the "fusee-cap" returned—which occupied about eight hours—it "batted" against the *edge* of the "stop" and could not pass under it; hence the stop. The projecting "flap" was reduced in length, and remedied the complaint.

(To be continued.)

A NEW PAINT REMOVER.

MANY queries reach us from time to time requesting information as to ready and cheap means for removing paint, tar, rust, grease, &c., from wood, metal, stone, and fabrics of all kinds. The following, from the *Building News*, may be of use.—Last

Monday we were invited by Messrs. Rendle Brothers, of 3, Westminster Chambers, to see some experiments made with a preparation upon various specimens of painted wood and metal. These were all old samples, well painted with several coats of good oil-colour. The compound, which is of a cream-like consistence, quite white, is spread over the painted surface, and after being left on a few minutes, is wiped off. The new "electric" paint remover is chemically prepared according to a scientific formula, in which potash and soda are the principal ingredients, but in which there is not a trace of lime present. Its action upon the body of the paint is thorough and complete, a saponification is set up which continues, the soda is liberated, and fresh soap formed, and this process goes on, the alkali being liberated as it is wanted, till the whole of the paint is removed. The specimen we saw acted upon only remained about a quarter of an hour subjected to the action of this caustic preparation, and the compound being wiped off, every trace of paint was found cleanly removed, and the wood exposed appeared as if it had been planed. Nothing could be a more satisfactory test of the destructive action set up by this material. Directly the compound touches, saponification is set up. The action of this preparation seems to be twofold; there is first the destructive action of the applied alkali, always caustic, and next a continued sponge-like action going on—in other words, a constant and perfect causticity is maintained. The result of the preparation on metal was equally convincing. A gas-meter which had been thoroughly coated was exposed to the compound for about twenty minutes, after which the japan was removed and the bright metal exposed. The other forms of this preparation we saw were of a weaker character and nearer soap in their composition. They are intended to remove dirt, and their action is just the reverse of the compound already described. The preparations are liquid and are soluble in water, and their cleansing power upon cloth of an unmistakably greasy and dirty character was almost magical. For delicate carvings and fabrics of all kinds these solutions are admirably adapted, and we think their use by restorers, decorators, and others will be highly esteemed. The modification of the solution for cleaning cloth is well adapted for re-tinting the linings of railway-carriages and stuff seats of all descriptions. No scraping or erasing is necessary. There is nothing injurious, we are told, in the preparation which can attack or injure metals or cloths, they all produce a minimum action on brushes, which is a consideration, and, what is very important, colour is not taken out by the use of these solutions. The price is less than that of other preparations. The "paint remover" can be easily applied by being spread over the painted surface to be removed. It is sold in 5lb. tins at 2s. 6d. each, and the patentees are prepared to give special quotations for large quantities in bulk for railway, gas, and shipping companies, &c.

NECESSITY OF CLEAR MECHANICAL CONCEPTIONS.—II.*

By WILLIAM D. MARKS,

Whitney Professor of Dynamical Engineering, University of Pennsylvania.

THE distinction between momentum and the really acting force in many cases which occur must be sharply drawn. If the acting force be constant, it will add equal increments of velocity in each unit of time, and the intensity of the acting force can be at once deduced by dividing the momentum by the time of its action. Thus a body let fall and acted upon by the constant force of gravity has at the end of one second a momentum Mg , and at the end of two seconds a momentum of $2Mg$, but the acting constant force is still Mg or $2Mg$, divided by the time two seconds. Thus we have the distinction, the momentum (Mr) is the intensity of a constant force which acting contrariwise upon any mass in motion, with the velocity r for one second, would bring it to rest; or, if the mass (M) be at rest, will in one second impart to it the velocity v . On the other hand, the acting constant force $F = Mr/t$ may act for any length of time, t , and therefore may be of any intensity.

Work has already been defined as force (F) multiplied by space (s).

If now for F we substitute Mr/t and recollect

* From the Journal of the Franklin Institute.

that for any free body put in motion by the action of a constant force; the space passed over is equal to one-half the final velocity multiplied by the time, we have work = $Fs = Mv \cdot t \times \frac{1}{2} = \frac{1}{2} Mv^2$.

This result at once reminds us of the term "*vis viva*," literally meaning living force, and shows us that the work expended in giving motion to any body and stored up in it is one-half the *vis viva*, can be separated into which the two terms (Mv) and $\left(\frac{1}{2}\right)$, the first being the momentum and the second the space through which the momentum will act in one second. Matter has the power of absorbing and storing up work while being given motion, and gives out work when its motion is retarded. A body in motion and not acted on by any force, will move in a straight line and with a constant velocity. If this body is acted upon by a resistant force, it will not stop until all of the work stored in it $\left(\frac{1}{2} Mv^2\right)$ is given out.

These phenomena are due to the inertia of matter, meaning by inertia the inability of dead matter to change its position or motion of its own accord, and the passive resistance which it offers to all action upon it. "Action and reaction are ever equal, simultaneous and opposite," but in a free body the reaction is always yielding to the action of a force in the form of motion of the body in the direction of the acting force, and the matter contained in the body acted upon stores up the combined force and motion as work. The moment of inertia of a rotating body is the statical moment of the momentum of the body and is equal to the sum of the moments of the momenta of its infinitesimal elements; it is the moment of that constant force with which a rotating body would resist being brought to rest in one second; or, being at rest, would resist having impressed upon it a certain angular velocity (ω) in one second. Thus each elementary particle (m) would have a momentum ($m\omega r$), and a lever arm (r) and its moment of inertia would be $m\omega r^2$; but since $v = r\omega$ we have $mvr = m\omega r^2$ as the moment of inertia of each particle and $\Sigma m\omega r^2$ as the moment of inertia of the whole body. The definitions of and formulae for the moment of inertia given in many text-books neglect the angular velocity and the acceleration of gravity (g) and are therefore only comparative measures of the moment of inertia, and do not give a clear conception of what the moment of inertia really is. If it is desired to know the amount of work done in giving the mass m the velocity v in one second, we have at once the expression (mvr) $\left(\frac{1}{2}\right)$ for the work

$= \frac{1}{2} mvr^2 = m\omega r^2 \times \frac{1}{2}$. A more complete and misleading misnomer than moment of inertia would be hard to imagine if the original inventor of the term meant by it what he is usually assumed to mean, viz., "the work lost or gained whilst the body is experiencing a change in the square of its angular velocity equal to unity," or "the weight of a body which, if concentrated at the distance unity from the axis of rotation, would require the same work to produce a given increase of angular velocity which the actual body requires." The moment of flexure used in discussions of the elasticity and strength of materials is an analogous expression to the moment of inertia, the modulus of elasticity taking the place of the angular velocity; it is a statical measure but mentioned here because of its similarity to the moment of inertia. The radius of oscillation of a rotating body is equal to its moment of inertia divided by its momentum; it is the mean radius or lever arm of the momentum; the extremity of this radius is the centre of oscillation or, as it is sometimes called, the centre of percussion of a suspended body, because if the body be struck at this point no shock will be communicated to its axis; it is the point where statical equilibrium occurs between the momentum of that part of the body between it and the axis of rotation and the momentum of that part of the body outside (away from the axis) of the centre of percussion. Since the angular velocity is a common factor of the moment of inertia and the momentum of a body, it can be and usually is neglected and the radius of oscillation is found by dividing the measure of the moment of inertia of any body by its statical moment. The centre of pressure is an analogous term to the centre of oscillation and is found in a similar manner. It is a statical term and its analogy is due to the fact that the pressure of water increases with the depth from the surface in the same ratio that momentum increases with the distance from the axis of rotation, or the elastic resistance of materials increases with the distance from the neutral surface of a beam. The square of the radius of gyration of a rotating body is equal to its moment of inertia divided by the momentum of the mass supposed to be concentrated at a distance equal to unity from its axis, if the angular velocity which is a factor of both terms be neglected, the square of the radius of gyration can be deduced as usually explained in the books by dividing the measure of the moment of inertia (Σmr^2) by the mass (M) of the body, the square of the

radius of gyration (k^2) is the mean of the squares of the radii of the infinitesimal elements of any rotating body. The centre of gyration of any body is that point at which, if its mass were supposed concentrated and revolving with the given angular velocity about the axis, the moment of the momentum of this concentrated body (MVh) would equal the sum of the moments of the momenta of its infinitesimal elements (Σmrv) while actually rotating around its axis. Since $k^2 = \Sigma mr^2 / M$ we see that it is the ratio between the actual moment of inertia and the moment of inertia of the mass assumed concentrated at a distance unity from the axis, the centre of gyration has no actual physical existence as has the centre of oscillation, but it serves a convenient purpose in mathematical investigation. From the definition of the radius of oscillation it will at once be seen that it can be deduced by dividing the square of the radius of gyration by the distance of the centre of gravity of any body from its axis of oscillation.

Force is actually exhibited and its action felt only when there is a change in the velocity with which a mass is moving. Centrifugal force, which is the intensity with which any body moving in the arc of a circle resists being drawn towards its centre, is a good example of this. Centrifugal force equals the momentum of a mass multiplied by its angular velocity ($Mv\omega$). Generally we can say: In any change of velocity, the intensity of the acting force is measured by the mass multiplied by the velocity which would have been generated in one second had the force remained constant. The theorem of virtual velocities to which frequent reference is made in works on mechanics, expresses in the form of an equation the equality of the elementary quantities of power being transmitted by any mechanism. Thus suppose the work acting any machine to be F_s and the work being done by the machine to be F_m , then letting dt be the differential of the time, we have $F_s ds / dt = F_m ds / dt$ or $F_s = F_m$.

This theorem may also be interpreted by saying that the power of all parts of a continuous train of mechanism at any instant is the same, frictional losses being neglected. The question at once arises: What is a machine? To which we would answer that it is "an assemblage of resistant parts," for the purpose of conveying work from one point to another by means of predetermined motions. Many of the laws relating to machinery are incorrectly phrased, and we repeat them in a corrected form: No machine can give out more work than is put into it. Losses of work occur in all machinery because of friction. Lost work due to friction usually disappears as heat. Whatever is gained in speed is lost in force in all machines. The work done by every member of a continuous train of mechanism is the same for one cycle. Perpetual motion, i.e., the creation of work, is not possible. These laws cannot be dispensed with nor in many cases be deduced one from the other; they are many of them mechanical axioms, and are for the most part the result of experience, and of a vast number of experiments never recorded and discussions long since forgotten.

GROWTH OF LAND PLANTS IN VARIOUS MEDIA.

BY numerous analyses of ash, it has been possible to ascertain those mineral constituents which may enter a plant in the liquid sucked up by it from the ground. The necessity or real value of mineral constituents of the ground for plants may, on the other hand, be determined by synthetic methods, the essence of which consists in endeavouring to support plants with a mixture of mineral salts, which the experimenter has purposely prepared. In the Agricultural Institute at Leipzig Herr Knop has, for several years past, carried on experiments of this kind, both personally and through his pupils. The following is an account of his recent observations on the growth of land plants in different media, in water, aqueous solutions of nutritive matter, earth, &c.

Plants which develop numerous root-fibres, and monocotyledons generally, flourish in aqueous solutions just as well and normally as in the best natural soil. Many dicotyledonous land plants also accommodate themselves to an aqueous medium, especially those which seem to have a certain natural power of accommodation—e.g., species of polygonum.

The unfavourable influence of a constant surrounding of the roots with water instead of earth, appears most distinctly in the cultivation of trees. One observes here, too, however, that a land root may be transformed into a water root, and that trees which in general adopt the drier ground for their station give out new water-roots, and protrude the points of land roots already formed, in the form of "water-roots," further into the nutritive solution. Land plants developed to a certain extent "water-roots" in earth to water.

when blo. a matter of indifference

what is the degree of concentration of the nutritive solutions. Land roots give new, colourless, or white continuations, and new secondary roots between those already produced in ground, most easily and best in distilled water. The process goes on more slowly in nutritive solutions containing salt to the extent of 0.5 per 1,000, and where the proportion of salt amounts to 4 or 5 per 1,000, the growth of roots mostly comes to a standstill.

Herr Knop describes a series of water cultivations. The first three were carried out by Herr Wolf Dübels. The objects of experiment were oaks, which were cultivated for a number of years, partly in a complete nutritive solution, partly in a solution incomplete by omission of iron, and partly in mere distilled water. One of Herr Wolf's oaks has stood since 1863, in distilled water only, renewed only once in the year, and is still alive.

Particulars as to the size, number, and weight of the plants and their organs are furnished in Herr Knop's memoir. The phenomena in the case of a cultivation without iron are interesting. The leaves formed on those oaks in May and June were always, notwithstanding the want of iron, large, juicy, and dark green; only the leaves of February and March, and in many years also those formed in September and October, were small and of bright green colour. These results are remarkable, even if we suppose that a trace of iron passed from the glass vessel and from the acorn into the plant; for, on the other hand, the plant must have suffered a not inconsiderable loss of all mineral constituents in the offshoot leaves.

The oak which has stood in distilled water since 1863 shows that the annual growth from the first to the eighteenth year has steadily decreased in proportion as the loss of mineral constituents by the casting of the leaves has increased, and that the entire product of seventeen years is about three times the seed. The stem is at present 8mm. diameter near the root, and 38cm. high, supposing it were stretched out. Until the year 1868, the stem had no secondary branches, and bore every year leaflets at the terminal end, altogether 24 pieces of 1.03gr. dry weight. Up to 1890, 93 leaves and leaflets were borne by the plant, dry weight 2.28gr.

For comparison with this oak, one is taken which has been grown since 1863 in a complete nutritive solution. This 15 years old oak is 1.64m. high if stretched out, and the stem close to the root has at present a circumference of about 5cm. The main root is somewhat thicker, and has a length of 20cm., while the group of secondary roots has specimens of 40 to 50cm. in length. Of branches of the first order there are two pairs. There are nine branches in all, mostly from 20 to 30cm. long.

The contraction of the stem and the branches of these plants cultivated in water is a consequence of the abnormal root development. This abnormality is due partly to the water surrounding, which hinders the exchange of gases between root and atmosphere. This, however, is not the only hindrance. For if, instead of a mere nutritive solution, one employs a soil thoroughly saturated with nutritive solution, the roots grow therein much better than in mere solution, though not so well as in moderately-watered ground.

GRAPHIC METHOD OF FINDING THE LATITUDE OF A PLACE.

"AMONG all the means employed by travellers of ascertaining the latitude of a place of halt, there are few," writes M. Adan in a recent paper to the Belgian Academy, "which do not involve conditions, easy to be fulfilled in observatories, but nearly always troublesome, or even impossible, during a journey."

"It would be a great advantage if the explorer had not to await the meridian passage of a known star, or make correspondent observations, the second of which is often missed by reason of the state of the sky; if, again, he had not to determine the local hour or the azimuth of a star, when the time passed at a halting-place required him to take observations on only one side of the meridian."

"Thus, it has long been common to commend the process of extra-meridian zenith distances, either of two stars, or of the same star, at instants, the interval of which, given by a pocket chronometer, is translated into sidereal time, and converted into arc. A doubtful observation may be recommenced a few minutes later, and the traveller will very soon have the latitude in any case."

"Still, this method has never, so far as I know, been employed, probably because of the complication of trigonometrical formulae not calculable directly by logarithms, to which it is necessary to have recourse. Perhaps it is for this reason that travellers do not bring back from their long journeys the geographical co-ordinates of the places visited, and leave their routes doubtful. It would suffice, however, to know a few points with an approximation of one to two sexagesimal

able to draw these routes on maps the scale adopted in production of the would allow.

possible to obtain the latitude by a with a precision which is greater, has been taken in constructing the projection of the celestial sphere, distant from the zenith the stars out, however, exceeding the limit of re refraction does not produce in-

ment the geometrical position of the points of the earth whence one sees same zenith distance is a circumfer- in a plane perpendicular to the line th and the star. The radius of this to the sine of the zenith distance.

ctive positions of the stars observed indicated on the projection; the depend on the dimensions of the xactness of its drawing. Then, by easy construction, one may obtain the two geometrical positions which ed by circumferences on the plani-

archus, and compass, then, suffice for the a problem before us; the traveller occasion to trouble himself with trigonometric formulæ, or logarithms, he will not have to await the end ion before being able to reduce or results. One of the points of inter- two circumferences is the projection of the place of observation. The en be given by the map on the circle the projection.

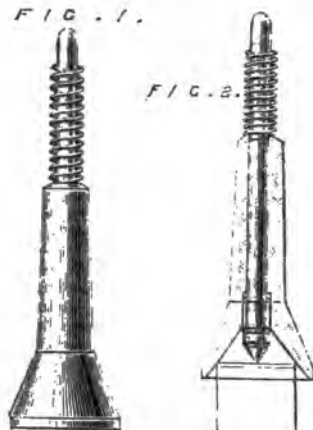
graphic polar projection seems the in most case; the celestial meridians nes converging to the centre; the ncentric circumferences whose radii ngents of polar demi-distances. It r. be advantageous, if one wished rve the same bright star, to place centre of the projection; the first ition would be constantly one of the , having for centre the projection of and it would merely be necessary to econd circle by geometrical means. elli were in any way deprived of suited for measurement of zenith ight draw on the stereographic p- erticals, in which are found, at interval is known by the chrono- of catalogued stars previously projection, provided he does not erides, which will enable him to t favourable stars for the instant sure to make observations.

the traveller take care to show on ation to stars observed at the first he positions of those whose zenith ll take at each halt in his journey, ain the relative situations of zeniths aversed, and from the map he will know the longitudes, if, at least, his y of a certain confidence." nishes, in a list (*Bulletin* of the my, No. 8), a certain number of , the choice of which is to be recom- ference to the precision of the graphic a their observation will lead. The he most favourable when the stars e each other, and the circumferences e geometrical positions of the zenith les comprised between 60° and 120° . d be 15° at least from the horizon, nt be used, removed from the zenith . The star whose zenith distance nit or is under it, will suit if the a reflection circle or a portable

the inclination of the wheel to the axis of the rotating cylinder. In this way it can be used to find the work done by a fluid pressure reciprocating engine, or the energy transmitted by a shaft or belt from one part of a factory to another. Moreover, by making the wheel very small and light, the strength of an electric current may be continuously measured, if the disc is inclined by means of the needle of a galvanometer in circuit. Mr. Boys has constructed, on the same principle, an electric energy meter which integrates the product of the strength of current and the difference of potential between two points with respect to time. In it the current is passed through a pair of concentric solenoids or coils of wire, and in the annular space between these is hung a third solenoid, the upper half of which is wound in the opposite direction of its lower half. By the use of what Mr. Boys calls "induction traps" of soft iron, the magnetic force is confined to a small portion of the suspended solenoid, and by this means the attracting force of the fixed solenoids upon it is independent of position. The middle solenoid is hung from the end of a balance beam, and its motion is retarded by a counter-weight, which admits of regulating the meter to give standard measure as a clock gives standard time. The motion of the beam is caused to incline the integrating wheel, and the rotation of the cylinder gives the energy expended in foot-pounds by means of an indicator or diagram, as the case may be. The object in giving an equal number of turns in opposite directions to the suspended solenoid is to render the instrument insensible to external magnetic forces.

THE BELL PUNCH.

THE "Bell Punch" here illustrated by perspective and sectional sketches, one half real



size, is a handy little device, made by Mr. R. K. Jones, of Birkenhead. It enables any amateur mechanic instantaneously to centre any round, square, oval, triangular, hexagonal, or octagonal article for the purpose of drilling or turning. In use the punch is held upright (as shown in Fig. 1) over the article to be centred, and the punch centre tapped, when the true centre of any geometrically-shaped article will be found. The punch will centre any size, from a quarter to one inch in diameter.

New Methods in Porcelain Manufacture.

—The paste used for porcelain often contains ferruginous particles, which give the baked articles a colour, or a minutely-spotted appearance, where a pure white may have been desired. The attempts hitherto made to remove those traces of iron with magnets have met with poor success. Recently, however, at two important French works, it was decided to set up powerful apparatus in which the electricity, instead of being supplied from batteries, was obtained by means of a small Gramme machine driven by a steam engine. The arrangement (which is said to work well) comprises a strong horizontal electro-magnet, with the poles very near each other, and between them a thin box. The paste, very liquid, enters the upper part of this box and is deflected towards the polar sides by a bent piece of zinc. As it flows down these sides, the iron corpuscles are caught. The apparatus is cleaned twice a day, by means of a jet of water, the magnet being unmade. About one gramme of iron particles is stopped in the passage of 12 kilogrammes of paste, and 500 or 600 kilogrammes of paste may be passed through one apparatus in a day.

SCIENTIFIC SOCIETIES.

CARLISLE MICROSCOPICAL SOCIETY.

THIS Society, which was established a few months ago in connection with the Carlisle Scientific Society, but which latterly has been working independently, held a meeting in the New Hall, Fisher-street, on Wednesday evening, 23rd ult., for the purpose of bringing its operations more particularly before the public, and to hear an inaugural address from the President of the society, the Rev. Canon Carr, M.A. Camb., F.M.S., F.R.M.S., vicar of Dalston.

Canon Carr, who was received with applause, first congratulated the members on having associated themselves in a society having for its object the promotion of microscopical research. His only regret was that a more able member had not been selected to fill the position of its first president. However, he would gladly do his best to promote the interests of the society, and he trusted that as time went on we should find their organisation would result in practical benefit to all. Standing side by side with that popular and useful society, the Carlisle Scientific Society and Field Naturalist Club, they had work of a somewhat similar character to do. Of that society the general purpose is to promote observation and to increase our knowledge of the larger objects in nature, chiefly those connected with geology and botany. The object of the Carlisle Microscopical Society is to pursue research where the other stops, to examine into the minute structure of objects which are either invisible to the unassisted eye, or which, though visible, have details too small to be investigated without optical appliances. In those researches they had great advantage over those who had preceded them. The microscope had of late years been brought to marvellous perfection, and it was still improving as an instrument of precision. All that our ancestors had to use in the examination of minute objects was practically the simple lens, followed in due time by Wollaston's doublet. He then proceeded to describe the various instruments which had been introduced in recent years, his remarks, of course, being of a technical nature and more particularly intended for the members. The simple microscope, with one or more achromatic objectives, and one or two Huyghenian eyepieces, mounted on a stand and furnished with a mirror underneath to reflect the light on the object, is all that is really essential for simple observation. Many improvements have been made in the stage itself, and many ingenious accessories introduced to facilitate the use and to increase the capabilities of the instrument. He then described in detail the binocular arrangement of Mr. Wenham, the concentrically rotating stage, and the swinging substage. Although the accomplished and experienced microscopist could by the accommodating power of the eye, and by successively focussing on different planes of the object, obtain even with the monocular instrument a very correct idea of its solid form, yet it was certain that the stereoscopic binocular microscope gave to the ordinary observer a much more accurate idea of the solidity of the object than the monocular instrument could give him, provided no optical sources of error came in to disturb the correctness of the image. Though some of the accessories to the microscope were expensive luxuries, it might be a satisfaction to them to know that save for some exceptional purposes the most skilful microscopists make very little use of them. A story was told of an experienced physician who, when asked what remedies he employed, replied that as a young man he had perhaps a dozen remedies for every disease, but that now he had more nearly one remedy for a dozen diseases. Similarly, the accomplished microscopist cares little as a rule for ingenious and costly appliances. True, with many of them fine results could be obtained, but it was equally true that by the skilful use of the simplest apparatus almost if not quite as much may be done. When they considered that the great researches and discoveries of Ehrenberg and others were made with glasses which would scarcely rank with the most mediocre of those now used, they would see how very much might be done without incurring the cost of elaborate accessories or of the finest high-power objectives. He touched on the pleasure which microscopists experienced in following out their investigations, warned them that the management of the light was of the first importance, and dwelt at some length on the various objectives of more or less power. "I cannot conclude," said the President, "without alluding briefly to certain remarkable results which have followed from investigations made by means of the microscope into the producing cause of some intractable diseases. It has been long known that germs which produce disease of various character are continually floating in the air in inconceivable profusion, and that on falling on tissue in a suitable state to nourish

TRIC POWER METER.

meeting of the Physical Society, ermon Boys exhibited and described a new integrating-machine of his its application as a measurer of the in the circuit of an electric lamp or ic motor. Mr. Boys's mechanical gs to the class termed tangent- consists essentially of a small disc g along the surface of a drum or n the wheel runs straight along the its axis, there is no rotation of the en the wheel is inclined to the axis s, and the integral is represented of rotation. Continuous action is ug the drum a reciprocating or in along its axis, so that when the elled to one end of the cylinder ck again. The new integrator is ed for measuring forces which are or variable, because, unlike other inertia and friction of the moving s so slight as to be quite inappre- eplied by causing the varying force to vary in a corresponding manner

them they grow and produce the disease in question. It has only been within the last few years, however, and in some cases within the last few months, that the germs of some of the most fatal diseases which attack animals and man have been detected by the microscope in tissue or in the blood, and not only detected but isolated, and not only isolated but cultivated, and not only cultivated but so attenuated and deprived of their virulence that inoculation with them could be safely resorted to, and the subject be thus practically rendered proof against the terrible disease in its most malignant form, even though exposed to its most baneful influence. I refer, of course, to the researches of M. Pasteur, Dr. Koch, Dr. Klein, M. Toussaint, and other distinguished physicians and veterinary surgeons. The experiments hitherto made by these observers have been chiefly but by no means exclusively confined to the diseases of animals. The first success was attained by M. Pasteur in his attempt to arrest the progress of the silk-worm disease. The germs of this disease were discovered. Infected insects or eggs were separated from those which were not infected, and such successful methods suggested for stamping out the disease that they were recognised both by his own and by foreign Governments. Afterwards his attention and that of other workers in the same field was turned to other diseases. The very fatal splenic fever of sheep and cattle, identified by continental writers with the murrain of Egypt, the pig-typhoid, the fowl-cholera, the cattle disease known as *la maladie de chaberd*, and even hydrophobia, have been the subject of careful experiment. In each of them a microscopic organism, a *bacterium* or a *bacillus*, less than the thousandth of an inch in length, has been found in the blood, and discovered to be the cause of the disease. The organism has been separated, cultivated in chicken soup, made almost innocuous by long exposure to the oxygen of the atmosphere, and then used for inoculation purposes. After this it is found that though the constitutional disturbance set up has been very slight, the animals so inoculated are almost, if not quite, proof against the disease, even though the germs of it in their virulent form have been introduced into the blood. In the case of diseases of other kinds, which attack the human subject, such as ague, malarial fever, and that rapid and fatal form of it, yellow fever, similar organisms have been found in the blood, and the treatment of the diseases by the injection into the veins of phenic acid, which is known to destroy such germs, has been attended with success. That like causes may be traced, and some kindred treatment successfully adopted, in the case of other epidemic or contagious maladies, seems to be highly probable, and as the result of this new microscopic departure in regard to the theory and the treatment of disease it is hoped that there may in due time be a large abatement in the death-roll attributable to such wide-spread and dangerous disorders as scarlet and typhus fever. Such investigations as these can, of course, only be carried out by those trained in medical science. But there is abundance of work for others to do in the examination of those most interesting animal and vegetable organisms with which our ponds and rivers and hedge banks teem. What we want is to enter into the matter with spirit, and with unflagging interest. We have already in our society a fair number of members who wish to avail themselves of the advantages it affords. Most of them are workers in the field of microscopical investigation, and I should hope that none of those who belong to the society will rest content without possessing a microscope of their own, that each one will do some real work so far as time and duties allow, that he will bring to the meetings anything of interest he may discover, and seek to give or to gain information. Teachers and students of physiology will find special aid in facilities for conducting those microscopical demonstrations which are essential to success in the line they follow, whilst those who are beginners in the use of the instrument will have assistance and advice from the more experienced members. It is our purpose to give our society an educational and instructive character, as well as to make our meetings interesting. Courses of subjects relating to vegetable tissues, insect structure, and so forth, will occupy a portion of some of our meetings, the topics discussed being illustrated by slides obtained for the purpose or mounted by members. Such slides and others will gradually form a cabinet which may be open to examination by members, whilst instruction in the art of mounting objects would probably excite much interest and do good service. Books of reference will be purchased for the use of members and such magazines and periodicals taken in as may suit their wishes and requirements, and keep them acquainted with the most important current literature on the subject. First-rate instruments and apparatus may be too costly to purchase, the subscription to the society being only ten shillings a year, but through the liberality of members even these may possibly in due time be had. Our object must be to make our

society a thoroughly practical and useful institution, and if we determine that no pains shall be wanting on our part to make it a success, I think we shall not fail. And then, as we search more and more deeply into the secrets of nature, and dive into those recesses which our instrument alone enables us to explore, we shall increasingly wonder at the power and goodness of Him who made all, who, whilst He studded space with suns and worlds, clothed also with exquisite beauty organisms too minute to be brought into view, save with the highest powers of the microscope, and others, doubtless, equally lovely, which elude our vision."

SCIENTIFIC NEWS.

TWO Dun Echt Circulars, Nos. 41, 42, are to hand—one containing a telegram from Boston, in which Mr. Sawyer announces that the star D. M. + 1°, 3408 is a variable of the Algol type, with a period of 5.24 days, Nov. 30.84, 1881, G. M. T., being an epoch of minimum. The star's place for 1882 is R.A. 17h. 10m. 33s., N. Dec. 1° 20' 6". The other is a translation of a code telegram from M. Palisa, giving the following elements and ephemeris of Comet *g*, 1881:—T 1881 Dec. 8.81 G.M.T., $\alpha = 52^{\circ} 139' 46''$, $\delta = 184^{\circ} 54'$, $i = 143^{\circ} 33'$ (mean equinox, 1881); log *q* 0.28267. The position on Dec. 11th will be R.A. 23h. 42m., N. Dec. 41° 1'.

A series of observations of double stars, made at the Washington Observatory by Prof. Hall, has been recently published. The measurements given are mainly those made with the great 26-in. refractor from 1875 to 1880. Speaking of the *comites* of Procyon, Prof. Hall says he has never been able to see any of these companions which would stand the test of sliding and changing the eyepiece, and he is therefore doubtful of their existence. He considers it an interesting object for the powerful telescopes of the future.

M. Gronemann, examining the hypotheses of the zodiacal light, thinks (1) that it consists partly of proper light; (2) that its connection with polar light is but secondary, temporary, and accidental; (3) that the cause of the second phenomenon is such that it may strengthen the zodiacal light and modify its spectrum; and (4) that the results of spectrum analysis rank with other arguments tending to find the source of the zodiacal light in the neighbourhood of the earth. Herr Gronemann thinks the zodiacal light a terrestrial phenomenon, though it is possible it is influenced by cosmic action.

At the meeting of the Balloon Society, held last week, a paper by General Hutchinson was read in which the author proposed to use compressed gas, by means of which the balloon could be made larger or smaller at will. "By turning a wheel the aeronaut in his car could so regulate the density of the gas as to keep his balloon at any altitude he chose." Provision is also made for steering. The explanation does not appear to have been satisfactory to the audience, although a "hearty vote of thanks" was passed.

An Aeronautical Society has been founded at Berlin with Dr. W. Angerstein as president. It will hold an aeronautical exhibition in 1892.

Prof. Robert Grant, F.R.S., of the University of Glasgow, has tabulated his observations of the great storm of Nov. 21-22, the severest remembered at Glasgow. At one time the wind-pressure amounted to 48lb. on the square foot, the rate of travel being 80 miles an hour.

The actions brought by the Nickel-plating Company have been decided by a Court composed of the Master of the Rolls, with Lords Justices Baggallay and Lush. The Court held that the patent claimed was not the process used by the defendants, and that in fact the plaintiffs had abandoned the process described in the original specification. The effect of this decision will be to throw open the art of nickel-plating, so long as the processes described in the specifications are not used.

The Board of Trade has requested the Consul at Philadelphia, to procure one of Dr. Thomson's instruments for detecting colour-blindness. It consists simply in a jointed rod, fitted with 40 numbered buttons, on which skeins of differently tinted wool are suspended, the buttons being hid by the jointed arm of the rod. The 20

numbers to the left are the green test, in which the odd numbers are shades of green, and the even numbers, "confusion colours," shades of grey, light brown, &c. From 21 to 30 the skeins are alternately, rose or purple and blue; and from 31 to 40 the odd numbers are red and "confusion colours," such as olives and browns, on the even numbers. The subject is requested to select ten skeins to match the green skein shown to him, and if he is colour-blind to that hue, he throws over odd and even numbers all along the rod, whereas if his vision is normal, he at once picks out the ten green skeins. The merit of the instrument is that Dr. Thomson, by judicious selection, has reduced Holmgren's 150 skeins to the more convenient number of 40, and finds them sufficient for testing men who apply for employment on the Pennsylvania railroad.

A society has been started in Clapham for the furtherance of scientific studies, the development of artistic and literary tastes, and the mutual improvement of a number of gentlemen by means of scientific, political, and literary debates and readings. This society is known as the "Surrey Scientific and Literary Debating Society." Amongst its scientific patrons are Sir John Lubbock and Professor Tyndall. The ordinary meetings of the society shall be held on every alternate Friday between November the 1st and June the 1st, either at the Gauden Hotel (next to Clapham-road station) or at the South London School of Pharmacy (Kennington-road). The secretaries are Mr. John Weale, 15, The Grove, Clapham Common, S.W.; and Mr. W. White, 5, Beaufort-road, Lavender Hill, Clapham Common, S.W. The first meeting is to be held to-night at the Gauden Hotel.

The French Society for the Encouragement of National Industry offers a prize of £40 for an industrial application of endomose of liquids. Molasses have been successfully treated by that process, alcohol has been concentrated, and tanning processes improved by an application of the principle of endomose.

It was lately found by Dr. Born, of Breslau, that when young tadpoles were subjected to special kinds of food (in one case vegetable food being given, in another mixed vegetable and animal), a large preponderance of females were developed, 95 per cent., of 1440 tadpoles. In these experiments there was an absence of what forms the chief normal food of tadpoles, viz., marsh-slime, containing various organic detritus, and infusoria, rotifers, diatoms, &c. M. Yung has recently experimented on the subject, specialising still more the food given; one group of tadpoles received only fish, another meat, another coagulated egg-albumen, another egg-yolk, while a fifth had meat, algae, and white of egg (without slime). M. Yung's figures (in *Comptes Rendus*) similarly indicate a predominance of females. The quality of the kinds of food tried has not, he thinks, a distinct rôle on sex; but he confirms Dr. Born's conclusion that a special diet afforded to young tadpoles from the time of their issuing from the egg, favours the development of a female genital gland.

To show the deadening of a magnetic needle by a copper disc, Dr. Krebs pivots the former on a point on the top of a vertical brass rod on which the disc can be moved up and down, and fixed with a screw. Two diameters at right angles are marked on the disc, and there is a small horizontal pointer with upward bent end under the needle. When the disc is fixed close under the needle, and the latter deflected through a quadrant to contact with the pointer, then let go, it comes to rest much sooner than when the disc is down. Again Dr. Krebs deadens a rotating copper disc fixed on the clock-work used for a siren disc, by placing a horse-shoe magnet with one pole on either side of the disc. To show the different heat conductivity, and specific heat of liquids, Dr. Baumgartner arranges, in a frame, a series of test-tubes holding mercury, water, sulphuric acid, glycerine, and olive-oil; all the tubes having similar thermometers, fixed through the caps. The temperature in all being initially the same, they are simultaneously lowered into boiling water, whereupon the mercury columns rise unequally. These experiments, with others, are given in Carl's *Repertorium*.

The thermometer has now taken a very important place in medical treatment. An

objection to the common thermometer is that the mercury takes some time to fully acquire the temperature of a part of the body. An improvement on M. Becquerel's application of the thermopile in this connection has been lately made by M. Redard. He applies one junction to the body, and exposes the other to a temperature which is varied till the galvanometer shows no current; the temperature thus reached is the one sought. The piece to be applied to the body consists of a small iron plate (with neck) having soldered into it, at right angles, an iron and a copper wire, which pass to it through an insulating handle. This piece is attached by means of a belt. It is connected through binding screws, and iron and copper wire, with the other piece, or junction, and with a small sensitive galvanometer. This junction dips, along with a mercury thermometer, in mercury in a wide tube, and this tube is inclosed in another holding wood spirit, which is heated with water, or cooled by blowing air through it.

An investigation of the nature of diphtheria was lately undertaken by Prof. Wood and Dr. Formad, at the instance of the United States National Board of Health. *Inter alia*, an infected town, on Lake Michigan, was visited, where one-third of all the children in a marshy district died of the epidemic. The authors affirm that a minute plant fastens on the white corpuscles, and multiplies until, with the interior destroyed, they burst, and the liberated cells go off individually to continue their work on other corpuscles. Thus increased, they poison the blood, choke the vessels, and are found in myriads in the spleen, and other organs rich in blood. The false membrane, supposed to invariably indicate diphtheria, may, according to Prof. Wood, be caused by ammonia, Spanish-fly, or any other irritating influence in the throat, as well as by the parasitical plant of diphtheria. This plant is exactly the same as found on the coated tongue. When Prof. Wood put plants such as are found on a healthy tongue in sterilised matter they failed to grow, whereas plants from the throat or blood of a person under diphtheria multiplied rapidly. The possibility of prevention by vaccination was suggested.

The rotating steam-engine of C. S. Tegner, of Gothenburg, is described in the *D. A. Polytechn. Zeitung*, and is pronounced the best invention of its kind; and one that has given good proof of its usefulness as a marine motor and otherwise. There are four double acting steam-cylinders arranged in one, which rotates about a central rod forming an obtuse angle with the shaft. In each rotation the four pistons move once to and fro. (We cannot here enter into details.) By reason of small volume, and the absence of the dead point, the engine is peculiarly adapted for ships, for driving dynamo-electric machines, &c.

There are now telephone systems in seven German towns, viz., Berlin (length of lines 1,218km.), Hamburg (827), Mulhausen (87), Frankfurt (151), Breslau (187), Cologne (60), Mannheim (123). Total length of line 2,654km. In Italy two telephone companies have been formed to work the Bell telephone, one in Turin, the other in Genoa.

An interesting find of remains of reindeer recently took place at the summit of Montrenil, near Paris. The formation seems to have been part of the bed of a river flowing through marls, and it probably belongs to the glacial epoch of boulder clay. More than 500 bone pieces of reindeer were obtained, and along with them bones of rhinoceros, horse, bison, and elephant; also numerous fresh-water shells. M. Gaudry traces in the history of the Paris valley in quaternary times, (1) a hot phase, (2) a great glacial phase, to which the reindeer deposit belongs, (3) another hot phase, (4) a temperate phase, (5) a momentary return of cold, (6) the present climate.

Certain changes of colour were lately noticed in the star α Ursæ Majoris. Herr V. Kovesligethy set himself to study the phenomena with a Zeilner colorimeter at the observatory of O'Gavalla. His observations range from 19 July to 20 September. Simultaneous observations of the stars α and β Ursæ Minoris were also made. The author finds a regular change of colour in α Ursæ Majoris, which is very well shown when the wave-lengths are taken as ordinates, and the times as abscissæ, for a curve of the

phenomena. The colour varies between the Fraunhofer lines E and F of the solar spectrum, being distributed pretty regularly on the two sides of the line δ . The period appears to be about 54.5 days. The two other stars named present irregular variations of colour.

Some idea of the traffic on the streets of Paris is afforded by a recently published statement giving the numbers of vehicles that have been counted passing in different streets in a day of 24 hours. The following are some of the higher numbers: Rue Montmartre, 100,000; Avenue de l'Opera, 26,000; Boulevard de la Madeleine, 23,000; Rue Royale, 20,000; Boulevard des Italiens, 20,000; Chaussée d'Antin, Pont Neuf, from 11,000 to 18,000; Boulevard Saint Denis, 15,000; Boulevard Haussmann, 13,000; Boulevard Saint Martin, 11,000; Boulevard du Palais, 10,000; and so on.

As proof that the stratified appearance of the electric light in rarefied gas is due to condensations in layers of the gaseous mass, Messrs. Spottiswoode and Moulton lately described an experiment in which they send a current at right angles to that giving the layers, and this produces on the further side of the tube, not a continuous phosphorescent light, but a series of luminous curves, with dark spaces between, corresponding to the bright parts of the other discharge (indicating, it is thought, something of the nature of shadow). Herr Goldstein shows in *Naturforscher*, that he described this experiment to the Vienna Academy in 1876. He interprets the effect as due to an altered distribution of the cathode light, by action of the positive layers.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 81, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made Payable to F. PASSMORE EDWARDS.

* * * In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this July, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physics: a view from whence great inconveniences derive their origin." —Montaigne's Essays.

LUNAR PHYSICS—SUNRISE AND SUNSET ON LUNAR FORMATIONS.

[19486.]—THE drawing of Plato in the "E. M." of November 11, 1881, p. 232, col. 2, appears to have been made so near the epoch of sunrise on Plato that if I am not much mistaken Dr. Boyston Pigott must have missed some of the fine and important features characterising sunrise on Plato. I am therefore induced to trouble your readers with some extracts from the report of the Committee of the British Association for the Advancement of Science, 1871, "for discussing observations of lunar objects suspected of change," with the view of elucidating such points as are characteristic of the western mountain border, the character of the floor, and especially the distribution of craterlets and crater-cones on the floor. On p. 72 of this report the following passage occurs:—"The importance of such careful observations as those which have furnished the data for this interval cannot admit of question. The determination of the epoch at which the floor first becomes illuminated, as compared with an easily computed phenomenon (sunrise at a given longitude on the equator) places at once within our reach the means of ascertaining when the appearances witnessed during the interval 10 to 24 hours after sunrise at 4° E. long. on the equator will be repeated. This is, however, a small result compared with the forms and progressions of the shadows; for by their aid, especially if well sketched, and their lengths carefully measured or even estimated in parts of those of the three measured peaks, γ , δ , and ϵ , the distance of the west wall from the terminator being at the same time ascertained, the irregularities of the west wall at sunrise and by a similar process those of the east wall at sunset, may be obtained with tolerable

precision by B. and M.'s method described in 'Der Mond,' § 65, p. 98, and in the Report of the Lunar Committee of the British Association 'Report,' 1867, p. 15. We have thus the power, by multiplying such observations, of becoming intimately acquainted with the breaks and gaps, the elevations and towering pinnacles of the wall, and are in a position for handing down to our successors details that may enable them to detect changes, if such should occur, of sufficient magnitude to become perceptible. The shadows which I enumerated on January 10, 1870, were six (Dr. Pigott says 'about six may be counted')—the longest γ , one between γ and δ , δ with its two peaks or saddle-form, one south of ϵ , and ϵ . Mr. Joynson, of Liverpool, gives, in his drawing of the same date, two peaks to δ . The irregularities, both of the floor and border, have come out by these observations with marked distinctness, and tend greatly to settle, for the present epoch, the main features. If, however, changes are in progress, they may be, as on the earth, extremely slow."

The first appearance of sunlight on the floor reveals to us whatever breaks or gaps there may be in the wall, and these have been carefully recorded by Mr. Gledhill, as seen with Mr. Edward Crossley's 9 in. achromatic, by Cooke. The first in order of time is on 1869, Oct., 13d. 7h. 0m., ten hours after the sun had risen on the equator at 4° 0' 6" E. long., the first streak of sunlight was seen to fall on the floor of Plato through the gap in the west wall between the two high northern peaks ϵ and δ . Neison gives the height of ϵ as 6,128ft., and that of δ as 6,369ft., while the average height of the west wall is about 3,200ft. The western extremity of the spire of sunlight through the gap was observed on or near the fault which crosses Plato from N. W. to S. E., and contemporaneous with its appearance on the floor, it brought into visibility craterlet No. 3, the principal of the triple group Nos. 3, 30, and 31, two of which were seen by Mr. Gledhill on Jan. 10, 1870, in the interval between ten to sixteen hours after sunrise on the equator at 4° 6' 1" E. long. The record by Mr. Gledhill is as follows:—Jan. 10th, 4h. 18m. in 1870. At this moment, 12h. 18m. after sunrise, on the equator E. long. 4° 6' 1", the first streak of light fell upon the floor. Within it and near its western extremity was seen No. 3, as two elevated objects very near each other, but quite distinct. I could not detect shadow between them after hard gazing, although it was easily seen to the N. E. of the lower object. The streak was three times the breadth of the two objects together where it inclosed them, and it became broader near the N. E. border of Plato; it was brightest about and to the west of No. 3, and inclined a little downwards at the east end. The two components of No. 3 are apparently of the same size, are equally but not very bright; they lie nearly E. and W. of each other, but the E. component is a very little to the N. of the other.

1870, July 6th, 8h. 0m. Twelve hours and a half after sunrise on the equator, E. long., 4° 11' 5". Mr. Gledhill again witnessed the first streak of sunlight fall upon the floor of Plato, and observed spot No. 3 just within it; he remarked that the streak lay parallel with the longest diameter of Plato, and did not decline from No. 3 as it did in January. On the 13th of October, 1869, at 7h., Mr. Gledhill remarked that the streak was a little inclined to the north, and not quite parallel with the rim. At 9h., of July 6th, 1870, Mr. Gledhill remarked that a line through the two gaps or breaks in the S. and N. border passed through the western ends of the earliest streaks of light thrown on the floor. This line appears to be coincident with the great fault crossing Plato. This phenomenon, the western extremities of the streaks of sunlight falling in a line with the breaks in the N. and S. borders was well observed in January, 1870. An elevation of the ground in the direction of this fault has been seen. It would, however, appear that differences in the lengths of the streaks would depend more upon the relative depths of the gaps in the W. border, than upon any unevenness of the floor.

The results obtained from the above extracts from the report of 1871, viz., the position of the triple group of crater-cones, Nos. 3, 30, and 31, as referred to the great gap in the western wall, may appear to many selenographers as of little moment, but the contemporaneity of their appearance, as seen from the earth with that of the first streak of sunlight falling on the floor of Plato, fixes their positions as referred to a well-marked portion of the western wall, and as they usually may be seen throughout the lunation, they, or rather No. 3 becomes an important element in the triangulation of the principal objects on the floor of Plato.

W. E. Birt.

Leytonstone, E., December 2.

ASTRONOMICAL.

[19487.]—It may interest "B. M." (letter 19433), to know that I wrote to Longmans and Co., some months back, asking if they sold Webb's copy of Beer and Maedler's Map of the Moon separate

pitch is in the direction of the motion, and then curvatively little cut or polishing goes on, while the motion is crossed and reversed continuing, the grain of the pitch is kept perpendicular comparatively much cut or polishing goes. Here, then, I say, is plainly revealed to us that the polisher is divided into a number of zones of unequal degrees of cut or polishing—one removing much more or much less than the next, also on from the centre to the circumference of the spher, which unequal polishing would impress on the face of the speculum, and produce the zones that Mr. Lassell invented the sliding of the speculum on its face-plate backwards and forwards to cure, but this only did it by making one error obliterate another, and not by removing the cause of the error, which is the object worth to aim at. I may just explain, for the benefit of any who have a Lassell machine, or wish to work that principle, that this curious zonal effect induced not by the proper motion of the polisher its loops round the centre of the speculum combined with the proper motion of the speculum round its axis, for with these combined motions the lines would be the same all over the spher, but by the motion of the polisher on its axis—round the pin that moves it in its loops (rich motion is caused by the friction between the polisher and speculum) combined with the proper motion of the polisher in its loops round the centre of the speculum. And that, therefore the proper way to improve the Lassell machine is not even as Delarue did, by controlling the revolutions of the polisher around the pin that moves it, as to keep it so that which the polisher takes up on an average when left uncontrolled, (which seems to be about once every five loops), but by so controlling its revolutions on its axis that it shall revolve very slowly, I should say once for every 50 or 100 laps—so that this motion shall not appreciably alter the shape of the loops; then the direction of the motion between the speculum and the polisher would be crossed and reversed the same fall zones, and thus do away with the zonal inequalities of polishing by this form of machine when the polisher is left uncontrolled. I did not try this improvement, as I saw the defect did not exist in the Rose machine, and I abandoned at least for a time the Lassell machine; but I do say after I have exhausted all that can be done by the Rose machine I shall return to the Lassell's, and try to perfect that form of machine for its continuous motion has so much to commend it to our admiration. Perhaps all this has happened for the best, for the majority of amateur who have machines have Rose's form, and I can now describe to them what can be done by its form, and very good specula can be produced by it; thus those who have this machine need not despair, I hope to give a drawing of my form of machine on this principle further on.

I feel must again refer to the subject of beginning figure when we begin to polish, or what we may more correctly describe as beginning to bring the machine and conditions into that mutual arrangement that they will work a parabola; then all we shall have to do will be to maintain these conditions &c., till we have polished out all the emery marks, when the speculum will be finished without any further trouble, and in the time only that it takes to polish—we shall thus save a lot of time and trouble. It is not generally known by amateurs that during the polishing, which will take about eight hours, there may alternately be given to the speculum by machine working, a spherical and parabolical figure some dozen times or more. This will not appear strange, when we remember that the difference, even on the edge of a 4ft. speculum with a 48ft. focus, between a spherical and parabolical figure is only the 21,000th of an inch, and that the depth of the emery marks cannot be less than the 2,000th of an inch—I should think near the 1,000th of an inch. I intend to measure this exactly the next time I do some fine grinding. Now, it is evident that in this 1,000th of an inch there is ample room for a dozen 21,000th of an inch. Now, as we in reality partly put a figure on the tops of the emery marks such as the machine and conditions will produce, even in the first half-hour we polish, and can, by testing by Foucault's test, see what figure it is, we can then begin to alter the machine and conditions, if we understand their laws, so as to bring the figure nearer to the desired parabola, now this is figuring, and so on for every future half-hour's polishing; and thus we utilise our polishing time for figuring as well. I generally, after the third or fourth half-hour's polishing, get or arrange the machine and conditions to produce the parabola, I have then only to maintain these and go on to the end of the polishing. I hope to show the amateur how to do all this for himself; but let him remember he must pay particular attention to every law I shall have to bring before him, and explain to him; and when he has mastered the application of these laws, all will become as simple as the

chemistry of this day compared with the alchemy or chemistry of three or four hundred years ago.

I think our next letter will be on the use of the side motion in the Rose machine. We will seek to decide whether it be of use or not, and what is its action.

H. A. Wassell.

Addenbrook Villa, Love-lane, Stourbridge.

THE ADJUSTMENT OF REFLECTORS.

[19491.]—As this subject has been made so prominent, perhaps my experience may interest the readers of the ENGLISH MECHANIC.

After making the circles of the eyepiece, flat, mirror, and black image of flat apparently concentric, the definition was not good. With a high-power eyepiece beyond (i.e., towards the observer) the focus, Jupiter appeared as a bright disc, surrounded by a diffused disc more above to the right. I altered the flat by three adjusting-screws at the back until these circles were approximately concentric. With the lenses out, the flat was still in the centre; but the bright image of the large mirror and the black reflection of the flat were to the right and above. The flat is now approximately in adjustment with respect to the axis of the draw-tube only—i.e., 90° vertically and 45° horizontally. Therefore, by inclining the draw-tube more below to the left and the flat above to the right till the bright image of the large mirror is central, the axis of the draw-tube and telescope are at right angles. All the parts now require a final adjustment by the ordinary method. My 9in. Calver showed Encke's division in the ring of Saturn on the 28th Nov.

Therefore, if all the parts are concentric, and there is a flare when the eyepiece is beyond the focus, the axis of the body-tube and draw-tube are probably not at right angles, and the latter must be inclined in an opposite direction to that flare.

Mimas.

SILVERING MIRRORS, &c.

[19492.]—AMATEURS may thank Mr. Brashear for a good and simple method of silvering. I have tried it and can strongly recommend it; it requires careful management in large and strong baths; it acts better with double the quantity of sugar solution—especially if white loaf sugar is used; sugar-candy is, of course, richer in saccharine.

In reply to Mr. Wassell, the 37in. speculum was manipulated from beginning to finish in its cell—lying on levers resting finally on three primary points.

I note Mr. Brashear's remarks on my method of working planes. There is not so much in methods as in working them out. I never saw any other method than my own. Will Mr. Brashear kindly describe in detail the methods of Steinheil and Dr. Hastings?

My plans are a little varied according to circumstances: the methods given in my hints are reliable and best for the amateur. He is not so likely to succeed by blocking, and, I may add, that by this method I made the 6in. plane for the 37in. speculum. I cannot advise the making of planes singly. By accident small portions of plate-glass are flat, but it is a rather tiresome search to select them.

While writing about planes I may, perhaps, remark that though a new form and outlandish position has been made out for the plane of a Newtonian, I have no doubt telescopists will allow it to retain its original and proper position and form—viz., an elliptical form, and placed in the centre or axis of the tube the same as the mirror. I quite agree in the opinion of the author of the new idea that "up to to-day (?) in no instrument by the makers will this position, &c., of the plane be provided," but I don't share his apparent opinion that to-morrow the "makers" will certainly adopt the new idea.

G. Calver.

THE LANTERN.

[19493.]—WITH the advent of dark winter nights the pages of the "E.M." have been generally enlivened by some correspondence on this subject, and chancing to look into the Vols. for Dec., 1875, and Jan. 1876, I noticed what a fund of information there was, either treating on the lantern itself, the best light, oxygen gas, &c. Hitherto very little has been evoked on the subject this season. With the idea, therefore, of stirring up our lantern friends I pen these lines, and with pleasure I note that our valued contributor, Mr. Lancaster, has something new in the way of a slide-holder. Without saying anything that should be, in view of that gentleman's very reasonable remarks in connection with it, like a revelation respecting it, I would say that some four or five years since I tried what must have been a somewhat similar idea, but possibly not so completely worked out. The basis of the arrangement, of course, fitted the slide-holder, as no doubt he does; but the difficulty I found was that one had with a biennial to reach over the fronts so to remove the used slide, when the holder was on the farther side to the operator, and notably so when the

bottom lantern was changed. Mr. Lancaster will see what I mean without stating matters further; and will he say if this is remedied in his new plan? If so, it certainly is a great improvement: the panoramic system, with a careless operator, being sometimes productive of broken slides, owing to their being pushed out, the operator having forgotten to remove the used slide.

There are also two other matters that I should like an opinion on, either from Mr. L. or anyone else who has had experience. It is, What is likely to be the best oil-light for the season? I see that Mr. Wright mentions Mr. Hughes' new 4-wick lamp; but he does not mention the price.* I am at all times open to obtain any real improvement, so that I should like some additional information on the matter. By the bye, Mr. Lancaster has, I fancy, a new oil-light. I should be glad if he would tell us something about it. The other item I was going to name is if anyone has tried the etho-oxygen light? and if so, I should like to communicate with them on the subject.

The lantern always has been a very great favourite with me, and I therefore welcome the dark season as giving full scope to its use. Some may say that it has lost its popularity. Quite so, if in the hands of incompetent persons; but the large audiences I had the pleasure of meeting last winter tend to prove that its fame is not yet quite lost. A good illustrated lecture will, in the hands of most competent men, command a fair if not a large audience—and I find that the display of diorama effects and statuary properly shown at the close, never fail to elicit warm applause. As an educational instrument it is certainly unsurpassed. The chief thing in which I fancy we have come to the end of improvements is the production of the oxygen. The light, I think, will be even yet improved; and with the new jet I mentioned some time since—the hydrogen being taken from the main—both economy of the oxygen and an improved light are both gained. I trust some brother lanternist will have something to say on the subject shortly.

Sunlight.

LANTERN SLIDE-HOLDER.

[19494.]—As the season for exhibitions is now approaching, the accompanying illustration of a new lantern slide-holder may be of interest to some of "our" readers. I have used for some time a stepped slide-holder, but with dissolving views I find it a great tax to remember the size of slides, three back, throughout the exhibition. I, therefore, devised this holder, which is automatic, for any two sizes. Mine are made to the square and the Woodbury size, as what transparencies I make of course I use $\frac{1}{2}$ -plates for, and what slides of Ferrier's I had I took to pieces and made up to Woodbury size. The $\frac{1}{2}$ -plates you have failed with here come in handy, as they come perfectly clean with hot water; so having reduced our stock of unframed slides to two sizes, we proceed to construct the frame, which takes a quarter of an hour. Take a cigar-box lid, soak off the paper, and dry before the fire, turning it about as any warping is observed, as we must have it perfectly flat. Cut the lid to 5in. by 4in.; clean the edges and smooth one side thoroughly with sandpaper; on this side we work. Referring to Fig. 2, we have the lantern-front with front plates separated by a pillar at each corner, through which a screw passes. The shaded rectangle below is a brass bar fixed to the two bottom pillars, on which bar rest the slides, each one being registered by a "pin" driven into it (and afterwards adjusted) which is stopped by the end of the brass bar. The slideholder of course has this pin, shown also at A (Fig. 1). The square and Woodbury slides are shown in position by the dotted lines over the hole cut in our cigar-box lid $\frac{3}{16}$ in. from the left-hand of the slide-holder. The operator stands on the right side of the lanterns. Two bars of wood are fixed to the top and bottom of the holder. Their shape is seen in Fig. 2. The purpose of the upper one is to hold several "pins" which prevent the slides falling forward. The bottom one supports a strip of brass 1-16in. thick, $\frac{1}{16}$ in. wide, and about 11 $\frac{1}{2}$ in. long. One end, as B, may be turned up to form a convenient handle; the other is also turned up $\frac{1}{16}$ in. to catch against pin C, to prevent its being pulled out too far. The bottom bar A is sloped a little towards the body of the holder in order to give the slide a bias in that direction rather than the other, so that each slide may be at equal distance from condensers and objective. On the brass strip, at about 3in. from each end, there is soldered a little block of brass 3-16in. cube. If, now, we draw out the strip by the handle B until we are stopped by peg C catching the other end, and, having placed a "Woodbury" slide on it so that the right-hand corner touches block D, push it back as far as we can; it will be seen that the slide is stopped at the proper

* And very properly. "Sunlight" will find that in the advertisement pages, to which such information should be confined.—Ed.

point by peg E, carefully adjusted in its place for this purpose. But if we do the same with a square slide, we see that before the slide reaches E the left-hand block is stopped by peg C, while block D has just pushed the square slide to the right place: this is the phase illustrated. The

FIG. 2

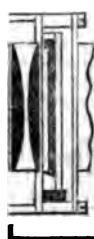
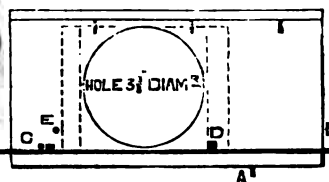


FIG. 1.

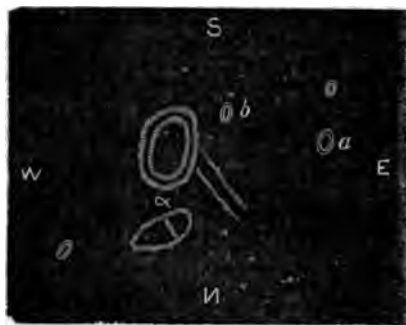


whole of the adjustment is confined to the two pegs C and E, except that it is convenient not to have the two ends of the strip longer than necessary. It is evident that this holder is more accurate than the stepped one, which depends on the finger. The springs holding the slides in my last-made lanterns are simply pieces of strong brass spring nearly straight, fixed at the right-hand end and pressing rather to the left of the middle of the slide. I will shortly describe the lanterns referred to. The two blocks should be 4 1/2 in. apart.

Lewis Arundel.

DIOPHANTES.

[19495].—On December 5th, at 8h. 15m., a good-sized crater was observed a little south-east of Diophantes, which is not shown in Neison's Map VIII. It is marked *b* in the annexed diagram. It



is not very much smaller than the crater *a*, and is much larger than the small crater shown a little south of *a* in Neison's map. Definition was very good, and it was suspected a crater, with 110 on my 5 1/2 in. Calver, while it was quite plain and easy with 186 and 200 + powers. It would be singular if so prominent an object had been overlooked, when the small crater south of *a* was seen.

A. Stanley Williams.

Brighton, Dec. 5th.

JUPITER-SATURN-COVERS FOR MIRRORS.

[19496].—ONE or two of your correspondents in their observations of Jupiter have remarked that the "red spot" is fainter in colour than formerly. I, observing with my excellent 5 1/2 Calver, have noticed the same peculiarity, not once only, but on two or three occasions.

I should describe its colour as "rose pink," whereas formerly the tint was something like brick-red. Is this change likely to be a first stage in the gradual fading out of the spot?

Dr. G. W. Royston-Pigott, writing in the MECHANIC of Nov. 25, gives us an excellent drawing of Saturn as he saw it on the night of Nov. 9. Observing on the same evening with my 5 1/2 Calver, power 200, I also saw Saturn, the night being exceptionally clear, and the air steady. I found definition unusually good, the chief division in the rings being almost as well seen as by your correspondent observing with his 8 1/2 in. Calver (power not given), as also the shadow of the planet on the rings—both this shadow and the ring division being blacker and more clearly defined than I had ever before seen them, even with larger instruments.

It may interest some of your readers to know that my large mirror—since I first had it some 3 1/2 years ago—has never had its cover on, except once when it was out of use during two or three months. I fancy covers are sometimes put on when it would be far better to leave the mirror without a close cover.

My plan is this. I always ke

"fine

muslin or net over the speculum end of telescope; this serves to keep out dust, while it does not prevent free ventilation. When not in use, I draw oversame end a cover made of American cloth, or similar material, tying it closely round the tube. The open end after putting its cover on, I serve in the same way, the flat having its cover on. About half an hour before using the instrument I take off covers. My telescope place is not as waterproof as it might be, but my speculum is as fit for work as when I first had it. I mention this as when there is no door in the tube by which to introduce the cover of the mirror, if this cover be used regularly, it is necessary to remove the mirror, and so to disturb the adjustments at every observation. It was the trouble of this, and the frequency with which adjustments made at the time of observation were imperfectly made, that set me upon devising some plan of getting rid of the difficulty. And, so far, the plan I mentioned has answered well. I have only to take off my outer cover or loose cap, and I am ready for work.

Brighton, Dec. 5.

T. B. D.

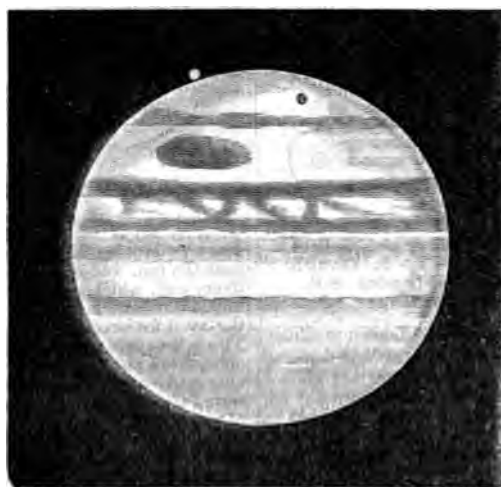
JUPITER-BALL'S DIVISION OF SATURN'S RING.

[19497].—I ENCLOSE a drawing of Jupiter made at the telescope at the moment of the egress of the

however, is a drawback. At press it either assumes the appearance of an alpenstock or a case of fishing tackle, and both are conspicuous when sauntering out of town. If a trip could be devised to shut up like a closed umbrella, the inquisitive multitude would be relieved the effort requisite to mentally speculate what a amateur had in his parcel, and why he invariably had it with him; although the said multitude might on other occasions question the sanity of a amateur if it saw him marching through the rain with his "umbrella" down. Now six triangular pieces of ash 2ft. 6in. long, with 1/2 in. sides, will form a nice size, but the joints to make twopieces into one leg and the attachments to the base-board, and the handle of the "umbrella" are difficulties. The readers of the MECHANIC have seen greater difficulties than these, hence I apply to their kindness with confidence.

ANOTHER DIFFICULTY.—In taking landscapes on a sloping, rough and woody places, it is sometimes impossible to get the object on the ground in the best position. Would a universal joint like those on gaseliers be steady enough, placed between the baseboard and legs? If so, the legs could be placed in the steadiest manner on the ground, and the requisite correction for levelling id position would be got by means of the joint. Would a set screw be required to hold the joint in position?

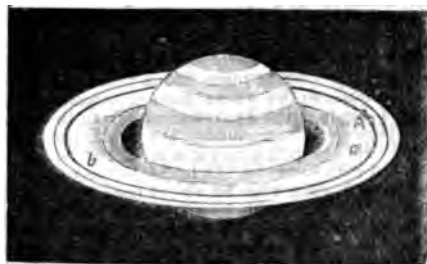
TIME OF EXPOSURE.—Mr. Lancaster, in his



third satellite, on Nov. 25. I have never yet seen the belts of Jupiter so distinct, and the various markings so diverse and so conspicuous. I noticed particularly, and have attempted roughly to delineate, a very delicately-marked penumbra which appeared to fringe the circumference of the red spot. The belt S. of the red spot seems gradually increasing in dimensions and brightness. The flocculent masses of white cloud-drift on the S. equatorial belt were very sharply visible.

Have any of the correspondents of "ours" noticed an excrescence on the f. portion of Ball's division of Saturn's ring?

I enclose a rough pen-and-ink sketch of the



general appearance of Saturn on the evening of Nov. 6, and of this excrescence in particular. I have marked it A in the drawing. It took the shape of a double-peaked shadow, stretching from Ball's division, of which it was an elongation, towards Encke's division. I have not seen it since. The shadows *a* and *b* are very plain now, but more distinct, perhaps, on the following portion of the ring.

Mars is improving daily, and I hope soon to be able to send a drawing of him.

W. Conybeare Bruce.

St. Nicholas Rectory, Cardiff, Nov. 28.

PHOTOGRAPHIC.

[19498].—TRIPODS.—Now, owing to cheap apparatus of manipulating the new processes, this craze is epidemic. The tripod,

instructions in a back number of "ou," and also with his plates, names five seconds as the extreme time of exposure, and states that the picture should begin to appear in 30 seconds.

I also find by the *Photographic Notes* that two minutes are ample for complete development. Now, with the Merveilleux, on sunny days, but in the shade, during August, I could do nothing with five seconds, and even twelve seconds took half an hour and upwards for development: sometimes I had to leave the plates in pyro solution two, four, six, and once ten hours, and in the cases the plates absorbed colouring matter from solution, which interfered with the printing. When a view has been taken, after a considerable exertion of leg and lung, it is very provoking to find things turn out so unsatisfactorily. The Merveilleux is deserving of its name in price and portability; and not caring to purchase a more expensive one, I shall be glad of the experience of others of the numerous purchasers of this apparatus and shall be obliged to Mr. Lancaster if he would state if the timing he gives is for this small aperture. I exactly carry out instructions supplied with plates.

Pyro.

AN IMPROVED METHOD OF CONSTRUCTING BUILDERS' IRON-MONGERY.

[19499].—I TAKE the liberty of sending you a short description of a mode of constructing certain articles of builders' ironmongery, which would greatly facilitate the fixing, and insure accuracy. This would apply particularly to sash-pivots for sashes that are hung on centres, thumb-screws for door shutters, and like fittings. The component parts of the above being independent or quite free of one another, require their relative positions to be very exact for them to work correctly.

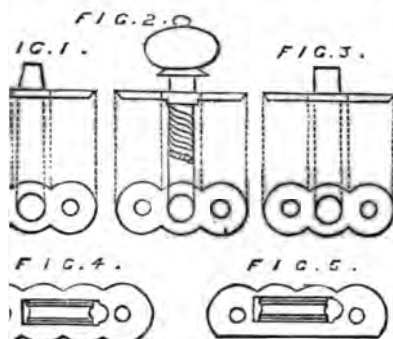
Suppose we take a sash-pivot as now in use: it is cast somewhere on the surface of a plate that is made in the shape of a parallelogram or oblong; we have no means to readily determine the exact positions for pivot and socket in the frame and sash, or, rather, we can determine the positions; but owing to the shape of the plates, we cannot with certainty be sure they will occupy them.

The construction as now proposed: The plates to

form of a number of detached segments of the working parts of fittings to be cast in one of the segments; the edges of these might have impression left to denote centres. segments of circles lin. radius, with centres at, might be taken as a standard for plates; could give a length of 2 1/2 in.

hang a sash on these pivots, draw a horizontal line, as is usual, on the stile of sash and return it on edge, a central line at right angles to this. Where the lines intersect, place middle segment of plate; mark the centres on the. Of course the intersections of the lines, one centre; three shallow holes on the edge, and the same on the frame, made with an oring-bit, would insure a much more rapid satisfactory job than it is possible to accomplish with oblong plates that have to be sunk into by means of chisel.

there is no need of details for thumbscrews: simple, with a slight modification, might with ease be applied to sash-pulleys. In sketches,

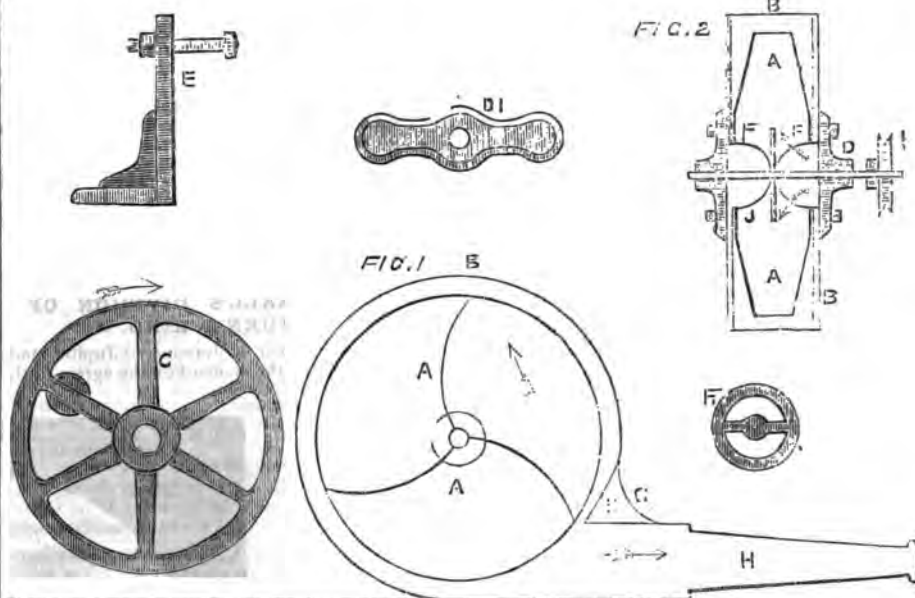


1 is a shutter stud; Fig. 2, thumbscrew; 3, sash-centre; Figs. 4 and 5, sash-pulleys. R. Gough. 3, Lower Kennington-lane, London, S.E.

HOW TO MAKE A FAN.

1500.]—To make a really useful fan is not a difficult task, providing we have a correct knowledge of what we require before starting. Let us see, then, it is a small domestic fan that is required; the fan proper, or the part that revolves, is to be decided upon, unless a set of castings is obtained, in which case it matters little what we commence with. But these instructions are intended for those who cannot obtain castings, and are perforce obliged to make shift as they can. Fig. 1, A, represents the fan in position; B is the outer case; Fig. 2 is a section through the line of centres of C, and A (the latter refer to the same parts in each figure). A full inspection of Fig. 2 should be made, as it shows the working parts can be seen. First, we have a small spindle turned out of a piece of fine iron or steel, straight and true; on this we have three discs: the centre one, J, is plain and the outer ones, F, are open in the centre, a bar across, as shown at F 1; these discs are 1 in. diameter, with 1 1/2 in. holes in them; the bored to fit the spindle, and fixed 2 1/2 in. from the outside, the blank one being in the middle. Now turn these true in lathe, top and bottom make two discs of tin plate 5 in. diameter, A, Fig. 1, which are dish as A, Fig. 2, holes in centre to match F 1; rivet or solder these to the inner face of the outer discs, using in lathe, bending them carefully until they run true. Now for the blades: these are of tin plate, cut to the shape seen in Fig. 2, and curved as seen in Fig. 1. These blades are 1/4 in. for a fan this size; rivet or solder these in between the discs, inserting the centre of the saw-gates cut in centre disc for that purpose that all are true and perfectly balanced by adding solder to the light side until perfectly poised. Now for the case: the sides of the case may be made of sheet-iron or wood—let us suppose any 1/4 in. thick cut to the shape seen in Fig. 2. If the curve G be adopted it will look better in some people's estimation, or the sharp K may be adopted. If the former, a piece must be bent to the angle K and fixed inside closing up the case. The object of this is to prevent the air being carried round again with the case, instead of being delivered into the discharge-pipe H, as shown by the arrow. Having lanced-pieces between the sides to keep them from covering the space between them with stout tin leaving one side loose to be removed for the opening of the fan. The distance must be such that the fan running freely without contact at F. Fig. 2, D D, show the bearings. D 1 is an enlarged view of same, which is as narrow as is consistent with strength, to allow a free passage for the air entering—shown by the arrows. Bore these out 1/4 in.

diameter, and screw on as shown. They must be perfectly true with each other and square with the sides, so that when the fan is inserted it shall run true with the sides. Now shoulder down the spindle in lathe to the holes in bearings, to allow of freedom without end shake. Now fit on the small grooved pulley I, and it is in condition to be tried.



The pipe H, also of tin plate, is oval at the end next the fan, and narrowed off to 1/4 in. at the delivery end, which is round. The wheel C is shown in position, and is grooved round the edge to carry the band for driving the fan by the small pulley I. This wheel turns on the stud in bracket E, shown apart from the wheel for the sake of clearness. One spoke of wheel carries a boss, in which is inserted the handle. The arrows show the direction of motion. The whole may be fixed to a board, or on a pair of light iron standards, the height of which will be the height of the firegrate. I know there are more simple forms of fan than this. For instance, the blades may be screwed on three arms of a boss fixed on the spindle, thus avoiding the discs; but such a fan will be noisy. The one here described is efficient, and whether 4 in. or 4 ft. diameter, will, if well fitted, be silent. And allow me to say a word to amateurs: Never begrudge a little trouble, if thereby you secure a better result. I have seen fans, both by amateurs and practical mechanics, which were simply intolerable, and had to be replaced by bellows. Lockstitch.

PURE ZINC-ELECTRIC LIGHT-DYNAMO-MACHINES.

[19501.]—I SEE the question of "pure zinc" raised in "ours," and thinking that I might do some good by stating some experiments I have made, I venture to do so.

In the first place I tried years ago, when working in the Owens College laboratory, to prepare pure zinc by distillation, but without success; and afterwards, when requiring pure zinc in the laboratory of a chemical works where pure chemicals were made, I again tried by reducing carefully prepared pure zinc compounds, but could not get "pure" zinc, as in this case it was sure to be contaminated with silica, &c. As to "P.'s" suggestion of preparing pure zinc by electrolysis it is certainly the best method if he could only do it. My results at electrolysis of not only zinc but other metallic solutions have not been crowned with success, as I have not yet met with the substance for the anode. For instance, suppose one is working with the chloride or sulphate of zinc, the zinc goes to the cathode, and the SO₄ and Cl to the anode, but my experience is that unless you get something that will combine with the SO₄ and Cl at the anode, you get no metal deposited at the cathode. Further, the compound formed at the anode must be insoluble in the solution in which it is obtained. Text-books on electrolysis forget to tell you these little things.

"Zu," in query 45463, requires information about the electric light. Let me tell him that the game is not worth the powder. Why not—supposing a hand-dynamo powerful enough—use the electricity direct, as otherwise you would have to charge a series of Faure's batteries for perhaps 48 hours to obtain anything like a light? The same as regards the Bunsen battery. You had far better use direct, or else you might have 10 Bunsens charging a Faure's battery for 24 hours; but

before any definite figures and measurements be given, one must know the size and resistance of lamp, also the power of light required. To charge a Faure's battery from a Bunsen's is very much like pumping water up a height to use it again through a turbine.

As regards the question of dynamo machines,

allow me to thank Mr. Lancaster, Mr. Hanson, and also "Anglo-Dane." To Mr. L. allow me to say that I prefer the experience of the many valued correspondents of "ours" to any results which may appear in connection with the forthcoming Crystal Palace exhibition. Also, makers want to make hay while the sun shines, and so they seem to me to form a sort of league to keep the prices up, give no comparative results, and to keep those outside in the dark as to the best form of construction. To Mr. Hanson my best thanks, but who is like many more in giving a description of dynamos—although he gives length of wire on armature, nothing is said about length of wire of field magnets. He states the R. of armature to equal the R. of field magnets. If what Dr. Siemens has stated—viz., the R. of armature to be 1-10 R. of field-magnets, or Mr. Kennedy that the R. of field-magnets should be 5 times the R. of armature, it seems to me strange that the Siemens machine referred to should be equal in R. for both the armature and field-magnets. This is a point that wants settling, and I think that some of our readers could give us the benefit of their experience. Also, I am sure that if somebody could give us some data to work on it would be of great service to many readers. For instance, take two examples: required, a dynamo to give, say, 2,000-candle power, and one to give 5,000; what size and form should machine be with length and thickness of wire on the armature and field-magnets with the R.'s in both cases, and how to calculate the power required to drive.

Seeing how rapidly electricity is coming to the fore, it is really time something was known definitely about the right construction of dynamos, and if there is a journal more suited than any other to settle this important question, it is ours; therefore, I appeal to all to contribute their mite, so that those wishing may, during the coming winter, get their drawings and patterns ready for their dynamo machines. As to our friend, "Anglo-Dane," I shall be glad to hear of the success of his machine; saying what it will do and also the length and R.'s of wire on it with power required to drive. I quite agree with him as to the space taken up with matters relating to tricycles, although a great lover of the sport, having been a bicyclist some fourteen years.

Cannot our best friends, "Sigma," give us a wrinkle about dynamos? Questor.

DYNAMO-MACHINES.

[19502.]—I AND many others, doubtless, have been waiting patiently for particulars of construction of dynamo-machines, and can testify to the boon it would confer to have the subject discussed with something akin to the skill and acumen that bicycles and tricycles are enjoying at present.

I live in the country, and the exhibition to come off in London will do little for me in the way of giving me an opportunity of seeing what is going on myself. I have been looking for a practical answer to questions like those of "Questor" for a

of the present are always to-morrow. Will some one invent a dynamo on the principle of a current which, worked with one of Faure's accumulators, will give a lighting, say, twenty to thirty candle power?

It is necessary to assume that the mechanical and electrical knowledge, and perseverance are not wanting. In the age of electrical discoveries are amateurs never to get beyond electric bells and telephones? I am confident our editor will not object to propose particulars where so many are interested, when we often see whole pages given to matters of a purely personal interest.

All we require is particulars of size of armature and magnets, length and number of wire required, plan of commutator, speed of revolution, and a few other wrinkles to set us going. Has Mr. Kennedy nothing to say or suggest? or is it possible that the thing cannot be done? and is this the cause of the melancholy replies of Mr. W. J. Lancaster?

Hybernian Celt.

WHITWORTH'S NEW SURFACE-PLATES.

[19503.]—MR. H. A. WASSELL will find engravings and description in Vol. XXII. p. 59, and if he should have no access to it, I will send him the number by post, as I have a duplicate.

J. C. L.

THE TAYPORT ACCIDENT.

[19504.]—ON Friday last (Nov. 20th) a very serious collision took place on the Fife section of the North British Railway at Tayport station.

A special coal-train arrived at Tayport, and the engine was run round to the rear of it in order to perform the shunting operations, and by some very strange omission no tail lamp was placed at the back of the tender.

The passengers and signals at Tayport are said to be interlocked, but the line is worked upon the block-system, and the true cause of the disaster is due to the fact that the directors and officials have neglected to provide these well-known appliances for ensuring an interval of space between all trains.

During the time the shunting of the coal-train was being performed the passenger-train from Burntisland approached, and was slackened at the "distant signal" the driver whistled, and Thomas Dippie, the signalman, thinking for the moment that the coal-train was clear of the main-line, lowered his "home-signal."

The driver of the passenger-train received no warning of any kind until he felt his engine dash into the rear of a tender.

Had the tender carried a tail-lamp the collision would have been entirely avoided, as the passenger-train, being fitted with the Westinghouse brake, could have been pulled up in the shortest distance. The collision was very violent, and five persons have unfortunately lost their lives, and others are very seriously injured.

On Saturday Mr. Morrison, Procurator-Fiscal, made an investigation at Tayport, from the notes of the proceedings now before me, it is quite clear that the Court was perfectly ignorant of the subject, as is shown by the utter absurdity of some of the questions asked. However, the result was that the Procurator-Fiscal gave his order that the signalman Dippie should be arrested and conveyed to Cupar prison, which order was at once carried out.

One or two facts still require further explanation before I can form an exact opinion as to the amount of negligence of which this man has been guilty.

I do, however, most strongly protest against the signalman being arrested and taken to goal like a common felon, more especially as bail to any amount was forthcoming, and there was not a shadow of an idea that this man would try to run away from justice. I may mention that Dippie is about sixty years of age, and has been in the service of the company for about thirty years, throughout the whole of which time he has borne an excellent character.

It appeared to me to be most unjust to send this man to prison, and therefore I telegraphed and wrote my opinion that bail should be accepted; in reply, however, I was informed that the guard of the goods train had just been also arrested, and conveyed to Cupar.

Magistrates and procurators fiscal in Scotland, are vested with considerable powers, but unfortunately they are in nearly all cases very severe indeed upon railway servants. The Rutherglen accident, and the imprisonment of driver McCulloch is one of the cases in point (see ENGLISH MECHANIC, Vol. XXVI. page 49).

Under the circumstances, therefore, I have now requested that the man may be admitted to bail, and have, at the same time, brought the facts of the case under the notice of several Scotch Mem-

bers of Parliament, and, if necessary, application will be at once made to the Lord Advocate.

Clement E. Stretton.

Saxe-Coburg-street, Leicester, Dec. 1.
P.S.—It gives me very much pleasure to state that I have received the following telegram from Tayport:—"The two men arrested in connection with the Tayport collision have been released on bail; much sympathy is expressed for their unfortunate position." C. E. S.

INDIAN RAILWAY PROBLEM.

[19505.]—THIS problem (letter 19371) may be solved approximately, by calculation, as follows:—In figure, page 209, join BC, BD, and CD. Let BC = m , CD = n , and R = radius, all in chains.

Then angle BCD = $1719 \frac{m}{R}$ in minutes,

And chord BC = $2 R \sin. BDC$

And chord BD = $2 R \sin. 1719 \frac{m}{R} + \frac{n}{R}$

By trigonometry—

$\sin. BCA = \sin. BAC \cdot \frac{BA}{BC}$

$\sin. BDA = \sin. BAD \cdot \frac{BA}{BD}$

But CAD + BDA = BCA + CBD

$\therefore CAD + BDA - BCA = CBD$

Let R' the radius which gives this angle upon CD,

then CBD = $1,719 \frac{n}{R'}$ and R' = $\frac{1,719n}{CBD}$ in minutes

and ought to be = R.

Assume a radius and calculate as above, and if R does not agree with R', then try R' in place of R, and calculate again till R and R' nearly coincide.

N.B.—The constant 1,719 is the angle in minutes at the circumference standing on an arc = radius, and is = $\frac{180^\circ \times 60'}{2\pi} = 1718.87335'$ more exactly.

EXAMPLE.

Let BC = 20, CD = 30,

BAC = 28.34° and CAD = 38.28° ,

BA = 40, and assume R = 100,

Chord BC = $20 \sin. 1719 \cdot \frac{20}{100} = (5.44^\circ)$

Log. 20 = 2.301030

Log. sin. $5.44^\circ = 8.999560$

Log. chord BC = 1.300590

Chord BD = $20 \sin. 1719 \cdot \frac{50}{100} (= 14.19^\circ)$

Log. 200 = 2.301030

Log. sin. $14.19^\circ = 9.393191$

Log. chord BD = 1.694221

Log. sin. BAC = $28.34^\circ = 9.679592$

Log. 40 = 1.602060

Log. $40 \times \sin. 28.34^\circ = 11.281652$

Log. BC = 1.300590

$\therefore BCA = 73.12^\circ$ 9.981062

Log. sin. BAD = $67.2^\circ = 9.964133$

Log. 40 = 1.602060

Log. $40 \times \sin. 67.2^\circ = 11.566193$

Log. chord BD = 1.694221

BDA = $48.88^\circ = 9.871972$

$\therefore CBD = 38.28^\circ + 48.88^\circ - 73.12^\circ = 13.04^\circ$

So, and R' = $\frac{1,719 \times 30}{804} = 64$ nearly.

Assume R = 64

Chord BC = $128 \sin. 1719 \cdot \frac{20}{64} (= 8.57^\circ)$

Log. 128 = 2.107210

Log. sin. $8.57^\circ = 9.191933$

Log. chord BC = 1.299143

Chord BD = $128 \sin. 1719 \cdot \frac{50}{64} (= 22.23^\circ)$

Log. 128 = 2.107210

Log. sin. $22.23^\circ = 9.580699$

Log. chord BD = 1.687909

Log. $40 \times \sin. 28.34^\circ = 11.281652$

Log. BC = 1.299143

$\therefore BCA = 73.51^\circ = 9.982509$

Log. $40 \times \sin. 67.2^\circ = 11.566193$

Log. BD = 1.687909

$\therefore BDA = 49.15^\circ = 9.878284$

$\therefore CBD = 38.28^\circ + 49.15^\circ - 73.51^\circ = 13.92^\circ = 822$ and

R' = $\frac{1,719 \times 30}{822} = 62\frac{1}{2}$, and nearly = R, &c.

The problem is sometimes indeterminate, as there is nothing to show whether the angles BCA and BDA are acute or obtuse. C. E.

TRICYCLES.

[19506.]—JUST a word or two on the subject, strangely enough, is by far more to me all carefully discussed, than devoted exclusively to the sport. What is the result, so far as I have been able to demonstrate, by repeated experiments; and so far, they show in a way possible that a large wheel, well beyond a given size, a drawback, was up or down for everyday riding. As points to which I would wish to draw are, that if we want a machine easy to a good hill-climber, without the use of pliances, such as are now attached to the machine, the largest practicable size thereabouts. The greater the strength so may the wheel be an inch or so large is very close to the limit. That the themselves finding this out is proved by introduction of that size wheel. The Macdougald means *steering*—*not* *driving*, I quite agree with him. If he drives, then I must dissent. The point I am quite convinced of is the backbone is an advantage. Not only the machine runs steadily, but it prok of traction, and "C. E." I note, is out; and I am glad, amidst the volu that "C. E." has spoken up in the he has. And his last paragraph supplies theory which I have refrained from as being theoretical only, but which is less, quite correct.

I would wish to say to "Pau" cordially accept the manly and str statement he made at page 255, and sure he will accept this in the fr make it in.

As instancing the difference of opi King's letter. He advocates a forw preference to the vertical one. Well believe this to be a matter of use. I accustomed to the vertical thrust; as have to ride one requiring a forwar propulsion of the machine ab. ut a mil me that I had doubts of reaching hom wards rode the same machine, with t to allow of the vertical tread in greatest ease and comfort.

If we come, not to technicalities, plain terms, surely "No. 179" (page gainsay me on the question of do What is a double driver? Why it is in ordinary running, both wheels. But on meeting a resistance, the wh should drive—not the one which meet This is my theory and definition of a The "Salvo" does not do this; there consider it a double driver; neither with the required test that, in turning outer wheel should drive. Here the " fails; therefore, I again condemn double-driver again. But in this is that the "National Special" meets whilst the "Salvo" does not. Wit the outer wheel drives on turning a wheel meeting the most resistance is the most work. In paragraph 6 the solution of the front-wheel ques lengthened backbone to the rear-se does much to meet that difficulty.

I see he is quite right also, except of of the brake. Unless the machine be fast and the spoon-brake is applied hard, it will not tend to lift the trail then it is due to the fact that the dr grip on the road, are coming to a st weight and momentum of the rider s ward carry him out on his face fr action of momentum and the bite of the wheels; and a hub-brake might do t no doubt would do.

[19507.]—"FABER" (19425) and (19452) have suggested improvement described a little time ago. To the t to say that I have never noticed any working of the simple joint at t as there is no reason why either a ball-s some kind of universal joint should not advantage. If "Pangul" will comm me, it will give me pleasure to end l for his criticism of how I propose to a culty he apprehends.

The seat arrangement, as figured s by me, was only intended to illu principle in construction, and not as a design equally applicable to every bil On my own machine, where both c connecting-rods are adjustable, there i the seat should be so. However, in e numerous inquiries how to adapt it with unadjustable cranks, I have re good deal of attention to this matter, have thoroughly mastered it. It w much space to describe how, and illu be requisite. Besides, different buil

would need special adaptations. I shall at all times be glad to assist inquirers by letter or in these pages.

"D. H. G.'s" letter (19422) on length of backbones is, to my mind, the most valuable contribution on tricycling matters that has appeared in "ours." I can testify from personal experience that the principles he enunciates are applicable with equal force to front-steerers. I never could make out why people should sacrifice every other essential good quality to quick-turning, unless with a view to their being able to perform the gyrations of a quadrille upon wheels.

I notice that Mr. King's views (19178) upon leg-thrust and back-purchase coincide with my own, as he will find by referring to back numbers.

To "No. 170" (19480) let me express my thanks. I am thoroughly familiar with the driving principle of the "Salvo," but not being myself a rider of this machine, I did not feel called upon to defend it, so I considered putting a question would be the best way to elicit such a valuable description as "No. 170" has given us.

W. H. Stacpoole Westropp.
Lisdoonvarna, Ennis, Dec. 3rd.

REPLIES TO QUERIES.

* * In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[43942].—**Hydrodynamic Railroad Brakes.**—I must express my obligations to "Essar" for his reply to my inquiry re "Hydraulic Railway Brakes," in "E. M.," July 22. I have little doubt "Essar" is correct as to relative efficiency of merit, though scarcely previously crediting it. I did not know such device had ever been tried or put in practice, except something of the sort in gunnery. Nor do I possess the back volumes referred to. The gist, however, of my proposition consisted in placing a thick cast-iron bored cylinder on the footplate or frame of the locomotive, behind, say, the driving-wheel, this cylinder to contain a fitted piston or plunger to act on the brake-block. The back end of the cylinder to be closed, from it to lead a lin. pipe of requisite solidity up to the driver's position, having also at its top end a lin. cylinder with piston or plunger therein. If, now, the pipe and the cavity in brake-cylinder behind piston be filled with water, the brake piston being 100in. in area, 1lb. pressure on the pipe piston will, by virtue of the "hydrostatic paradox," put 100lb. pressure on brake-piston, fixing a lever over the lin. piston, like the principle of safety-valve lever, the long end being ten times the short 1lb. at the lever's extremity, will put 10lb. on the lin. piston and 1,000lb. on the cylinder-piston. The point of the lever now screwed down with a force of 20lb. will put 200lb. on the pipe piston and 20,000lb. on the brake-piston, or a binding force of over 9 tons against the wheel—enough, possibly, for the most common emergencies. What the power exercised by the Westinghouse and other brakes expressed in tons is I do not know; 50 or 100 tons might, with facility, be applied with water. The continuity I proposed to effect by side rods from block to block along the train, so putting the binding force on every wheel at once.—**HYDRODYNAMIC.**

[44637].—**Puckle's Conic Sections (U.Q.).**—I feel sure that no such key has been published.—**OLDHALLIAN.**

[44752].—**Chloride of Zinc Battery (U.Q.).**—The battery I am going to recommend to this querist is a most reliable one. I have made one myself, and it has never failed me yet. Take an earthenware vessel (a white jam-pot will do) to hold 1 quart, or a stoneware jar to stand about 5½in. high, and pour into it 1 pint of water; into this put 2½oz. bichromate of potash. Let it all dissolve, and then add 2oz. hydrochloric acid (unskilled spirit). 1 carbon-plate goes into this outer cell, about 5½in. long by 2½in. wide; get a porous cell of the white kind 6in. long and 2½in. diameter. It is necessary that this cell be a wide one. Put into it 1 fluid ounce of chloride of zinc and fill up with water. Into this cell goes an amalgamated zinc rod. When the circuit of this battery is broken there is no action upon the zinc. It will last for three months without recharging. It is not so strong as a Daniell cell of the same size. The inventor of it is Mr. H. J. Dale, of Little Britain, London, E.C. It is not a patent.—**LANCASHIRE.**

[44827].—**Waterwheel.**—I should be pleased to help you, but I want more explicit data. What do you mean by "a full of 3ft."? Is that the maximum diameter you could allow for an over-shot waterwheel, or do you mean that the head of water in the pipe is only 3½ft.? If you will measure the quantity of water that issues in, say, half a minute, and let me know, or else give the length of supply-pipe, and the head in feet, or

pressure per sq. in. (either will do), I shall have something to work upon. Let me know also what height your wheel could be, and I will give you dimensions.—**GLATTON.**

[44999].—**Self-Feeding Fountain.**—Your best way is to allow the water to flow over the wheel as you first proposed, and attach a pump to force the water back into the tank again, and to provide the necessary additional power, connect a magneto-electric engine with the water-wheel. But there is no motor of that class to be had that can be worked by permanent magnets. It must be done by electro-magnets. The various plans that have been suggested in this journal can easily be found by referring back. A battery will in that case be required; but that might be such as the Fuller, or other constant form. If the water be allowed to flow on to the wheel, then the descending water would put into the wheel a given quantity of power to help to counterbalance the column of water to be lifted by the pump, whilst the electro-magnetic engine would supply the deficiency.—**SUNLIGHT.**

[45044].—**Oxy-Hydrogen Microscope.**—I have to correct an error that somehow or other got into my reply of Nov. 18th. I intended saying "a Triceratium, 2ft. in diameter on a 6ft. screen." This I have done over and over again, and I shall have much pleasure in a short time to give particulars of my micro-fronts. I may here give "Antares" a wrinkle, one that may be useful to him. One of the times when I was experimenting upon several new forms of front, I hit upon, really by accident and not by design, a plan for increasing the size of an object at will. I took a double concave and held it in the path of the rays after they had crossed, thus producing a very much greater divergence in the cone of rays going to screen. The position of the concave was alterable, so that the image could either be reduced or enlarged at will. Now, as to micro-objectives: for projection they cost as much to manufacture as an objective for the table microscope, and who will pay £33s. to £8s. for a combination of the kind I described? I would most willingly make them and advertise them, but I know it would not pay me to do so. My objectives have the largest lens nearest to the object, the smaller lenses being where they should be—nearer to the apex of the convergent cone of rays. If "Antares" will only look at the pencil as it emerges from the posterior lens in his power, he will find three-quarters of it useless. I reverse this. I use up all the rays and waste none. "Antares" cuts the ground from under his feet. November 11th, he distinctly says that he has a specially good 3in., by Dallmeyer, specially made for projection. What does this do if it does not endorse all that I have said? Why, I would give "Antares" a combination that should be as good as Dallmeyer's 3in. for as many half-crowns as he paid Dallmeyer pounds. I was not referring to low powers at all when I wrote my first letter. Any combination, with both lenses about same diameter, will do for projection; but show me a 1-5in., 1-6in., 3in., or 1-10in., that will touch a properly-made objective for projection; and although I have had thousands of objectives through my hands, yet I shall then see something I have never seen before; and I shall store in the nerve-cells of my cerebrum something that has never yet been stored there, and when once there it will never be lost.—**W. J. LANCASTER.**

[45124].—**Model Yacht.**—If "Landlubber" will procure No. 816, and look on p. 334, he will see tables from which he can calculate the sizes of masts and spars for any given dimensions of yacht.—**T. P.**

[45125].—**Incrustation of Cast-Iron Pipes.**—Fill them up with petroleum, and after allowing them to soak for a day, you will probably find the incrustation can be removed as a core. It ought to slip out with a few taps. What is the use of a "fuel economiser" with pipes in that condition? However, you had much better have the deposit there than in the boiler.—**NUN. DOR.**

[45127].—**Fishing-Rod.**—"Angler" should refer to pp. 218, 287, of the last volume, Nos. 841, 844, where he will find some useful information; but a 16ft. rod is rather a long 'un for a novice to try his hand at making.—**J. T. M.**

[45130].—**Horse Clippers.**—"Cutler" does not say what shape or make of clippers he wishes to sharpen; but I think he may try what he can do with a file.—**ESSAR.**

[45132].—**Change in Pitch of Railway Whistle or Bell.**—If, on the next opportunity, Mr. Tuttle will carefully observe the phenomenon he refers to on p. 308, he will find that the pitch does not "gradually go down" but drops suddenly, just when the bell passes the listener. The gradual decrease in loudness of the sound as the bell recedes, is apt to lead one to think that the pitch is decreasing, but theory and experiments agree in showing that the pitch varies with the relative motion of the two trains, and not with their distance apart.—**J. BROWN, Belfast.**

[45172].—**Asphalte Roof.**—There seems nothing objectionable in the materials used; but why not use slates? Anyhow, the rain-water would require filtering, and if a cheap and light roof is required, that can be made by tarring the roof first, then laying on sheets of strong paper and tarring again. The "tar" to be made of equal parts of pitch and tar, and thinned with coal-tar naphtha.—**ESSAR.**

[45206].—**To "Sunlight."**—I am about starting the drawings of a new compound engine (not a tandem); if it will not be asking too much of you to tell me the point of cut-off of steam, assuming in the new one the bore of high pressure to be 3½in. by 5in. stroke, and the low 8in. and stroke, of course, 5in. also; shall I still have to retain the same size eccentric as in my present engine (3½ by 3½), that is, cut-off 6-10th of stroke? Of course, that should be cut off sooner in the 5in. stroke. In your reply to my query of Nov. 11th, you state I should not require so much steam in the high-pressure cylinder, and in both cylinders is it requisite to cut off the same part of stroke.—**AMATEUR.**

[45227].—**To "Chemistiana."**—I here give "H. W." a brief description of the method adopted by some manufacturers of bisulphate of lime, say, to make 60 or 80 gallons at a time, as required by "H. W.": fit up a cast-iron vessel, holding about 100 gallons, with lid, and manhole in lid. In the lid are screwed two pipes, one for the addition of sulphuric acid, the other conveys the sulphurous gas away when generated. The cast-iron vessel, which is heated by means of a furnace underneath, is filled with charcoal, or some kinds of coke answer better; a gallon of rectified vitriol is added, and fire applied to the furnace. When the heat has got up, the sulphurous gas begins to come off, and is conveyed by means of lead pipe from top of still first to a vessel, made in the shape of a Wolf's bottle, containing a little water to wash the gas. The washed gas is then conveyed to a vessel containing from 60 to 100 gallons of water and about 50lb. of whiting or chalk, that is carbonate of lime. This vessel is fitted up with an agitator, in order that the whiting may be kept in contact with the gas, which is passing into the mixture of water and whiting. The sulphurous gas is passed into this mixture until all the whiting disappears. The agitation may then be stopped, and the gas allowed to pass in the clear liquid until the required strength is obtained. When the gas ceases to come over from the cast-iron vessel, more vitriol is added. One charge of charcoal will serve several times, the acid only being added as the gas is required. When, by the addition of acid and increase of heat, no more gas is obtained, the charcoal is spent or exhausted, the manhole or lid is taken off and the residue scooped out, and sold to manure makers.—**CHEMISTIANA.**

[45232].—**Speed of Boat Engine.**—If "Nemo" will be advised, such a boat as he proposes is totally inadequate for use on the Mersey. To build such would only end in disappointment, and a wet jacket, if nothing worse. Also, paddle-wheels are quite inconsistent with such a small boat, even for smooth water.—**MERSEY.**

[45232].—**Speed of Boat Engine.**—Now you have given me some idea of what you want. As it is a paddle-engine you are thinking of, the engine, 2½in. by 5in. would do, although it is somewhat small; therefore you won't get much speed. First, let me say that you must not expect more than very little speed—say about four miles an hour. The boiler you name is not at all suitable to the case, but if it has an arrangement to carry the fire in—a casing lined with fireclay—you might do something with it. In that case you would want a grate 10in. by 12in. long. But even this wasteful size depends on the area and length of chimney. It should be 5in. diam. and 5ft. or 6ft. long, with the exhaust thrown in with a good-size nozzle. If everything be properly arranged, such a boiler would keep 30lb. of steam well enough for a paddle-engine. What I should advise you, if you have not got too far on with the boat, is to have a larger engine and boiler, and let the latter be either a vertical or horizontal, with internal furnace tube. Is there anything else you want to know?—**SUNLIGHT.**

[45264].—**M.R. Express Engines.**—The 1472 class have driving and trailing-wheels (coupled) 6ft. 8in. diam., and cylinders 18 by 26. Their other dimensions are similar to the general type of M.R. express engines. Their Nos. are 111-115, 1400-1409, 1472-1491. The 1492-1501 class have 7ft. wheels and cylinders 18 by 26. Both these classes were built by the M.R. Co., 1879-81. Nos. 1502-1531, Neilson 1880-1, cylinders 18 by 26, driving-wheels, 6ft. 9in. These run the London express between Leeds and Nottingham, and are stationed at Leeds and Bradford (1520 and 1524).—**METRO.**

[45287].—**L. and N. W. Railway Goods and Mineral Engines.**—In answer to "Iron Horse"

I beg to append a few more details to "Diomed's" reply. Mr. Webb's latest class have cylinders 18in. by 24in., six coupled wheels 5ft. 1½in., boiler 9ft. 10in. long, and 4ft. 1 3-16in. diam., weight about 33½ tons. The engine fitted with Joy's gear is of this class, and weighs:—

	Tons.	Cwt.
On leading wheels	11	6
On driving "	12	0
On trailing "	10	1
Total	33	7

Boiler contains 199 tubes, 1½in. diameter, 10ft. 1in. long; heating surface (tubes) 985·2 sq. ft.; fire-box 94·6 sq. ft. His mineral loco's are similar in dimensions, but are lower in the wheels. Mr. Ramsbottom's goods-engines are hardly so heavy. They have cylinders 17in. by 24in., and 5ft. coupled wheels. They weigh about 27 tons, distributed as follows:—Leading wheels 9 tons 14 cwt., driving-wheels 10 tons, trailing-wheels 7 tons 6cwt. They have a wheel-base 15ft. 6in. I have the weight of another goods-engine, but am not sure which class. It is:—

	Tons.	Cwt.
Leaders	8	4
Drivers	9	1
Trailers	12	11
Total	29	16

There are still some of Mr. Connell's goods engines running. They stand very high, and are very heavy. The old Crewe goods were quite the reverse of heavy, as they weighed under 20 tons. They were designed by Mr. Trevithick. One of this class weighed:—

	Tons.	Cwt.
On leading wheels	5	15
On driving "	9	0
On trailing "	4	15
Total	19	10

They are not used for goods traffic now, having been relegated to ballasting, shunting, and light traffic. The original Lancaster and Carlisle engines are same build but much heavier. That is, they have outside cylinders, are coupled behind, &c. They are now much used for light-passenger, ballasting, shunting, and piloting. There are also some goods tanks with 6-coupled 5ft. wheels, and weigh 32½ tons with tank half-filled; built, I believe, by Mr. Ramsbottom; they stand on same wheel-base as his goods engines, viz., 15ft. 6in. I hope this may suit "Iron Horse."—CARSTAIRS.

[45299].—Organ-Coupler.—Do you not see that you have got one coupler involved with the other—to some extent? and that the pull by a spur on the swell-sticker would be anything but "sweet." Write privately to Mr. Taylor, of Leicester, or to Mr. Dresser. You may mention my name if you like.—J. W. W.

[45304].—Oil in Watches.—To possess a watch "perfect in every respect" is a great curiosity. My experience respecting high-class instruments enables me to suggest to our querist that the instrument should be again tested by an experienced workman, who devotes himself chiefly, if not entirely, to examining and timing watches for "temperature and positions." I am of opinion that "W. W.'s" watch is imperfect as to such, especially if it be of the quality as stated in his query. If the variation of 8 or 9 seconds in 24 hours by change of position only, an experienced "timer" (not merely a cleaner) doubtless could readily correct it if the temperature element be perfect. The variation referred to is above the average of a first-class instrument.—SECONDS' PRACTICAL WATCHMAKER.

[45305].—Keyless Geneva Watch.—This query, as it stands, is beyond my means of replying to, inasmuch as I read it—namely, having an "escape-wheel" of 30 teeth. It may be a model of recent introduction; if so, I for one would be glad to be informed as to its merits, after some competent person has examined and tested it.—SECONDS' PRACTICAL WATCHMAKER.

[45306].—Polishing Iceland Spar.—This process has apparently been held as a trade secret. Willow wood, as suggested by "L. W." will not answer as a polishing bed. It is much too hard, and nothing but scratches would result from its use. Calc spar, on account of its soft nature, requires a different treatment from glass. The spar is first cloven into suitable-sized rhombs by means of a razor-blade, struck very smartly on the back with a light hammer. The piece may then be brought down to the desired size by means of grinding emery and a metal plate; but emery is too hard to be used for smoothing, and will not work off a face by its particles diminishing in size. Powdered pumicestone should, therefore, be used. Placing a pinch of this on the lap, either of metal or glass, with a drop of water, it should be well worked and equally distributed over the lap with the "bruiser," which is a small block of glass ground on the face, till the powder feels quite

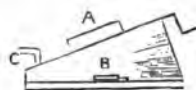
smooth and free from gritty particles, then rub on the spar, wiping away the surplus surrounding powder at times, and continue this till the best possible face is obtained, which should be quite free from scratches. Next gum a strip of paper on to a piece of plate glass (a gummed label will do), and when dry go over the surface of the paper with a small piece of flattened pumicestone. This will rasp off any possible prominence in the paper, then rub a lump of ordinary rottenstone on the paper and sweep off the coarse dust with the finger-end. Now apply the smoothed face of the spar, and without any moisture rub it to and fro till the highest state of semi-polish is obtained, applying the rottenstone from time to time. The finishing polish has now to be given to the partly-translucent spar. Take a strip of the finest close-wove alpaca, and, having smeared the plate-glass lap with "tacky" (which is pitch rendered semi-fluid by turpentine), rub the strip of alpaca down till it is closely adherent to the glass. The final polish is obtained by the very finest washed putty powder, oxide of tin, mixed with water and applied to the alpaca surface with a small camel-hair brush; when the polish is nearly complete finish it off on the lap nearly dry, using a very light pressure. In order to expedite the polishing, I have used a circular lap covered with alpaca, running at a rather high speed in the lathe, but more attention is required in maintaining a true plane figure, for the polish comes up so rapidly that if the preliminary smoothing has been effected completely, one minute will sometimes suffice to finish the surface.—F. H. WENHAM.

[45332].—Coil to give Quarter-inch Spark.—I will send drawings and description for you to work from in another week or so. I will make the drawings to scale, so that you will be able to make the coil exactly right.—W. J. LANCASTER.

[45344].—Enlarging of Photos.—What I thought was that you would have thrown the image, by the aid of a lantern, on to a suitable sheet of paper, tightly strained, and then copy the image on the back. Would not this plan suit you? the card being rendered transparent as suggested. Next to this is the regular process of taking a negative, from that a transparency, and then making an enlargement on Morgan's paper.—SUNLIGHT.

[45348].—Launch Machinery.—Many thanks to "Sunlight" for his reply. I think of getting a new boat 19ft. by 4ft. 6in. by 2ft. 3in. Would "Sunlight" kindly say if this size would do better for present engine and boiler, and give some hints as to best shape of new hull. Would putting in a thicker piston and reducing stroke of the engine to 4in. or 5in. be any improvement, or would I lose power by doing so? The bars were at first 18in. long, but so much fire would not burn. I reduced them to 16in., which was better, and then to 12in., better still. The flue is reduced from 9in. diam. to 5in. diam. at the back, where it branches out into the two 3in. tubes, which come to the front again. These, "Sunlight" says, should be 1½in. Would it do to put diaphragms in them at smoke-box end, to reduce the orifices to 1½in. The 5in. opening seemed unable to allow of a draught enough to burn coal on 18in. bars, but the petticoat-pipe may give a greater draught, and I shall try the old bars in again. With the petticoat should the blast orifice be kept reduced to ½in. diam. as it is now? There is a good deal of back-pressure with this size, but larger will not burn the fire briskly. The plan of laying fire is very good indeed, and I am greatly obliged for "Sunlight's" attention. P.S.—Grate area in Government launches is very small, 1 square foot for a 5½in. engine.—STEAM GIG.

[45350].—Pig-Iron Analyses.—The temperature you mention is readily ascertained by placing a thermometer (held by a clamp) in the dish. I cannot quite see what you require a temperature of 2220° F. for, unless to smelt the iron. A pair of bellows often used in the laboratory might be made as below at A. A thin piece of india-rubber is stretched, and when working is filled like a balloon. B valve, C outlet for air. As to the estimation of



carbon in iron, I am very sorry I cannot give any information, as it is a thing I have never worked at, and should be very pleased indeed if "Avon" finds an accurate and quick method if he would kindly publish it. There is, I believe, a method with chloride and sulphate of copper.—J. C. BELCHER.

[45351].—Lathe Query.—If "R. T. J." can get to see one of Cunliffe and Croom's 3in., or Archdale's new 6in. lathes, he will see what he wants. Our lathes are made with a bracket with

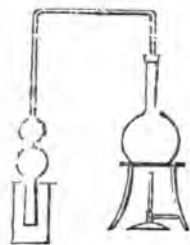
a handle. It is fastened with screw on back of headstock with two wheels—say two 20 wheels—so that he can unscrew pin, and throw in or out of gear with the wheel on end of spindle.—YOUNG TURNER.

[45354].—Lantern Slides.—By a background I assume you mean such as the sky of a picture. It is done by what is termed "dabbing." To practice it you require a piece of kid glove. First of all, lay on at the extreme top of the picture a streak of colour, then some little distance down another, but much narrower and with far less colour. I prefer myself to lay on the first streak, say ½in. wide, and the second one half that width, then have ready folded the piece of kid, so that it forms a ball or dabber, and with it keep dabbing the two lines of colour, blending them carefully one into the other. This gives the deep blue at the top terminating in faint blue at the horizon. A little practice will enable you to gradually blend the colour. Clouds are then put in with a leather stump or a piece of leather rolled up to a point. Any large surface can be so treated; but if it be the clothing of figures such as in Scripture slides, I do not care to use dabbing, but lay on the colour thin, and after the first coat is hard deepen up the shadows, working the depth of colour with a brush squeezed dry and flat. This gives rotundity, and avoids the appearance of flatness. It is this mode of treatment that gives the figure-subjects in Carpenter and Westley's slides the appearance of fairly standing out from the background. Woodcuts of any kind do not answer, to my mind, in the lantern, therefore, I would not advise you to try and transfer such to glass. But if you want to experiment for yourself, proceed as follows:—Damp the back of the picture, and be sure to keep the printed side dry. Next, pour over the previously-warmed glass-plate the medium of Canada balsam and turpentine, and quickly press the picture on it, well working out all air bubbles. When hard, you can then rub off the greater part of the paper. When this is so, flood the plate with another coat of balsam and mount for use; but you will not like the resultant picture in the lantern, I feel sure.—SUNLIGHT.

[45355].—To Mr. W. H. Davies.—To cover the treble portion of a set of hammers, the old felt must first be carefully removed by inserting the blade of a penknife just at the blow, and cutting outwards, so as not to risk injuring the under covering. The thin end of a slip of taper-felt should then be cross cut into strips, a little wider than the hammer, each end of these strips being shaved slightly thinner, to make the felt look neater when it is on the hammer—the shaved side is placed underneath; each piece should then be glued, leaving the part that is at the blow free from glue. It should then be drawn tightly over the hammer-head, and quickly tied with tape, to keep it in its position until the glue has set. In trimming, the felt should be cut with a very sharp thin-bladed knife—a small table-knife will answer pretty well—any rough edges may afterwards be smoothed down with a hot iron. For the keys, I should recommend celluloid as a covering instead of ivory, as this can be put on in one piece. This may not seem of much importance, but after "Platylus" has made a few joints (?) he will be quite able to appreciate the trouble it saves; it has also the advantage of being easily stained to match the old ivory; this may be done with a solution of anatto in a mixture of ether and methylated spirit, which will, of course, be applied after it is polished. Enough celluloid for a dozen keys will cost about 4s., but as for the felt, I think he will have to pay much about the same price, whether he requires the whole slip or only a part; this would be from 2s. 6d. to 4s., so he had better perhaps make up his mind to cover the whole of the hammers, and make a thorough job of it. For where to get the materials, I must refer him to the front page advertisements, where he will see that fittings and materials are supplied.—W. H. DAVIES.

[45362].—Sulphate of Ammonia Analysis.—Moisture.—Dry 10grms. at 212° F., and after some hours, weigh. The loss indicates the moisture. Weigh out 10grm. of the sulphate, and dissolve to 500cc. with water, and measure off six portions, four of 100cc. and two of 50cc., and determine the NH_4SO_4 (combined) SO_3 (free) CSN , and $\text{Fe}(\text{CN})_6$. NH_3 . This may be done as described in our last number, or as follows:—Put 100cc. into a clean flask connected with the apparatus shown. Measure into the beaker 30cc. of standard H_2SO_4 (1cc. = 0·10 SO_3), and into the flask 30cc. of caustic soda, 12° Twaddell, and close it immediately. A low light is now placed beneath, so as to boil gently. When three-quarters of an hour have elapsed, the CaCl_2 tube is removed from the beaker and the distillation stopped. A few drops of neutral litmus are then added to the beaker, and the contents titrated with standard soda (1cc. = 0·031 NaO) till neutral. The quantity of soda used, when deducted from the 30cc. of acid, equals the quantity of acid neutralised to the NH_3 .

when multiplied by '017, gives the NH_3 in 2grms. Free SO_2 .—Titrate standard soda till neutral, and multiply



used by '640, and then by 50. d).—To 100cc., which is made slightly acid, add an excess of BaCl_2 , filter, wash, and weigh, and make the following

Quantity found in Analysis	of SO_2	what does x
80		

of free acid deducted from this equals Sulphocyanides.—A standard solution prepared by dissolving 10grm. of pure litre with water lcc. = '003052grm. en, 50cc. of the liquor is put with 5cc. of HCl , and diluted with 5cc. of perchloride of iron ntly shaken; the colour produced is to under the same conditions as the above : lcc. of the standard NH_4CSN into a 5cc. HCl , 500cc. of water, and 5cc. of iron. The two flasks are now white porcelain slab, and the colours lcc. does not produce a colour dark is tried, and so on until they are alike, of NH_4CSN used multiplied by ten by 100, gives the quantity of CSN . s.—Dissolve 10grms. of pure K_2Fe lcc. = '00576 of ferrocyanogen. rmed exactly as above : the quantity d by '00576 and then by 100 gives the errocyanogen.—J. C. BELCHER.

Mosses.—(1) Take a thin slice off the rose that grow in large, compact, also gum down a stem showing its lcc. This is very important, as in the pinnation is usually one-sided. possible, some good published exsiccates Spruce's "Musci Pyrenaici," which a better than any description, but be apply much pressure; (2) Your plant subulate; but you should observe the eristome, which in Subulate and a few ted into a tube, and forms the sub-bia. The colour varies from pink to at the tubular portion is paler. The y have one or two rows of larger and You should cultivate the habit of mosses in the field, and using the little as possible; by close attention and general appearance of the plants, know a great many species. Stark's d only to a mere beginner. You will work giving modern classification.—

Tallow (Analysis of).—I think if ill try the following he will not fail Take 3 or 4 grains (not more) and dry a. not allowing the temperature to rise 212° F., and after some hours weigh. cates water. The fat is now made hile in that state about 20cc. of ben-radded and filtered through a weighed sidue is dried at 212° F. and weighed; ally organic matter. The filtrate is dryness and weighed; this gives the in the quantity taken for the analysis. HER.

Carbonated Soda or Refined Alkali. 10cc. to dryness and weigh. Or CO_2 and soda by difference. The rally employed is that of taking the ty and referring to proper tables.—J.

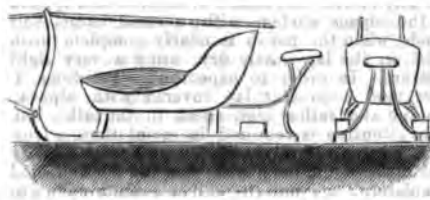
Winger Sewing Machine.—Needle too low. A blunt-pointed shuttle, ing broken, regulator-bar too high, tested by turning the machine slowly needle is just entering the cloth, then or take up should commence to t first see that your needle is in its n.—GENTUS.

Straightening Steel Wire.—I "page 311, refers the querist to a uted by myself, and which you ated in No. 850, page 431, and con-

cludes it is just what he ("G. M.") requires. "S. R." will please excuse me if I venture to differ from him. Reference to my instructions and illustration will show that I limit the action of the tool to number 16's to 21's; the instructions, as given, would, no doubt, go to 24 or even higher, but I should doubt the action on thicker than 16's. To imagine that 10 to 11 gauge-wire would straighten steel $\frac{3}{8}$ thick would be like trying to overturn a block of stone a ton weight with a rod of $\frac{1}{4}$ in. iron. For sizes I name I will guarantee the tool's action. For stronger wire a stronger arrangement. When it reaches $\frac{3}{8}$ in thickness and the metal cold, I should say hammer and anvil.—F. W. MARSHALL, Shipley, Yorks.

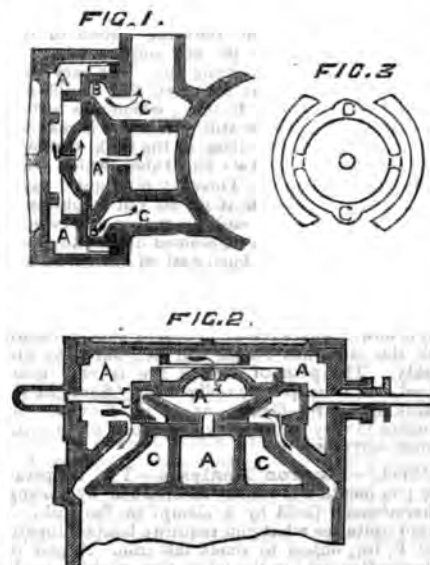
[45380.]—**Water-Glass—Soluble Alkaline Silicate.**—You could get this at, or through, any chemist for a small sum.—J. C. BELCHER.

[45381.]—**Sledge.**—I append a side and end elevation sketch of a sledge for one horse, such as



are used extensively in my native country, Denmark. They are intended for two persons, one inside (generally a lady) and one outside. The outsider sits on a seat similar to that of a bicycle with his feet resting in two boxes. They are very swift and easy to draw, but require some skill in management when turning sharp corners. They are easily upset, but this is rarely accompanied by any accident.—ANGLO-DANE.

[45383.]—**Church's Slide-Valve.**—I cannot give Mr. Thomas J. Scutt any information respecting the working of above valve on the various engines mentioned, neither do I know whether it was fitted to any of the N.W. engines; but it is fitted to some of Mr. Adams' new engines on the S.W.R. I have a vertical section of the valve, Fig. 1, which I reproduce. Fig. 2, horizontal sec-



tion, and Fig. 3, the plan of ports I have worked out from the vertical section, but I am not certain whether they are correct. Steam is admitted into the steam-chest and passes through the hole in centre of valve, and fills the space A inside valve; the area of valve subject to pressure is thus reduced by the size of steam-space inside; the remaining pressure on outside of valve serves to keep it steamtight against the valve-face. The exhaust steam is admitted into space B, which runs all round inside of valve, and then into the exhaust ports C. It will be seen from the drawing that the valve has two rubbing surfaces, the valve face and the circular casting fixed in the centre, the outside of which forms the exhaust passage and the inside the steam-space which balances the valve. I believe one of the advantages claimed is that it can turn round in the bridge, which prevents grooving and making the surfaces wear evenly.—E. L. P.

[45385.]—**Prevention of Slip in Belts.**—In the case of wooden pulleys or drums, a piece of an

old belt is nailed on to the drum with flat-headed nails. To prevent a belt slipping on an iron or metal pulley, the belt or strap must be taken up (i.e., made shorter), or if the belt fits its work and still slips, a little powdered resin thrown between the belt and the pulley as it is working effectually stops slipping; this is the method adopted in the City Saw-Mills.—A. TAVENER.

[45389.]—**Friction.**—The amount of force in this case is as follows:—To raise the weight, 14·86lb.; friction, 22·33lb.; total, 37·19lb.; coefficient of friction, '08. If the pitch were $\frac{1}{4}$ in., the friction would be doubled—to do the same amount of useful work—viz., two turns of the screw.—GABARRI.

[45390.]—**N.E. Engines.**—The bogie tanks built by Neilson and Company, 1874 (940 and 950 class), have leading- and driving-wheels coupled, and the trailing-end carried upon a bogie. Cylinders, 16 by 22; diameter of driving- and leading-wheels, 5ft.; diameter of bogie-wheels, 3ft.; 175 tubes 2in. in diameter; 2 $\frac{1}{2}$ in. pitch; length of tubes, 10ft. 9in.; the tank contains 960 gallons. These dimensions are taken from the *Engineer*, Vol. XXXVIII., page 282. The tanks built by Hawthorn and Co., 1875, and numbered 1430—1439 are similar. Those built by the N.E. Company are somewhat larger: the driving-wheels of some are 5ft. 2in., of others 5ft. 6in. No. 1,000, shown at the Stephenson Centenary, is one of the latter, also Nos. 10 and 65. Other numbers are 62, 108, 276, 357; but I do not know to which of these classes they belong. This company have fitted most of their tanks with the Westinghouse brake. Of the Furness engines, I know nothing more than that they are mostly built by Sharp, Stewart, and Co.—METEOR.

[45390.]—**N.E.R. Engines.**—Does "Carlisle" mean 1431-1435 class? If so, here are a few of the dimensions. They are not, however, built by Neilson and Co., but by R. W. Hawthorn and Co., Newcastle. Cylinders (inside), 16in. diameter, 22in. stroke. Boiler—Length, 10ft. 6in.; diameter, 4ft. 2in. Firebox—Length, 3ft. 10in.; width, 3ft. 4in.; depth, 5ft. 7in. Tubes—Number, 175; external diameter, 2in.; length, 10ft. 11in. Heating-surface (total) 1,049 sq. ft. Weight—On leading-wheels, 13tons 15cwt.; on driving-wheels, 13tons 8cwt.; on trailing bogie, 20tons; total weight, 47 tons 3cwt. Leading and driving-wheels, 5ft.; bogie-wheels, 3ft.; tank contains 1,000 gallons water; coal-space for 3 tons. I believe there is a slightly larger class, with cylinders 17in. by 22in. and 5ft. 6in. coupled wheels. With regard to second part of query, I know but little. The Furness Railway have some 5ft. 6in. single-tank engines, with cylinders 16in. diameter and 20in. stroke, or a tractive force of 79lb. for each pound of pressure in cylinders. Weight, 23 tons; heating-surface (tubes), 842 sq. ft.; firebox, 72 sq. ft.; total, 914 sq. ft. The goods and mineral engines have wheels about 4ft. diameter. The style of painting is much the same as on the L. and S.W. engines. Some are built by Sharp, Stewart. The former class have dome placed close to chimney, and Salter's valves, inclosed in brass funnel over firebox. There are some heavy 6-wheel tank-engines for working heavy goods and mineral trains over long banks of 1 in 80 to 1 in 100. The principal dimensions are:—Cylinders, 18in. dia. and 24in. stroke; wheels about 5ft. (net sure); total wheel-base, 15ft.; heating-surface (tubes), 1,048 sq. ft.; firebox, 96 sq. ft.; total heating-surface, 1,144 sq. ft.; grate, area of, 15 sq. ft. Weight—Leading-wheels, 13tons 16cwt.; driving-wheels, 14tons 11cwt.; trailing-wheels, 13tons 8cwt.; total, 41tons 15cwt. Tank capacity, 1,000 gallons.—CARSTAIRS.

[45394.]—**Electrified Water-Basin.**—I suppose "Electrified Water" has two brass handles attached to secondary wire of his coil; if so, he must, if he uses an "earthenware basin," place one handle in the basin, covering it with water, and place the coin in the bottom of the basin. Now the other handle must be held by the party wishing to extract the coin in the right hand, and try to take out the coin with the left hand, or *vice versa*. It will be seen that the finger coming in contact with the water completes the circuit, and a severe shock takes place which effectually prevents anyone even touching the coin. Try the effect with a weak current first. If "Electrified Water" wishes to manage the shock neatly, disconnect the handles from the secondary wire and solder a wire to the outside of a tin bowl, taking it to one of the secondary terminals, and if he has a stone or brick floor, get an old galvanised iron pail, or a piece of iron plate 2ft. square, solder a wire to it, and bury it in the earth, 3ft. or 4ft. from the surface—in damp soil is best, in the garden, for instance—and empty two or three buckets of water on the earth covering the plate. Now take the wire into the other secondary terminal, and if the soles of the boots of the party wishing to extract the coin are not over the average thickness, when the fingers of either hand touch the water the circuit is complete through earth from the

one terminal of secondary to the bowl of water, and from the other secondary terminal to the earth-plate, through the earth, up the body from the floor to the surface of the water. If the boots are taken off, the shock is very powerful; and if the floor is of boards, substitute for the earth-plate, outside the house, a plate of iron or tin, 1 ft. square, lay it on the floor, with a wire soldered to it and taken to secondary terminal, then, by standing on the iron plate, contact is made the same as through earth. If "Electrified Water" requires further information I will gladly oblige.—SERGEANT A. SHARPE.

[45396.]—Capacity of Tank.—I notice that this query has been rather clumsily answered, and that the best formula has not been given. The following is accurately correct, and easy to work:—Add together the squares of the diameters and the product of the diameters. Multiply this by the height, and then by .2618 (which is one-third of π). In algebraic symbols, $.2618 H (D^2 + d^2 + D \cdot d)$. The answer comes out thus: $100 + 81 + 90 = 271$, which, multiplied by .2618, gives 709.478 as the answer. "R. M. A.'s" formula is of little use without a table of logs., and he has made some error in working out. The formula given above is a modification of "R. M. A.'s." This correspondent has made a mistake in his next reply, by taking the atmospheric pressure (which need not have been introduced) at the value per square inch instead of per square foot.—PLOXY ALMON.

[45398.]—China Painting.—"Pangul" must not think of making his paints: they can be bought ready for use much better and far cheaper. Perhaps the best book for a beginner will be "Amateur Pottery and Glass Painter," published by Chapman and Hall, price 5s., by Hancock, of Worcester, who also makes and supplies the finest colours. Good results can also be obtained by using the paints in collapsible tubes sold by Leclercq, Barbe, and Co., 60, Regent-street, London. They only require the addition of turpentine, spirits of tar, or other vehicle to make them ready for use.—W. T. BASHFORD, Portobello, N. B.

[45399.]—Automatic Musical Instruments.—Your correspondent may see the "Pianista" at 10, Charter House-street, a recently-established branch of a Paris house for the manufacture of all kinds of musical instruments. I have used one of these apparatus for six years, obtained directly from the inventor, and can testify to its capacity for the faithful rendering of the music of the greatest composers. It may be used to play the harmonium or any organ, but is specially well adapted to the piano, by placing it against the instrument, the keys of which it covers to the extent of four and a half octaves, or some fifty-four notes. Self-folding perforated cards in volumes are used to interpret the music, the notation of which may be achieved by an amateur with any mechanical aptitude; the notes being marked on the cards by means of a graduated divided scale, and then cut through with a hollow punch. The most difficult part of the process is adjusting the time, according to the conception of the composer; but this is obtained by the regular division of the cards, like the bars in music. Mechanical pianos, even with changing barrels, soon fatigue, and the organette is popular probably on account of its comparative cheapness. The music of the cards does not work in a circle, and may therefore be of any length; and the pneumatic principle of the machine permits the performer to develop a quality unknown in mechanical music—that of expression, for, while he turns the handle with the right hand, with the left he presses a lever, compressing the air in the reservoir, causing the hammers to strike loud or soft, prolonged or short, following closely the idea and instructions of the composer, and providing the notation is correct, the time leaves nothing to be desired.—W. H. H., Brixton.

[45400.]—Celestial Globe.—There is a small book by W. Newton on "The Use of the Globes" that will give you exactly the information you require. The problems, some 35 in all, are very nicely worked out, and will be easily followed. You can get the book from Newton's, Temple Bar, London; and I would advise you to get it at once, as there are a host of things to be done with the globe when you know how to do them.—W. J. LANCASTER.

[45400.]—Celestial Globe.—You will find the sun's place in Ecliptic in the *Nautical Almanac* on the first page of every month; but the sun's place on the Equinoctial (or celestial equator) is given every month in "ours," which will do as well for you. For instance, what is the position of the heavens at Pekin at ten o'clock (local time) on the 6th December (of any year)? The Sun's Right Ascension on the 6th December at Greenwich, noon, all the world over, is 11h. 51m. It may be taken the same at noon at Pekin, which event took place 7½ hours before. Well, find the point 11h. 51m. on the equator, not the ecliptic, of the globe; it will be, of course, between XII. and XI.,

about ½ from XII. (you notice the figures are reversed), then bring this point up to the proper side of the brazen meridian, and you have the position of the heavens at noon everywhere in the latitude at which the globe happens to be placed. Then set the hour circle, with the XII. against the brazen merid., taking care the globe does not move. Next find the latitude of Pekin, whatever that may be, say, 40°, and elevate the equator of the globe, that is, turn the globe in its three supports, till the 40° on the br. merid. is level with the wooden horizon. You have now, if the globe has not turned on its axis, the heavens at Pekin at noon by local time, and by standing at the Pole and turning the globe till 10 hours have passed the meridian, or, of course, 10 hours of the equator, you have the heavens at Pekin at local 10 o'clock on the 6th December. You turn the globe to the left when you stand at the Pole; but mind it doesn't turn except when you want it. The "First Point of Aries," or Vernal Equinox (marked Ω —don't mistake it for Leo), is where the Ecliptic cuts the Equinoctial at 21h. or at 360°. But don't fall into the error of confounding these signs with the constellations. The constellations have always had the same stars: the signs once were coincident with them at one time; now the Vernal Equinox, or "First Point of Aries," is a long way back in Pisces (constellation), as you see if you look at the globe. The signs are nothing more than lengths of 30° measured along the Ecliptic, starting from Ω , which slowly moves backwards from age to age among the stars. Shall be pleased to help you again.—LEWIS ARUNDEL.

[45401.]—Intensifying Photographs.—The wet process is very much better for copying engravings than the dry, and I should advise you to use wet plates for the purpose. Dry plates are magnificent for landscape photography, but for copying engravings you want a process even more under your control than the dry process is. Now, to copy an engraving, you should so place it that the camera will be in a line with the light which illuminates engraving; then you are sure of getting a well-lighted picture. Develop thinly, well wash, and commence redeveloping with pyro and silver, keeping the developer in continual motion, and as soon as it is badly discoloured throw it away: mix fresh, with greater quantity of silver, and push on until negative is as black as you want it; then swirl and fix.—W. J. LANCASTER.

[45401.]—Intensifying Photographs.—Let "Density" expose, as he says, and develop with the ferrous-oxalate developer, adding a few drops of a solution of bromide of potassium to keep the shadows clear. The density will come up splendidly. Do not fix in cyanide—use a saturated solution of hypo. If the plates are good, the exposure correct, and the development continued sufficiently long, and in every stage till fixed a very non-actinic light be used, the negative will be all he desires.—W. T. BASHFORD.

[45403.]—Printing from Dry Plate Negatives.—You have developed your negatives too much. A dark apparently opaque wet negative will print in less time than an ordinary thin dry-plate negative. The colour of the film is very non-actinic, and should not be pushed too far in the developing, otherwise all delicacy of light and shade is lost; better have a good boldness in a rather thin negative than to get all so opaque that an hour is required to print in sunshine. A good dry-plate negative should print sufficiently in 20 to 30 minutes, with such a light as you ought to get in China.—W. J. LANCASTER.

[45403.]—Printing from Dry Plates.—"R. N. China" most probably pushes his development too far. It is difficult to give the precise information asked—perhaps the following may help: Lay the finished negative on a piece of white paper; the parts that should print quite black ought to show through the paper with scarcely any colour; if highly tinted, something is wrong. Perhaps light has gained access to the plates during some part of his manipulations, perhaps too much ammonia, or too little bromide has been used in the developer, or perhaps the plate has been left too long in the developer, or the plates may be over-exposed, though in the latter case the negatives are usually thin and weak. Next hold the finished negative between the eye and the light, and place some opaque object behind the negative such as a pencil, the outline of the pencil ought to be seen quite distinctly even in the densest parts of the negative. If not, the negative is much too dense or hard. This may be brought about by too short an exposure, or by a developer not sufficiently energetic, i.e., not enough ammonia or too much bromide or a great excess of pyro. A good negative should show most delicate gradation of tint in the dense parts (high lights), and also every delicate gradation in the thin parts (shadows). The time of printing does not necessarily indicate the quality of a negative: some of the finest negatives that have ever been produced by professional photographers have taken a fortnight to get the best result in a print, and some most excellent negatives will produce fifty

prints in one day. As a rule, the best results are obtained by printing in the shade, not in direct sunlight. Does this inquirer "fix" his negatives? After developing wash, and place in a solution of hypo (5oz. to 1 pint of water) until all the yellow unaltered bromide is dissolved. If he does not do this, the unsatisfactory results are accounted for.—W. T. BASHFORD.

[45404.]—Varnish.—It is recommended to use a weak solution of bichromate of potassium instead of water, for the Indian-ink. This is said to render the drawings insoluble; or instead, let "E." use the following vehicle for his colours, and they will not "run" when coated with size prior to varnishing:—Pale shellac 5oz., borax 1oz., water 1 pint. Place these in a vessel of boiling water till dissolved, then strain. Use the clear fluid. There is a varnish for applying direct to paper that answers well, but I cannot lay my hand on the recipe.—W. T. BASHFORD, Portobello, N.B.

[45407.]—Re-lacquering Telescope.—You can re-lacquere your telescope with ease. In the first place, remove all lenses and carefully stow them away until telescope is finished, then have a small centre punch and hammer ready for marking each part. As you pull them to pieces, mark each part one, two, three, &c., at each end, so that you can put all into proper places again when finished. Then clean all the small parts in the lathe, polishing and lacquering with a pale gold lacquer. The lacquer you had better purchase, you cannot make it good; at least, you can make it good enough for bedsteads but not for telescope work. Now, as to the tube, don't apoil it as "Sunlight" recommends you to do by finishing it in the lathe. Whenever I see a telescope-tube that has been finished and lacquered round in the lathe, I always feel inclined to give it to somebody short of a bedpost, or put it in the scrap-room. Then warm the tube, get some spirits of wine, and clean off all the old lacquer, then set to work to scrub the tube from end to end with fine emery-paper and oil, until all old marks are removed, then with a piece of thick cloth and oil polish it in straight strokes from end to end, one hour for every inch in diameter, then clean off with fine lime-dust, polish up with clean rag, and, then, when all is clean, warm the whole tube and lacquer with a tuft of cotton-wool, taking a stroke from one end to the other, and so on, until all the tube is successfully lacquered. Don't hurry it.—W. J. LANCASTER.

[45410.]—Focus of Spectacle Lenses.—To MR. LANCASTER OR "SUNLIGHT."—The ordinary method is to get an image of an object—e.g., the sun or anything else, so distant that the rays from it are parallel before reaching the lens; then the distance from centre of back of lens to the image is the focus of the lens, supposing the lens to be a convex one. To obtain the focus of a concave lens, you put with it a convex lens, which exactly neutralises it; then the negative focus of the concave is equal to the positive focus of convex lens. You can do all this mathematically, but there is some difficulty in obtaining the exact foci, unless the thickness of lens and the index of refraction of the glass are taken into account.—W. J. LANCASTER.

[45412.]—Photography.—Ordinary gelatine plates do not make good transparencies, but you can have plates made on purpose for transparencies. These come out nice and clean with plenty of tone with the ordinary pyro-developer. A swing-back cannot be made to work with a sliding body camera. If you have a bellows-camera and will say so in another query I will tell you how to make and adapt a swing-back. You can make a rising-front; all that is necessary is to cut the hole in front about 2in. higher, and make a mahogany frame to slide up and down to carry the flange into which the lens screws.—W. J. LANCASTER.

[45412.]—Photography.—Certainly gelatine plates can be used for the production of transparencies for the lantern. The swing-back and rising-front are only needed in landscape work. The rising front is simply an arrangement so that the portion of the camera front that carries the lens slides in grooves, so that the lens can thereby be raised above the centre line of the camera. A swing-back is shown at page 393, No. 871, which will, I think, do more to elucidate than mere description. Its construction is also described at the same page.—SUNLIGHT.

[45413.]—Tonnage of Yacht.—Lloyd's "Yacht Register" gives the following rules for measuring the tonnage of yachts:—From the length deduct the breadth, multiply this result by the breadth, and that product by the half-breadth, and divide by ninety-four. Length is to be the distance from the fore-part of the main-stem to the after-part of the stern-post on the range of the upper-deck. Breadth is to be the greatest external breadth of the vessel. Depth is to be the distance from the top of the upper deck-beam amidships to the top of the floors.—A FELLOW OF THE LLOYD'S SOCIETY.

[45414.]—Sizing Heddles.—If "Weaver"

will write me with particulars of class of yarn used in his heddle, also sort of warps they are required to weave, and give his address, I will help him out of his difficulty.—F. W. MARSHALL, Shipley, Yorks.

[4516.]—**Fitting-up Lathe.**—You should decide first whether you wish for an ornamental turning-lathe, which will also do very light metal work; or an engineer's lathe, which will not be suitable for light work, but only for strong metal work. If you wish to do both you had better have two lathes, as the two cannot well be combined, because the engineer's lathe, with back gear, requires a strong mandril, which cannot be driven fast enough for small work without too much labour; nor can it be made to traverse conveniently. Also the slide-rest for metal-turning is quite different and much more strongly made than the delicate apparatus used for ornamental turning. If, however, you do not wish to have two lathes, and yet to be able to do all kinds of work, I should advise you to get a good engineer's lathe to begin with, and have an ornamental-turning headstock and slide-rest to replace those for metal-work when you wish to do light turning.—F. A. M.

[4516.]—**Fitting-up Lathe.**—I am afraid you don't fully comprehend the magnitude of the job you name. Unless you have a planing machine and a good lathe already, you would stand no chance of success at all, unless you had nearly the entire work done for you by an engineer, or some one who has all the necessary tools. If you have such, or could get access to them, I would then willingly give you full instructions; and I would, in passing, say that the Whitworth lathe-heads were fully described in this journal, and if you have the back volumes I will look the article out and quote you page and No. To make a lathe you must understand pattern-making also. What I should advise is, to buy a set of castings, ready to fit up.—SUNLIGHT.

[4518.]—**Small Medical Coil.**—To MR. LANCASTER.—If you have made the coil up as I described it (answer 44916), then you shall soon finish it, and when done, take the current yourself first, before giving it to anyone else. Now, then, let us go to the watchmaker, and beg a bit of an old watch-spring, about 3-16in. wide, if he has it, and 1 1/2in. long; and perhaps, if we know him, he will be good enough to drill a hole in one end, say, 1-16in. in diameter, and another hole, say, a little smaller in diameter, and half an inch higher up the spring; then, giving him a penny or twopence (if he charges), we go home, and turn one end of a piece of iron (out of 1/4in. bar, say, 1/4in. long), down until it will pass through the hole at end, then rivet it over, or, if we have tools, we will drill a hole into it, and tap it, then screw it to the spring; in the other hole we want to put a small piece of platinum, riveted over; then we must make a brass upright, with a slit in it, and a screw to tighten the slit; the end of spring is held firmly in this post, and in such a position that the piece of iron is just opposite to the bundle of iron wires in coil. Then we must make another post, having a platinum-tipped screw, which goes immediately opposite the platinum on spring; screw it down until it presses gently on the spring, then connect the end of wire from coil to post carrying spring, and connect another wire from post carrying screw to one of the binding screws from battery. I may send a more detailed description, with drawings, in a week or so.—W. J. LANCASTER.

[4520.]—**Electric Bell.**—You can do this easily. Let the bell be hung in the house, and connect one wire to the gas or water-pipe—better to the pipe from cistern—then lay another wire in the earth, one covered thickly with guttapercha, and don't remove the guttapercha until it is joined to contact-maker. Now, if you have a fair knowledge of when the tank is either nearly full or empty, then one bell will answer; and to make it ring, you will want an iron rod or tube, going from top of tank to bottom, and moving easily up and down this, a collar connected with a float; then at the top you want a spring, or, rather, a double spring, very much like your mouth in the normal condition, to be kept open instead of closed. In the place of your teeth you must have platinum contacts. Now then, connecting the insulated wire to top jaw of spring, and the lower spring to tank, and having a cord or chain attached to float and upper jaw, the apparatus will be ready for action; thus, when getting empty, float will descend, pulling chain, which in turn will pull down upper spring until contact is made and bell rings. Water enters, float, of course, rises until it presses up against lower spring, this closes up, and makes contact bell again ring. This is very simply done if you go about it the right way. Let me know if you cannot follow all the instructions.—W. J. LANCASTER.

[4523.]—**Omnicycle.**—I have had no personal experience of the Omnicycle. I have, without success, more than once sought information about

it in these pages. Those who use it speak highly of it, but then I find that most riders think the machine they ride is best. As far as I can judge from minute examination of its principles of construction, I look upon it as one of the most interesting machines extant. The power is applied in the best possible way, and the expanding segments are highly ingenious. I should probably have long ago purchased an Omnicycle only for its weight, want of compactness, difficulty of access, and, above all, to its being entirely dependent upon the brake when going down-hill. Every machine that runs free down-hill and cannot be controlled by pedalling should be supplied with a second reserve brake. Were these drawbacks remedied, I believe nothing could touch upon the Omnicycle.—W. H. S. WESTBORN.

[4523.]—**Omnicycle.**—My opinion, from what little I have seen of the machine, is that it has drawbacks that very largely counterbalance its advantages. The variable stroke is quoted as an advantage. No doubt it is in theory, but in practice, a man who rides with, say, a 6in. throw-crank would find himself at a loss to run with a longer or shorter throw. I myself, for instance, usually ride with a 6in. throw. I have another machine that undoubtedly goes easier and mounts a hill better, but having a shorter throw, I cannot do with it what I can with the heavier machine and 1in. longer throw. Of course, this is use, but on the same principle, to alter the speed of the "Omnicycle" would and does feel very awkward. One is used to a given travel, and if we alter this, the feeling arises that we are either grinding round and doing nothing or that we move in a large circle but get little result. Not to waste space, I would say that the acknowledged strong points of the Omnicycle are—(1) the hill-mounting power it possesses, but which would be likewise possessed by any machine that has either very small wheels or has ordinary ones geared down like the "Arrow"; (2) that not only can the length of stroke be varied, but that the pedals act also as efficient and comfortable foot-rests. Against we have (A) extra weight; (B) want of power to back pedal (which, in my mind, is an important item); (C) the deficiency of good turning properties. That is, the machine will not turn in a narrow road well. You must turn slowly and carefully, or the two drivers will both propel and force the steering-wheel sideways across the road without turning round the machine; also, in running fast there is a great tendency to turn over. (D) The width is also rather excessive, and it is not everyone who has a coach-house or other building with large doors that will admit it. As to the danger in a case of emergency, owing to the machine not being an open-fronted one, I need not say here, as that point is well known. I do not see how the weight could be reduced myself without altering the principle. Taking it in all it is not a machine I should myself care to buy after the experience I have had of various makes. As to size of wheel I do not think that you could do better than use a 40in. wheel, at least for up and down hill riding.—SUNLIGHT.

[4524.]—**Problem.**—If the rent were the same throughout the lease, the purchase would have to be paid by B. and A. in proportion to the times during which they hold the lease, that is in the proportion of 2 to 5. Since the rent is increased during B's tenancy, this proportion must be diminished in proportion to the rents paid, that is in the proportion of 5 to 6. Hence, B's share of the purchase money is to A. share as 2.5 by 5.6 to unity, or as 1 to 3. B., therefore, pays to A. one-fourth part of £1,850.—C. E. F. N., Cheltenham.

[4524.]—**Problem.**—I think it will be admitted that A. and B. should each pay his share of the premium in proportion to the length of time during which he occupies the house, and also in proportion to the rent or value of the house at the time of occupancy; in other words, each should pay his share of premium in proportion to the total amount of rent paid during his incumbency. We have, therefore, the rule of three question: If a house producing a rent of £3,700 (for the whole term) requires a premium of £1,050, what premium should be paid on the same house when producing a rent of £1,200 (for B's term)?—Answer: £340 10s. 9d., which is B's share. A's share will, of course, be the difference between this sum and £1,050, or £709 9s. 2d.—M.I.C.E.

[4525.]—**Electricity.**—You could fix a cam or pin on the shaft, so as to press down a lever once in each revolution. This lever should then be arranged to make the contact complete every time it went down in the circuit of a galvanic battery and electro-magnet. The electro-magnet can be placed where you want the dial, which is to show the number of revolutions, for which purpose you had better have a proper counting-machine, with a ratchet-wheel of ten teeth worked by the magnet armature, one tooth at each contact. You might make the machine with a clock, but a gas-meter dial would not answer. Use a Daniell battery, as a Leclanché would be quickly polarised, and occasion some mistake in the counting.—J. SUTCLIFFE.

casion some mistake in the counting.—J. SUTCLIFFE.

[4525.]—**Electricity.**—You could do what you want much better and simpler by clockwork than by electricity. The train of wheels used for a gasmeter would answer, but perhaps another wheel would be required to show tens, and to move first wheel one division when the larger wheel has gone round ten times. This can readily be done, and the number of revolutions can be registered on the dials with certainty. Now, if you do wish to go to the trouble of constructing an electrical recorder, I will tell you how to make one to register in an office, if you like, any distance away, the number of revolutions, showing tens, hundreds, and thousands, all different markings, but there will be some little trouble in constructing it.—W. J. LANCASTER.

[4526.]—**Slow and Quick Speed Governors.**—Very much depends on outside points of the question. For instance, the quick speed governor on a slow-running engine would, if properly adjusted as to the governors' weight, very ably control the speed, because as the speed in the least increases, the governors, being just on the balance, a very small additional speed would send them up and close the throttle. Then, again, the position of the throttle and the capacity of the steam-chest would materially affect the question. Supposing the capacity of the steam-pipe and steam-chest be considerable, although the throttle might be quite shut until the steam thus inclosed had gone through the cylinder, the closing of the throttle would not in any way hold the engine. On the contrary, if the capacity was very small, the moment the throttle closed the inclosed steam would not be sufficient in volume to propel the engine-piston more than one stroke, which would not make much difference. No doubt the quick-speed governors are the best, as they can be adjusted to catch the engine the moment a given speed is attained. But the perfection of regulators, in my opinion, is the Corlies plan of the governor, controlling the steam-admission direct at the valves themselves; or the Allen-Porter, where the governor runs fast, and controls the speed by a slot link, thus cutting off the steam as the speed shows any tendency to increase. Not only this, but a governor, although a good one, may be so set that it fails to act, whilst another, and really inferior one, carefully adjusted, appears to act much better, because, from the accuracy of the adjustment, it controls the steam-admission better. Very much depends on the details of construction, and general arrangement besides.—SUNLIGHT.

[4527 and 4529.]—**Geology.**—To "T. G. F."—The queries of Mr. Hale in this and former issues all refer to very common fossils of the Gault, and any work which treats of this formation will give him all the knowledge he asks for, and more. The Eucrinite flourished in greatest luxuriance during the Palæozoic period; after that time it thins out very rapidly, and in existing seas it is represented very doubtfully, indeed. They are found very beautifully preserved in the Silurian limestones of Dudley, Sweden, Bohemia, and other places, but are never found entire in the Gault or the Chalk. I have forgotten the name of the tests he mentions, but they are common in the Gault and in some of the Eocene subdivisions. The nodules are not coprolites. The nucleus may be the remains of an organic substance of some kind. Nodules occur plentifully in many formations, sometimes containing a fish, fern, or, indeed, anything. It is this nucleus which attracts the particles to it, the attraction lessening with the density of the enveloping medium. You must, of course, understand that at this stage the nodules were soft, the hardening process coming afterwards.—T. G. F.

[4528.]—**Faure Accumulator.**—The cost of the Faure accumulator, with ten plates of the size I gave—namely, 4 1/2in. by 2 1/2in., was about fourteen or fifteen pence, exclusive of the vulcanite cell for which I paid sixpence secondhand. A bichromate battery is almost useless for the purpose of charging a Faure cell, as it runs down in about a quarter of an hour when in a closed circuit. To light a Swan's lamp at least a dozen Faure accumulators, each having at least ten plates not less than 12in. by 10in., would be required. The rule *ex nihilo nihil fit* applies to a Faure accumulator as it does to everything else; that is to say, you cannot, even in theory, get more energy out of a Faure cell than you put into it during the charging process; but, in practice, there is a loss of at least 20 per cent.—H. B. T. S.

[4529.]—**Geology.**—The nut-like balls J. Hale speaks of may be septarian concretions, the cracks in which have been filled up with pyrites. Such small nodules are common in the London clay. If he likes to send me a specimen, I can speak with greater certainty.—W. H. SIMMONDS, F.G.S.

[4531.]—**Electro-Magnets.**—To MR. LANCASTER.—Now, in making electro-magnets, you

should let the core-bobbin and length bear a constant ratio to each other; thus, the diameter of wire-bobbin should be three times that of core, and the diameter of core should be one-sixth of its own length. Thus, I fill in below the particulars necessary to make an electro-magnet to pick up the required number of pounds:—

To lift	Diameter of iron core.	Length of poles after being bent.	No. of wire and diameter when wound.
lb.	in.	in.	No. in.
10	3-16	1½	26 9-16
20	5-16	1½	24 1
40		2½	24 1½
60		3½	20 2
80		4½	18 2½
100		5½	18 2½
140	1	6	16 3
160	1	6	16 3
180	1½	6½	14 3½
200	1½	7½	14 3½

The amount of the wire upon each bobbin is difficult to get, but wind on as carefully as possible until its diameter is equal in each case to last row of figures.—W. J. LANCASTER.

[45432.]—Blueing Watch Screws.—W. Moore, by referring to page 54, "E. M." No. 861, "The Watch, &c.," will find all he may require connected with his query.—SECONDS' PRACTICAL WATCHMAKER.

[45435.]—Japan for Iron.—The heat of the japanner's oven is not sufficient to twist the iron. Besides, the heat being equal all over, the expansion is also equal.—SUNLIGHT.

[45436.]—Meal Elevators.—The speed varies with the specific gravity of the material to be conveyed. No speed can be fixed without particulars of the meal products for which the elevators and conveyors are to be used, and the conditions regarding exhaust, if any.—MERSEY.

[45438.]—Berliner's Violin.—If "Manchester" will refer to the letter again, he will see that B represents the bridge in both cuts. It goes through the larger hole. In Berliner's first design the fingerboard itself is extended sufficiently to take in the length of strings, and is spread out at tail-end so as to permit a hole sufficiently large to allow of the passage for the bridge being cut. I thought the modification shown the best, and therefore sent it.—ESSAR.

[45439.]—Cleaning Indian Brasses.—Cut a lemon in slices about half an inch thick, rub the article all over with one of the slices, then brush the juice into the indentations, an old toothbrush is as good as anything, then wash well in cold water, and wipe perfectly dry with a cloth, then polish it up with a clean, dry washleather.—W. A. S.

[45440.]—Intensity Coil.—To MR. LANCASTER.—Your coil ought to take more than another pound of wire. Wind it on carefully and tightly. I would go on with 36, and put on enough to make 2lb. in all, then you should get a good 1½ in. spark, see that every layer is insulated from the others.—W. J. LANCASTER.

[45441.]—Bunsen Battery.—To MR. LANCASTER.—Do not attach the terminals at all to the carbon. Let each one be easily removed, then you can take them off and clean them when done with. In whatever way you may adopt to fix them permanently, you will soon find that they will corrode and be useless; but, have them to screw on, then it is an easy matter to keep them clean and ready in a moment for use. In the bichromate cell you can fix them; drill a hole into plate, and then let in a wire and fill with lead, or, have the plate longer than you want it, then make a hole through each plate and fasten the screw through it, having first dipped the plate into melted paraffin for a few seconds.—W. J. LANCASTER.

[45442.]—Casting Flywheels with Wrought-iron Arms.—Flatten the ends of the arms. Then split or hag them with a chisel; then heat and dip in coal tar, and pour in the metal on the top of each arm.—CAST IRON.

[45442.]—Casting Flywheels with Wrought-iron Arms.—In foundry where I was once employed, the wrought-iron arms were heated and dipped in coal-tar whilst hot, before putting in the mould. Same method was adopted with pipe-nails. Though for light pipes the pipe-nails used to be galvanised.—CHEMISTIANA.

[45444.]—Drying Stoves.—Some stoves have two furnaces in the end, and some have a fire lump to sit just inside the door. This helps to heat the stove quickly and helps the draught of the furnace. The plan you mention is as good as any, only build as near the size you require as possible.—CAST IRON.

[45445.]—Repairing Compass.—Carefully raise the brass bezel, or edge turned down over the glass, with a sharp-edged tool. Care and patience are the requisites of success. When the edges are turned back enough to take the glass out, the resharpening of the point is a small matter. By the bye, are you sure the bluntness of the point is the real cause? And have you proved that the magnet has not lost its power instead, and that from that cause the card is sluggish? If it be as you say, after resharpening, replace the glass, and turn down the edge with a burnisher in the hand. If you have a good lathe, with appliances to hold the lot, it renders the burnishing far easier. To fix lenses in the cells, having cut up the thread, turn out the cell to the size. It should not be too tight, remember. Also, that the lens beds at the bottom of the cell, not jams on the sides. When this is carefully done, turn down the edge of the cell on the outside to a mere knife-edge. Place the lens in the cell, and with a finger of one hand lightly hold it in the cell, whilst with the other you apply a small chisel-shaped burnisher to the thin bezel, which will, if of the right height and thinness, quickly turn down neatly over the glass. It is a matter requiring both accuracy of workmanship and expertness. But with a little practice you should succeed. I have myself made the cells for lenses of various sizes, from a micro-objective to a 9 in. enlarging lens, and filled them in, and have not found any difficulty, so long as the work was perfectly true and accurate in turning the cell and bezel. Anything I can do to put you in the way, I shall at all times be pleased to do.—SUNLIGHT.

[45446.]—Microscope Magic-Lantern.—I do not know what the power of Mr. Lancaster's new lamp is. But no doubt on a suitable screen you might show objects up to a foot or so in diameter. I prefer myself a picture well-lit, even of smaller size to a large one badly-lit. A good screen for the purpose is a sheet of drawing-paper or cardboard, or even a sheet of tissue-paper, as recommended by Mr. Chadwick, stretched on a child's hoop. I don't know if the new lamp the gentleman I named has brought out is better than the Newton Triplex. But that would show fairly well on a 24 in. disc. Much also depends on the powers. I am assuming the use of fairly high ones and ordinary micro. slides. Happy to be of any further use to you in the matter.—SUNLIGHT.

[45449.]—Artificial Light.—What you want is a powerful gas-lantern such as used by Mr. P. Maitland Laws. It is a 68-jet "Wigham" burner, and the makers say it is equal to 1,250 standard candles. It is placed in a domed lantern or case lined with glass mirrors, whilst between the light and the sifter is a blue glass shutter. A friend of mine personally inspected the arrangement, and I designed a modification of it for him to make it further automatic. This is the class of thing I should advise you to make, as by its use negatives on dry plates can be taken in as little as eight seconds' exposure, that being with Swan's plates. If this will suit you I shall feel pleasure in giving any further particulars; and I may add that there is nothing you cannot construct yourself except the burner. I do not know if this apparatus is yet known, except to a few, but it certainly deserves to be, as it enables a photo to be taken with rapidity and without daylight.—SUNLIGHT.

[45453.]—Caoutchouc Tubing.—Give the tubing two or three coats of whitelead paint.—W. A. S.

[45454.]—Model Steamboat.—Refer to page 286, No. 818, Vol. XXXII., where you will find illustration and description of a boiler to suit you, except that it would be too large for your boat; let it be 8 in. long instead of 12 in., and the other dimensions may be retained with advantage—as plenty of steam is a fault on the right side. For a suitable lamp see page 456, No. 825, same Vol. Anything else you desire to know I will with pleasure tell you.—SUNLIGHT.

[45456.]—Condenser.—No doubt, from standing, the air-pump has got rusty; as soon as you started again the rust cut through the packing of the bucket, so that the vacuum is impaired. After working a week or two, if you took the bucket out and repacked it, you would, no doubt, get as good a vacuum as before. In the mean time, reduce the injection water a little, until the vacuum alters on the gauge. You may do something in this way, perhaps; very likely you will find that you have too much. Another thing is that the standing of the engine may have damaged the face of the slide-valve, so that steam leaks past that also. SUNLIGHT.

[45458.]—Pumps.—If the knock is not on the bearings or gears, I can tell you where it is almost certain to be—that is, in the air-vessel. From the absorption of air by the water, the air in the vessel has, no doubt, disappeared, and hence you get the shock from the entire column. I think you will find this the most likely cause by far.—SUNLIGHT.

[45459.]—Mirror.—Try the effect of a little

fluoric acid (liquid). You might of acid from glassworks, if any in your hood; you will require a little gauze or vessel to put the acid in, also a perchloric acid to apply the acid. Burn a piece of glass with candle, so that your mirror was burnt, and try on that first. Whatever you do with fluoric acid on your fingers, and if stick them in the schoolboy's hospitable fingers—the mouth.—CHEMISTIANA.

[45462.]—Stiff Lathe.—Most likely getting in and the oil gumming is the lathe running stiff. Remedy clean the journals and bearings with and then again clean out and there a good lubricant, such as almond-oil, is all right and perfect, it shows well as before. A flywheel would not be easy in the face of gummed-up bearings, of course, a grooved driving-wheel.—SUNLIGHT.

[45463.]—Electric Light.—If you electric light for six hours at one time battery, 16 to 24 cells, with carbon high. Do not try Faure's battery dynamo-machine: you could not do hours, and would require an engine, storage battery is an extravagant thing the galvanic battery, but when wanted in experiments of ten minutes, it can be used with great advantage could get a fair light with 30 square foil, and four cells 8 in. Bunsens will in about two hours to work five or only.—J. SUTCLIFFE.

[45466.]—Boiler Pressure.—I do not say definitely, unless after act. But if the work be good, you may 50 lb. steam-pressure with safety. But I say "if the work be good." If the rivets are too far apart, and badly among other points. Also, you say brazed in, not riveted. This is certain of weakness, therefore do not make highest pressure I name. A good size you quote should stand at least pressure.—SUNLIGHT.

USEFUL AND SCIENTIFIC.

Electrical Methods of Search the Body.—Professor Bell lately the Paris Academy the modification induction balance with which he put the position of a projectile in the body consists essentially of two flat coils, that the edge of one is over the axis one coil receiving a vibratory current phone is the circuit of the other mounted in a wooden case, are a body, and from the nature of the when the ball is approached the latter can be inferred. A quite different method, however, has also been devised by Professor Bell, suggested apparently by ingenious electric sounds or probes, conductors are used, and the ball circuit. Professor Bell inserts a fine unsuspected region. It is connected by of the binding-screws of a telephone surgeon holds to his ear; the other being connected with a metallic mass skin. When the needle-point touches electric couple is formed, and the current a sound in the telephone. The surgeon use his knife with confidence, guided He may make several incisions of necessary, without danger, and any provoked by etherisation. This simple should prove useful on the field of battle with success with a lead ball introduced of beef. Contact of the needle with effect, but a very distinct sound was time the ball was reached. A modification in inserting a vibrator in the circuit; musical note in the telephone at each ball and needle. Again, if the circuit battery, the telephone sounds may several persons at once. A sound is heard, whenever the needle enters the skin reaching the ball, it is much intensified lessened resistance. A galvanometer in place of the telephone.

Writing on Metals.—Take half nitric acid and one ounce muriatic acid, and shake well together, and then use. Cover the place you wish to be melted with beeswax; when cold write your plainly in the wax clear to the metal instrument. Then apply the mixture with feather, carefully filling each letter. main from one to ten hours, according appearance desired; then wash with wax.

POWERED QUERIES.

and titles of queries which remain unanswered are inserted in this list, and if still repeated four weeks afterwards. We trust our readers will send what information might of their fellow contributors.

Oldhallian has replied to 44637; Lanca-

yes, p. 98.
yp., 98.
erans," 99.
Screw, 99.
Engine Indicator, 99.
erans," 99.
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ak-s, 99.
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Electric Machine. To Mr. R. Kennedy,
ical Model, 194.
ransferring Pictures, 195.
ng Fine Balances, 195.
35.
ese Mud, 195.
p of Wales, 195.
ngines, 195.

QUERIES.

It's-Eye Lantern.—My bull's-eye when turned towards a white wall, and the lamp in an inverted position, projects a clear disc of light! And can any way to make it do so? The effect of lens is 2.9-16in., the radius of 16in., and the distance 1in. Distance flame to plane side of lens, 2.3-16in.

g-Oak.—Which is the best method of (about 12in. diameter) dug up about three times immersed in water? Should it be cut up first? If the latter, in what way long will it take to dry sufficiently for—A. R. W.

Model Paddle Steamer.—Will any giving a dimensioned sketch of a model 1p 3ft. 6in. long?—W. J. D.

Canadian Railways.—Could any of lent oblige by giving information as to use of promotion on any of the Canadian railroads there be a chance of a situation for a mechanic, who has had experience of locomotive factory and on the road? An early reply oblige—CARLISLE.

Multiple Object-Glasses.—To "ORDERIC" W. G. 1.7.—I am sure many others as I must feel obliged for the interesting original question has elicited from both respondents. I am, however, a little uneasy the principle, because the forms for use so widely in the recommendations given, having now read each other's remarks, men would kindly tell me which is really the best arrangement, I could order the re confidence in the result.—QUEEN.

Water-Pipes.—I shall be thankful for which the velocity and discharge of sewer-culminated, with plain figures showing the area.

the Centres.—Can anyone tell me height adopted by Whitworth, or any of the centres of a foot-lathe from the base.

Ins.—Is there any reliable work published of the construction and management of terra-cotta?—S.

Graining Face-Plate for 5in. Lathe.—Kind readers tell me how to turn a face-plate without back-gear? I have managed 13in. of the centre; but, when I bring the other parts, it knocks the edge off the J. C.

Steel Barrels.—Will some competent kindly inform me on the following?—class double fowling-piece, I am anxious of Henry rifled steel barrels 30in. long, muzzle-loading, with top action locking, &c., be strong enough for the rifling of the regulation cartridge, and sighted to All the parts are finely finished and light, a slight fillet where the sharp corner would be angle.—AFRICANS.

Winter's Ring.—To Mr. LANCASTER.—(1) Is a cylinder electrical machine, will you be so kind as to fit a Winter's ring to it to make it spark? And, if so, how am I to proceed to fit it on machine?—TAU SIGMA.

Polishing Brass in Mixture of Nitric Acid and Alum to Impart a Red.—The above paragraph has been going appeared recently in the "E. M." but I give the promised result, although I have ingredients in various proportions. I find it any of my fellow-readers have been—S. B.

[45478.]—**Moon, Map of in "Celestial Objects."**—Will "F.R.A.S." kindly instruct us amateurs how best to mark off this map so as to show the position of the terminator from day to day, when the Moon reaches the meridian of Greenwich?—J. C. L.

[45480.]—**Photographing Microscopic Objects.**—Would any of our correspondents kindly give me a few hints on photographing microscopic objects? I wish to enlarge the small objects to put in an album. I have a microscope and camera. Any information would be gratefully received.—S. FAVENOR.

[45481.]—**Heating-Power of Dynamo.**—Will any practical electrician of "ours" say what the size and weight of a dynamo-machine would be making 1,000 revolutions per minute to keep a platinum wire, 6ft. long, in a brilliant white heat in the open air? The wire to be 1-32in. in diameter. How many of Faure's secondary batteries would do the same? And, what would be the actual horse-power of engine required?—ZARES.

[45482.]—**Fusible Fluxes.**—Will any reader of "ours" give me the definite proportions of the fusible double silicate of alumina and protoxide of iron? At what temperature it becomes fluent? And, name the most comprehensive work on fluxes, either for pottery, glassmaking, or metallurgical processes?—ZARES.

[45483.]—**Lantern Optics.**—To "SUNLIGHT," or Mr. LANCASTER.—I have a French Lucidum, 8-wick, oil, 4in. double condensers, and double achromatic portrait lens. I want to know the best method of projecting a spectrum on to the screen with such an instrument? Should the front lenses be removed? Also, what other simple optical experiments could be shown with such a lantern, which is in every way similar to the Scioptron? I suppose the bisulphide of carbon form of prism is the best for amateurs as well as the least costly.—YOSAMITE.

[45484.]—**Speculum Grinding, Dr. Blacklock's Machine for.**—Will Dr. B. please give larger diameter of the mitre-wheels he is using, and say whether the size would be strong enough to drive a polisher for a 9in. 1.—J. C. L.

[45485.]—**Rouge versus Putty-powder.**—Some persons use the one and some the other for polishing glass lenses and, I presume, specula. Which is the better substance for the purpose? And, would oxide of zinc answer as well? I use rouge, but working with it is about as nasty as making pitch polishes. I am thinking of using gutta-percha in place of pitch. Has it ever been used for the purpose?—J. C. L.

[45486.]—**To Mr. A. H. Allen.**—My sincere thanks are due to Mr. Allen for his kindness in publishing one of the advance sheets of his new work—viz., on Commercial Glucose, in reply to my query addressed to him. If not pressing too much on Mr. Allen's time, I should be extremely obliged to Mr. A. if he would give me the following information in a detailed manner and as clear as possible:—I dissolved 20 grammes of the "saccharose" or "brewer's sugar" in 150cc. of water. This solution had a specific gravity of 1.0437, and when examined by Mitscherlich's polarimeter, turned the plane of polarisation 13° to the right. Temperature of solution 63° Fah. Now, my polarimeter is adjusted so that 30 grammes of pure dry cane sugar dissolved to 100 cents in water gives a polarisation angle of 40°. What I wish to know is, how am I to use this polarimeter in the analysis of this compound brewing sugar, as I have no information bearing on its application to this purpose? I shall esteem it a great favour if Mr. Allen will kindly show details of how to work, and calculations necessary to use the polarimeter named. It is one of the ordinary Mitscherlich's construction. I have made several attempts to work it, but have failed.—BREWERS' CHEMIST.

[45487.]—**Electro-motor for Revolving Vacuum Tubes.**—I am desirous of making a small electromotor for revolving vacuum tubes, say about 6in. tubes. Would Mr. Lancaster, or any other gentleman, kindly give me full instructions for making one, and show how the coil is connected when the tube is revolving? Kindly give full particulars clearly, as I am a beginner. Also, will Mr. Lancaster say what the various parts required to make it would cost, and greatly oblige!—A. A. Hull.

[45488.]—**Variable Cut-off Motion.**—Will our esteemed friend "Tubal-Kain," or "Sunlight," please tell me which is the cut-off motion for a horizontal engine to work the best? Can a single-plate at back of main-valve be made to answer, or one that is actuated by right and left-hand screw? I have seen a variable cut-off working with a link and sliding block raised by a screw at the same end obtained by this method as by a right and left-hand screw.—W. SBYUL.

[45489.]—**Turning Granite Rollers.**—I have some granite rolls to turn, such as used for chocolate refining, about 1ft. diameter. Could you tell me what tool is used besides the diamond? I have heard there is a steel tool used for turning marble columns. Please state description of make and if patented. I have a good self-acting lathe.—PETER.

[45490.]—**G and S. W. Railway Engines.**—Will any reader oblige with dimensions of single outside cylinder engines used on this line prior to introduction of 93 bogie class? The wheels are about 6ft. 6in., and general aspect not unlike "Lady of Lake" class (L. and N. W. R.), only I don't think they have domes. Also, a description of engines used on this railway about 1850 or so. About that time the prevailing type of locomotives for passenger traffic on the various Scotch railways consisted of light 6ft. singles, those on the North British built by Hawthorn, on the Edinburgh and Glasgow by Sharp, Roberts and Co. (now Sharp Stewart), and those of the Caledonian some by Jones and Potts, Newton, others at the Co.'s works, Greenock.—CAPTAIN.

[45491.]—**Silicate Solution.**—Will some fellow-reader tell me of a solution of silicate, other than enamel, that will adhere to iron and appear like glass?—CUTCH.

[45492.]—**Telescope.**—I have a single-draw telescope the body of which is 3ft. 6in. long. I am going to make

it of three draws, but there is a diaphragm 5in. from object-glass, which will prevent tube getting in full length. Would it be injurious to the instrument to take it out? The object-glass is achromatic. Also, how to blacken inside of tube?—TELESCOPE.

[45493.]—**Fixing Burnished Bands on Picture-Frames.**—Will "Jack of All Trades," or any other kind reader of "ours," oblige by informing me how to fix those burnished ribbons or bands such as one often sees over the mitres of picture-frames?—BODOL.

[45494.]—**Bicycle Crank.**—How can I remove the key from the crank of a bicycle? And, when wanting to fix crank again, is the key driven in hot or cold?—P. S. D.

[45495.]—**Coil to give a Quarter-Inch Spark.**—To Mr. LANCASTER.—I have read your reply to "One Perplexed" in last week's issue giving quantities of wire for 1in. coil, and, being about to make one, beg to ask you (with many apologies to the original queries) to set me right as to the following:—Can I make such a coil with cotton wire instead of silk wire? What weight of wire is primary coil? How am I to proceed to make a contact-breaker? How to proceed to make condenser? And, how connect it? As I am entirely ignorant as to fitting up, I should be very grateful for any hints you could give me as to method of winding and insulating coils; if there is a machine for winding? And, if so, how to make, or where to purchase it? I should be very grateful if you could give me a figure, as I do not know anything about the induction coil.—TAU SIGMA.

[45496.]—**Cement.**—I want a cement to fasten a plate of glass to the front of a zinc case filled with a liquid composed of methylated spirits, potash, glycerine, saltpetre, and water. Also, a japan or paint for the inside that would resist the solution. All the oil paints and cement would be acted on by the potash; the japans, mainly being composed of shellac, would be destroyed by the spirits of wine. Would plaster do for the cements? And, could a coloured wash or paint be made of paraffin wax in some solvent that would stick to the metal?—AKATONIST.

[45497.]—**A Cheap Powerful Perfume.**—I am obliged daily to melt in pans over gas a quantity of rosin—about 70lb. This at all times makes an unpleasant smell, more especially should it become overheated. Perhaps some of "ours" could suggest something that would make things (smell, at least) a little more pleasant. It must not add much to cost, nor interfere with transparency of rosin.—J. W. L.

[45498.]—**Dew-cap.**—(1) I find, notwithstanding my dew-cap of about 1ft. long for a 5in. object-glass, that when I am studying objects at a high elevation dew is deposited. Can "F.R.A.S." or some other of your experienced telescopicists, give me a hint? (2) Dew having deposited, the telescope being in a Berthou observatory, how best to get rid of it? To wipe it in the observatory and then put cap on, or take object-glass out and dry at fire, or how?—ELEAZAR.

[45499.]—**Berthou Observatory.**—My observatory in wet weather is damp, consequently brasswork tarnishes very much, eyepieces get misty, &c. (1) How best to keep observatory dry? (2) How to restore brilliancy of lacquer on brasswork?—ELEAZAR.

[45500.]—**Reflecting Telescope.**—To Mr. W. J. LANCASTER.—I am thinking of making a reflector 6in. diameter and 5ft. focal length, on the Newtonian principle. Can I use a metal speculum in lieu of glass? As glass I am almost afraid to attempt at first, but am an adept in metal-working. If a metal speculum will answer, I can turn a hard-wood pattern to proper radius and get it cast—grind and polish it myself. Is it cheaper than the glass form? If so, will you kindly state probable cost? And, any further information will be gladly received by—A MARINE FITTER.

[45501.]—**Stand for Sextant.**—Will one of your readers show how to make a sextant stand so that the instrument can be placed in any position from the vertical to the horizontal? In measuring the horizontal angle BAC, which portion of the sextant should be placed exactly over the point A.—AERONOS.

[45502.]—**Geneva Watch.**—Will "Fellow Workman" give instructions how to put a new ratchet-wheel to winding square of Geneva watch, the clickspring having cut the teeth of the present one away?—BARONDSBY.

[45503.]—**Printing Press—Power Required.**—What power is required to drive a large cylinder, 8 page, tape, newspaper machine, made by Brown, Kirkcaldy, one side (4 pages) printed at a time, fed above, and delivered below. I want to erect a new engine, and do not wish to incur more expense than is really necessary. Please say if there is any difference really between 1 H.P. steam-engine and 1 H.P. gas-engine? And, if so, what is it? An answer from practical experience will oblige.—POWER.

[45504.]—**Electrodes.**—Can any reader inform me how Gaudoin's carbon electrodes are made? I know that they are made of dried wood carbonised and dipped in different solutions to give it the necessary hardness; but what I want to know is, (1) how they are carbonised? (2) what are these different solutions composed of?—LANCASHIRE.

[45505.]—**Watch Jewels, &c.**—Would someone be kind enough to explain to a beginner the difference between jewel-holes, jewel-covers, and jewel-slips? Also, end-stones and foot end-stones?—TAYING TO LEARN.

[45506.]—**American Clocks.**—Will some kind reader of the "E. M." tell me what is meant by single and double O.G. in American clocks?—TAYING TO LEARN.

[45507.]—**Cleaning off Useless Negatives.**—Is there any way of cleaning off useless negatives, saving the glass and recovering the silver?—C. W. CARFORD.

[45508.]—**Cleaning Woollen Goods.**—Can any of your readers give me a recipe for cleaning woollen cloth?

ing from dirt-spots or grease, without washing the garments!—JOHN LUXBURY.

[45509].—**Making Wood Fireproof.**—I have been told that a certain mixture can be made, which, if put on wood like paint, renders the wood much more proof against fire. Can any correspondent tell me how it is made?—FIREPROOF.

[45510].—**Magneto-Electrical Machines.**—Would Mr. Lancaster, or one of the readers of the "E.M.," be so kind as to tell me how to fix a dial to one of these machines to indicate the strength of the current that a person is taking?—C. E. R.

[45511].—**Gelatine Films.**—Are these less satisfactory or more difficult in working than dry plates? Do they require specially-constructed dark slides? I reside in a very remote locality, and find carriage of the small quantities of dry plates I use rather costly. I have no time at my disposal to prepare my own. Where can I read a full description of Morgan's paper?—M. H. S. W.

[45512].—**Turpentine.**—Having a quantity of essential oils that I suspect to be largely adulterated with turpentine, I should feel obliged if Mr. Allen, or some other kind reader, will inform me of the best quantitative method of testing them? What is the nitro-prussid copper test?—FEARLESS.

[45513].—**Rosin.**—Will Mr. Allen, or other of our chemical readers, inform me if there is any solvent for common rosin that will not be of a greasy nature, the same as turpentine, spirit, &c.? I have tried carbonate of soda solution, but find it makes a kind of soap. The purpose for which I want it is to put on stone in chromolithographic work.—JOS.

[45514].—**Power of Field-Glass.**—I should be glad to know whether new eyeglasses, with longer focus than the present glasses, would increase the power and range of a 12 lens binocular, 2in. object-glasses, power 4 or 5 diameters, 6in. high when focused, and will draw out about 3in. further, which would allow, say, 3in. longer focus to be used? If the power would be increased, to what extent?—A. BARTLETT.

[45515].—**Connecting Rod.**—Could any correspondent assist me which is the right way to get the correct length of the connecting-rod or a beam engine, which is already fixed, and say whether the centre of the crank-shaft should not be quite plumb with the centre of the gudgeon in the beam, when the beam is at mid-centre. In looking over Templeton's work, I find that the length of the connecting-rod of a beam-engine is the perpendicular distance between the centre of the flywheel shaft and the centre of the beam, and in the table of parallel motions it is thus shown, and that the centre of crank-shaft is plumb with the centre of versed sine described by the beam, the same as at piston-rod end. Now my own impression is that the centre of the crank-shaft should be quite plumb with the centre of gudgeon in the beam when at mid-centre, and the length of the connecting rod should be taken between the centre of the gudgeon in the beam, and the centre of crank-pin when at the same level as the centre of crank-shaft; so that all centres in beam, crank, crank-shaft and parallel motion would be on a level at one end the same time.—CAMBRIDGE, Kates-hill.

[45516].—**Hand Thresher.**—To "SUNLIGHT."—I have a hand thresher which thoroughly removes the grain and chaff from the straw, but only about half the grain falls below into receiving-box, the remainder being pitched out with the straw, and scattered about in all directions. The straw then requires to be thoroughly shaken up, the chaff and grain passed through two sizes of riddles, and afterwards through the fan. What I am aiming at is a kind of attachment to the thresher into which all the grain and chaff shall pass with the straw, and there be winnowed, dressed, and delivered separately. The attachment, driven by belt or gearing from the thresher, or separately, would require shaker (revolving or otherwise), riddles, and fan; and the arrangement of which is what I should be greatly obliged for. I may state that only about the fourth of a sheaf is fed at a time, and that the straw (cut) is comparatively short. A drawing would be prized, as I am not a mechanic, though a pretty fair carpenter!—STRAITHAY.

[45517].—**Brush Dynamo-Electric Machine.**—Will not "G. F. C. Clapham" (p. 264, reply 45281), give a description of his brush dynamo through your columns? as I am sure it would be interesting to a number of your readers. I have heard several old subscribers speak of it. A good plain description of small machine, with difference between plating and lighting, also different lamps. Please also say what battery is best suited for electric gas-lighting lamp, as I have one with zinc and silver foil, made by the Electric Gas-light Company (Limited), and it failed the first week. I am not able to tell what solution is in, but it is very weak, and has a peculiar smell. I should like to make a new battery, and if you will kindly tell me which is the best form, I shall esteem it a favour!—A THREE YEARS' SUBSCRIBER.

[45518].—**Astronomical.**—Could any reader of the *English Mechanic* give a beginner a few simple directions for finding the Nebula in Orion? I understand the Nebula in Orion is around the star 5; but my map does not give the star 5. I should like to know how to find some of the more conspicuous nebulae and double stars which can be divided by a 2½in. telescope? Can the satellites of Saturn be seen with such an instrument, because I can never see more than one, and I am not quite sure that it is a satellite? Should my telescope divide Castor? Any information on the above subjects will be gratefully received and acted upon by—AN ASTRONOMICAL TYRO.

[45519].—**Chest Pain.**—To Dr. EDMUNDS.—About a fortnight ago a pain seized me under the left breast and almost perpendicularly under the arm. It hurts me coughing or working, and I feel a slight pain when at ease sitting in a chair. I am of a strong and healthy constitution besides, and don't think it is the lungs. Bowels not really regular. Went to a druggist and doctor of my club, and the stuff I got seems to be a cough mixture, and I am none the better for it.—A PAIN SUFFERER.

[45520].—**Rag Pulp Balls.**—Can Mr. Lancaster, or

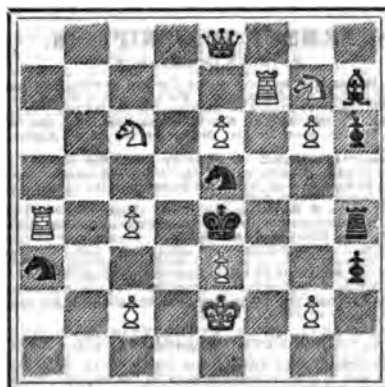
any of our readers in the paper trades, inform me how to make rag pulp into round balls, about the size of billiard balls and equally hard? Is there any kind of cement or size that I can mix with the pulp that will make it hard when dried? I saw some time ago a notice of railway-wheels being made of paper. This is something like what I want, only in balls.—PAPER.

CHESS.

ALL Communications for this department must be addressed Chess Editor, 22, Chancery-lane, W.C.

PROBLEM DCCXX.—By J. PAUL TAYLOR.

Black.



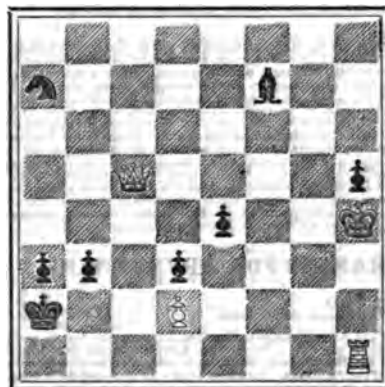
White.

White to play and mate in two moves.

PROBLEM DCCXXI.—By G. CHOCOLATS.

(From *Trentino's Chess Monthly*.)

Black.



White.

White to play and mate in three moves.

SOLUTION TO 716.

- | | |
|----------------------|---------------|
| White. | Black. |
| 1. Q to K Kt 2. | 1. Anything. |
| 2. Q or B mates acc. | |

SOLUTION TO 717.

- | | |
|---------------|---------------|
| White. | Black. |
| 1. Kt to Q 4. | 1. Anything. |
| 2. Mates acc. | |

NOTICES TO CORRESPONDENTS.

CORRECT SOLUTIONS TO 716 by H. Planck, A. Schmucke, S. L., W. J. Jubb, J. W. P., and W. W.; to 717 by H. Planck, A. Schmucke, S. L., W. J. Jubb, J. W. P., (a very good two mover), and W. W.; to 715 by A. Schmucke.

A. S.—Amendment received in time.

J. W. P.—Attended to.

NOTE.—Our problem last week by Mr. Planck should have been acknowledged from the *Figure*. The White Pawn on Q Kt 4 and the Black Knight on Q R 2 are not required in Mr. Pierce's problem. With these on the board, the problem is impossible.

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden, London, W.C.

"THE BUILDING NEWS" is the Principal Journal representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Inter-communication" if he wants to know anything about his trade; to write to the Editor if he has any suggestions to make and to advertise in the paper when he wants work.

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ANSWERS TO CORRESPONDENTS.

*. All communications should be addressed to the Editor of the *English Mechanic*, 31, Tavistock-street, Covent Garden, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or when tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*. Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 7, and unacknowledged elsewhere:—

C. RICHARDSON.—A. Norfolk.—G. Davies.—S. Grove.—H. King.—K. B. Williams.—C. J. Stock.—A. E. Oakes.—J. L. B.—Ural.—Caloric.—E. W.—D. H. G.—Canadian subscriber.—R. R.—A. Fellow Workman.—Jack of All Trades.—R. T. B.—R. J. T.—Surgeon Dentist.—W. L. O.—A. Trotter.—G. K.—Stockton.—Vulcanite.—Water.—Gloworm.—J. Hale.—May.—Young Engineer.—Centaur.—O. J.—H. Husband.—Labor Omnia Vincit.—America.—Electric.—T. B. A.—G. L. Scott.—Crank Pin.—A. Smith.—S. P. F.—A. Butler, Bow.—A. Lover of Science.—H. M. Gerrard.—Wallington.—R. E. C.—E. P.—R. T. Lewis.—Enquirer.—Working Foreman.—Millwright.—Bazooka.—Iron Horse.—J. C. King.—Ploni Almoni.—A. B.—C. Birchall.—A. E. Binnie.—Rev. T. Floyd.—New Subscriber.—Georgia.—J. D.—Orderly Vital.—W. Watson.—J. Huntley.—A. Would-be Piper.—B. R.—Sheffield.—Reverend.—Mottis.—J. W. C.—H. K.—R. Pears.—Oakland.—A. B.—Barium.—T. G. Elger.—Aconite.

CARBOLIC. (Must see a textbook of Chemistry, or a Chemical Dictionary. 2. Many recipes in back volumes. See p. 140, Vol. XXXI. A solution of vanadate of ammonium mixed with tincture of galls forms a good marking ink.)—BOSHER. (Fully explained many times. Consult the articles on the Indiarubber and Gutta-percha Industries, pp. 30, 51, 8.) Vol. XXXII.—MAGNO. (Do you mean slag or mineral wool?)—POWER. (For the purpose of calculation, eleven men are reckoned as equal to one horse-power. One man-power is taken as "0009 of a horse-power.")—W. U. (For stops to one-row harmoniums, see illustrations and description on p. 330, Vol. XXI. Consult also the indices from Vols. XX. to XXV. for references to much information on the subject.)—NOSHO. (The noise was caused by air in the pipe, which was remedied by the overflow pipe allowing a free current to pass down. The arrangement as depicted is a very insensate one.)—W. H. (Try ordinary tinman's solder, or use some old type-metal. We do not understand how the plug can be so soft that it "wears away." Do you mean that it is melted on the fire side?)—CONYER. (You will find all you require in nearly every back volume. See a letter in last week's number, for instance.)—AN OLD SUBSCRIBER, Redcar. (The dandelion is a perennial, which can be easily cultivated by transplanting the rootstocks or by sowing the seeds in spring. The root, probably does not reach maturity until it is three years old. It is extremely doubtful whether anyone sals the seeds of the common variety, but a larger-leaved sort used for salading is kept in stock by nearly all the principal seedsmen.)—G. REILLY. (The process has been given many times. See, for instance, p. 239, Vol. XXXI., where two methods are described. The simplest plan is to pour mercury on to tinfoil, and then place the glass over that by a sideways motion, so as to skin the mercury of its outward film as it were, and bring the fresh surface in contact with the glass, which must be perfectly clean.)—MOX. (Purely a commercial question, of interest only to the questioner. 2. Hematite is applied to all minerals consisting essentially of anhydrous peroxide of iron. The "common ore" of this country is argillaceous carbonate of iron.)—ALRA. (Any good ink of the required colour. The principal constituents are galls and sulphate of iron. See many recipes in back volumes. 2. Add a few drops of oil of cloves or carbolic acid.)—BRACKETT. (Do you mean a dye or metallic powder? If the latter, they are varnished, and the bronze powder dusted on. If the former, it is probably aniline brown.)—G. H. K. (It is simply the difference between the given figures and 99.)—TARPAULIN. (You should use what is called "dable boiled" oil and vegetable black to imitate the so-called "tarpaulin"; but if real tarpaulin, mix the tar with whale-oil.—ROSA. (Camphor, 2dr.; proof spirit, 2½ fluid oz.; nitre, 14dr.; sal-ammoniac, 1½ lb., are the usual ingredients. 2. No definite rule. For dimensions, &c., of a number of good coils, see p. 410, Vol. XXXI. You could use No. 40 for the secondary, but 36 is preferred.)—H. MILLS. (No sketch accompanied your letter.—J. C. B. (It would be held more firmly when dry.)—QUARTER PLATE. (Apparently you mean Lancaster's phantasmograph. See last page last week.)—FEVER. (Run paraffin oil round the junction, then heat the bottle, and invert it. If the stopper will not fall out with gentle tapping, probably the only way is to drill a hole through, and pull it out by inserting a bent wire.—STEAM BOILER. (It depends on the character of the deposit; but most likely it will have to be chipped off. See many recipes in back volumes; but why not purify the water before running it into boiler?—W. G. DARTCOTT. (Scrape the parts

thoroughly clean, and try again. Are you sure it is galvanised? If not, try your flux after you have killed the acid by means of scraps of zinc.—FITTER. (Without being informed of your object, no definite reply can be given; but procure the catalogue of practical works issued by Mr. Calvert, Great Jackson-street, Hulme, Manchester.)—ACROSTICS. (No one can prevent the actual noise; but presumably you wish to prevent it being heard elsewhere—say, on a floor above. That may be done, if there is a ceiling, by filling in between the joists with sawdust, and by putting a rubber washer between the floor and the shaft hangers. Each case must be considered on its merits; but you give no particulars.)—U. W. L. (Procure Babbitt's metal or some other suitable alloy from the metal warehouse; or, if you must make, try 10 tin, 1 copper, 1 antimony.)—AMMONON. (Yes, several; escape of gas being the principal. 2. Would not do at all, as the pressure would force out the gutta serena, or if that were prevented, the balloon would be too heavy. 3. It could be, and, we believe, has been, done. 4. The requisite quantity of zinc and dilute sulphuric acid would add enormously to the weight, as does the force pump. 5. Seeing that such a material has never been used, how can any one tell you cost, size, &c. 6. Baking-powders are composed of bicarbonate of soda, tartaric acid, and some cheap fecula, one pound of the acid to a pound and a half each of the other ingredients.)—W. G. B. Junr. (Fill up oak with plaster of Paris and water; rub down and size. For mahogany, various fillings are used, such as Russian tallow (or mutton suet) and plaster of Paris; the latter mixed with size, or a solution of alum and whiting, all coloured to suit the wood.)—ABRAHAMIAN TUNE. (Dig up shears by which you can raise and let fall a heavy weight on the tube, the head of which is protected by a wooden cap: a guide should be provided for the weight. In the case in question, so great a depth was reached because the ground was sand.)—J. L. M. (You can buy Bessemer's gold paint in various shades of many oilmen, and at all artists' colour shops.)—H. R. L. (For horizontal windmills, see pp. 14, 40, Vol. XI.; pp. 108, 516, Vol. XII.; but you should also consult pp. 201, 312, Vol. XIII. There is a great deal of information about windmills in those volumes.)—R. R. ARMY. Temperance. (You must acquire the art from some teacher—no book.)—BENEDICT. (Try the effect of lime wash; let it dry on, then scrub out with hot water and soda.)—R. A. C. (One of the simplest and best plans is to make up a bundle of straw or hay of about the diameter of the well, but so that it will pass freely to the bottom. Attach a weight and a rope, and work it up and down rapidly in the shaft, say, a dozen times; then if a candle will burn at the bottom you may safely descend. 2. Dab the glass over with a handful of putty, or wash with a solution of Epsom salts or Glauber's salts, to which a little glue or gum has been added.)—BASORCI. (The best plaster of Paris, mixed preferably with alum-water.)—W. W. MOUNTAIN. (You will find Mr. Root's paper in the *Transactions of the American Society of Mechanical Engineers* or in the *American Mechanist* of Nov. 28 and Dec. 3, the latter number containing a full report of the discussion. We have several circulars of "novel propellers," but are unable to utilise them, though we should be pleased to give an account of successful experiments with the propellers.)—T. W. (Have you tried camphor liniment, or a solution of sulphate of copper. Any respectable druggist will make up a suitable lotion.)—A. E. M. (You cannot have looked over many volumes. Here is a good recipe: Take galls, 2 lb.; logwood, green copperas, and gum-arabic, 1 lb. each. Crush all to powder, and boil in 51 gallons of water for a couple of hours, strain, and bottle for use, adding a little carbolic acid.)—MILLER. (A battery is very expensive, and altogether out of place, when, as you say, you have "plenty of power at hand." If you must have the electric light, get a dynamo-machine. They are not quite so expensive as you think, especially as you want only one light.)—LORANACE. (Polish the barrel bright, place on a red-hot iron plate, and when the colour appears turn off into water. Or coat with blue lacquer.)—ARTHUR. (You would want two batteries and Morse keys if you have two bells to one wire, making earth by sinking plates in the ground. See the indices of back volumes.)—K. B. (You were answered on p. 292, and referred to p. 238.)—W. W. (1. Bed in mortar. 2. The stairs are probably good specimens of the joinery put into modern houses, the wood new and green and the creaking incurable; if, however, it is old work, something must be done somewhere.)—A. I. (Why not write Mr. Lancaster privately? Such questions are in his ordinary way of business, and you can hardly expect him to answer in these columns.)—T. B. (Then the reviews would be advertisements, which we object to, without being paid for. Query next week.)—E. J. R. WERN. (1. Give it up. You cannot do it on a small scale. 2. We do not understand; 640 acres are one square mile. 3. Get a book by Mr. Scott Barr, published by Lockwood and Co. 4. No, but the basis is, doubtless, good land. Common zinc ointment would answer all the purposes. 5 and 6. Don't dose yourself with medicines; eat good wholesome food, live temperately, take moderate exercise, and take up some innocent hobby on which to relieve your mind between the hours devoted to work—gardening, bicycling, fishing, anything rational and harmless, and you will not worry yourself about "cleansing the blood.")—GENERAL F. GRANT. (We thoroughly agree with you—no completely indistinct that we hardly think it worth while to provoke needless controversy by inserting your letter.)—PERPLEXED. (A question for the lawyers altogether. If the club or association, or whatever it is, expels your friend, he may, if he thinks fit to spend his money, challenge the decision in a court of law, and probably upset it.)—LORD OF THE ISLES—W. B. P. (We cannot spare any more space for queries merely having reference to numbers and editions of engines.)—T. R. (Any patent agent advertising in these columns will obtain an American patent for you.)—COLLIER MANAGER. (Too much to ask of any correspondent.)—A. SCOTT. (Very likely; but if the author wishes for our opinion he must send a copy in the usual way.)—J. W. C. (Why not get a photograph from Mr. Beasdale? You will find his advertisement in this number.)—J. S. COB. (We replied to both your queries on p. 292 under the signature of "Mercurius.")—A. SMITH. (No; unless the beverages contain an undue percentage

of alcohol, as has been found the case lately with some of the "Temperance" drinks.)

Let.—N. W., Faling (1st query; second next week).—Your queries can only appear in the "Sixpenny Sale Column."

W. W. Dewabury.—Dorothy.—Dix.—T. Ward.—The Village Philosopher, and others have replied to queries already similarly or adequately answered.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a *First Wrapper*, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

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Advertisements must reach the office by 3 p.m. on Wednesday to insure insertion in the following Friday's number.

Holloway's Pills possess the power of expelling all pestilential humours from the human system, where they become necessary in every household at those times when fog and other atmospheric impurities taint the blood during its passage through the lungs. The purification effected by these pills will prevent pleurisy and chest complaints.

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Bicycle, 50in. Exchange anything useful. New, perfect.—MARR, Cupola, Sheffield.

Parrot Cage, new. What offers cash or exchange?—MARR, Cupola, Sheffield.

All sorts of Instruments and Apparatus exchanged for others. Good value allowed.—DR. CARLTON, Science Depot, Chelsea-street, Tottenham Court-road. Established 1862.

Scientific, cost £6 8s., given in exchange for Lathe, saws, youth Bicycle, or others.—E. J. EMERY, Walton, Ipswich.

Lathe (Gentleman Amateur's), valuable, 8ft. bed, overhead motion, divided head, over, eccentric, variety of other chucks, slide-rests, and etc. etc. as too numerous to mention. Recently offered in "E. M." for sale for £40. Will exchange for first-class microscope, astronomical telescope, modern diving apparatus and photographic slides, for electric or limelight. Must be by known maker. Can be seen by written appointment. W. BUCK, 10, Farringdon-street, E.C.

"English Mechanic" exchanged for "Knowledge," 3 or four days old.—FIRKILL, "Raynham, Dyke-road, Brighton.

Large Aquarium, slate and plate glass, on massive oak stand, contents 100 gallons. Suitable for public institution. Cost £14. Exchange Trouse Lathe or offers.—H. S. ST. MARK'S-ROAD, Wolverhampton.

Exchange.—Wanted, a small useful Printing Press and Type. Would give Garden Seeds, Bulbs, or small shrubs to value.—H. ELLIOTT, Marlow, Bucks.

20 Vols. of "English Mechanic" for a good i-plate Camera and Lens.—J. J. Lower Keston, Hereford.

"Photographic News," Nos. 1 to 644; "Photographic Notes," 217 Nos.; "Photographic Journal," Nos. 20 to 202. What offers cash or exchange?—J. Goss, York Villa, Carlisle.

Set single Horse Harness, silver mounted, worth £10. What offers or exchange for a good Tricycle, Bicycle, or Fireproof Safe.—S. GILLMAN, North Curry, Somerset.

"Encyclopædia" (Blackie's), 14 Vols., cloth, excellent condition, cost £7 14s. 6d. exchange for Hosiery Goods or anything useful.—FARMY, 27, Suffolk-road, Surrey-gardens, Waltham.

A superior Improved Pocket Microscope, maker McKENZIE, of Chesham, London; fitted with four high-power objectives, lenses double eyepiece, rack and pinion adjustment. 20 pieces printed instructions. All fits in a leather case; cost 35s. take 1/4 cash, or good exchange.—BAIRD, 80, Woodchester-street, London, W.

Gas Fires, two complete (patent), quite new; catalogue price 37s. each. Will exchange for fifty shillings in Hardware goods wholesale.—W. H. SLATER, Sunderland.

How's Treadle Sewing Machine, excellent working order; exchange for 70s. in hardware goods, or offers. Cost £7 10s.—W. H. SLATER, Sunderland.

"Les Trois Mosquitos" and other French novels, about 18 volumes, in exchange for French or German books.—GASSEL, 14, Newsey-road, Warrington.

Exchange.—I have 2 good Bicycles, one 50in. and one 44in., also one lady's Watch, value £2 10s., and 11 volumes of Blackie's "Encyclopædia," cost £7 14s. Will give part of the whole for a good Iron Lathe—slide-rest preferred.—Apply, A. H. C., 2, Elm Villa, Malmesbury Park, Bourne-mouth.

Wanted, a Press and Type to print circulars 8 inches square. State full particulars. Offers.—A. S. JAMES, Swell Mills, Dover.

Surveyor's Level, Tripod, and Chain; cost 25 10s. Exchange Musical Box, Gold Watch, or good Bicycle.—MORRIS, Gash Hall, near Hildon. No cards.

Musical Box, large, plays 12 tunes; cost £18 six months ago. Offers.—HAWSON, 12, Great Crown-court, Haymarket, W.

Superior Plate-glass Aquarium, holds 8 gal. lons mahogany frame, worth 50s. What offers in exchange?—F. UNDERWOOD, Beverley, Yorks.

What offers for 8 years "English Mechanic," from January, 1871, up to date? Also: "Mechanical Engineering," in 10 divisions, by SCOTT BURN, together or separate.—G. HALL, Knapley, Alfreton, Notts.

Pair of very handsome Single Needle Telegraph Instruments, by best makers, best valued at £7. What offers?—"BATA," Helbroughston, nr. Sturbridge.

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THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 3d. for the first 16 words, and 3d. for every succeeding 8 words.

For Sale.

Electrical Wires; silk, cotton, indiarubber, and gutta-percha covered. Bell and handle cords.—W. RICKARD, Derby.

"The Night-light Clock." Illustrated and described on page 370, No. 294. Price, carriage free, 5s. 6d.—F. ROBERTSON, 12, Greek street, Soho, W.

Photographic Apparatus. Cheap complete sets for amateurs. Instructions free.—MONTAGU AND SONS, 20, Granbourn-street, London.

Astronomical Telescopes.—The Complete Equatorial, 4in. aperture, 4ft. focus, first quality doublet. Iron stand, finder, 3 powers, screw motion, £13 13s. Good 5d. for "Use and Adjustment of Reflecting Telescopes," with Photo.—F. E. FARRIS and Co., Opticians and Electricians, Southampton.

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Fret Saws, 2s. 2d. per gross.—LE RICHE, Smithford-street, Coventry.

Harmonium, £5; 7 stops, walnut case, full compass, ivory keyboard; bargain.—S. COLLIER, King's-cross.

Lantern Photographs, 10,000, with readings, from 6d. plain, is. coloured.—A. FENNER, Emily-street, Birmingham.

Lantern Photographs for Hire. List and sample picture for 5d. in stamps.—A. FENNER, Emily-street, Birmingham.

Triplex Lantern, Achromatic Lenses, full size, best light, limelight excepted, 44s.—FENNER, Emily-street, Birmingham.

Complete Limelight Apparatus, equal to 200 candles, 9s. List of Apparatus 3d.—A. FENNER, Birmingham.

Chromatope, with 5 designs and Eidotope, complete from the manufacturer, 10s.—A. FENNER, Emily-street, Birmingham.

Harmoniums, second-hand; returned from hire. All prices.—VENABLES and Co., 187 and 189, Essex-road, Islington.

Pianos, second-hand; returned from hire. Extensive showrooms.—VENABLES and Co., 187 and 189, Essex-road, Islington.

Hunter's Piston Lubricant, and for heavy machinery; a trial solicited.—JOHN HUNTER, Bathgate, Lillington.

Silver Cream rubbed on will renovate perfectly old electro. Genuine silver; 13 stamps.—ARMY OFFICE, Liverpool.

"English Mechanic."—Wanted, Volume II. (bound preferred) Also indexes to Volumes II., V., and X.—K., care Mr. Streeter, 113, High-street, Croydon.

"English Mechanic."—Wanted, Volume II. (bound preferred) Also Indexes to Volumes II., V., and X.—B., save Mr. Streeter, 113, High-street, Croydon.

English Mechanic

AND

OF SCIENCE AND ART.

SATURDAY, DECEMBER 16, 1881.

REMARKS IN MICROMETRY.

Journal of the R.M.S. for August, there appeared an offer from Prof. A. Rogers, of Cambridge, to present a ruled stage micrometer which he would undertake to examine and publish his report. Having had the pleasure of corresponding with Prof. Rogers, I ventured to be the recipient of his liberal proposal, and to detail the result of the inspection.

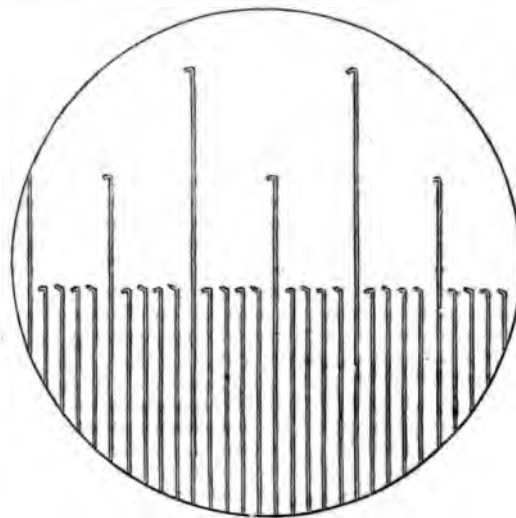
Before the micrometer arrived, its test-plates had been sent to me, and the ruling is so delicate as far as the well-known Nobert's test-plates, though all visible, the object, and the lower ones require low power (4-10) dark field, but imperceptible under deeper light. Perhaps, as this test-plate has been referred to in the *English Mechanic* of 18th November last, page 251, it is interesting to state that Mr. Rogers, an optician, of New York, from whom I obtained, lately sent me the reply to inquiries as to the ruling. "You need a first-angled immersion objective, one-sixth, of 116° balsam angle. Oil of cedar being the best; I used a quartz prism,* or a hemispherical lens to the under-side of the plate of glycerine, a flat-wick lamp, wick turned towards the prism, Beck's condenser (such as a popular microscope) interposed directly upon the slide. I did not use a mirror at all, and have resolved 90,000; Mr. Faslott claims to resolve them to 150,000, and Prof. Rogers to 120,000."

It is not improbable that the ruling of the micrometer might be similarly faint, and so difficult to decipher by use: and it was therefore on its arrival, that the perfectly clear and distinct, vellously slender, under objective class and power. On glancing at the slide, held in the hand at a distance, the play of iridescent colours was seen; and on looking through it with the eye or candle at the distance of the diffraction spectra are brilliant and considerably; the first two on each side the centre being separated and overlapping. Placed on the stage, and viewed with a two-angled objective, and any of the various contrivances obtaining a dark field, the ruled micrometer, which are with a dark pigment as is common, like streaks of diamonds; and illumination a singular appearance. In some of the lines a slight intermingling of the glass has appeared, the course of the ruling giving an effect of deeper cuts in some. But, as this effect is invisible in dark field, and as there is certainly in the width of the several lines, arises solely from the nature of the ruling and the more so, as these apparatus cuts do not often extend for

the entire length of a line, and sometimes occur side by side for a few lines in broken intervals.

The micrometer is of the ordinary 3 by 1 size. The ruled portion is a centimetre in length, and contains 1,000 spaces, subdivided at every fifth and tenth, the lines being thus the one-hundredth of a millimetre apart. The band comes at each end within 0.65mm. of the raised cement circular border which protects the junction of cover and slide. And it so happens that this raised edge is thick enough to prevent the approach to the ends (and the ends only) of o.g. such as 1-20, whose working distance is very small. The width of the band, i.e., the length of its shortest lines, neglecting those that project, is 1.375mm. Every tenth line is 1.6mm. long, and the principal spaces of 0.1mm., which they indicate, are subdivided by a shorter prolongation of the fifth lines, which measure 1.55mm. These measurements are the average only, for the lengths of the individual lines vary a few thousandths of a millimetre, and the lower edge of the

makers, Messrs. Cooke and Sons, of York, with additional draw-tubes, for use, either as an eyepiece in the usual manner, or in the sub-stage, giving an aerial image of the spider-lines as proposed by Dr. Piggott. [*M. M. J.*, Vol. IX., page 3.]. This latter method, however, so far as my own experience goes, is more ingenious than effective; principally because all vibration of the micrometer in that position (and it is hardly possible to avoid tremor altogether with high powers) is magnified by the whole power of the microscope. There is one advantage possessed by Jackson's E.P.M., in the spring action, which moves the whole scale, and consequently its zero point, with extreme nicety. In the spider-line micrometer, unless of large size for telescopic use, one wire is generally fixed, and the only way to bring a given point of an object under the microscope to coincide with that wire is by the screw-action of the stage, which, with a high-power, is far too sensitive and rapid. To obviate this difficulty, a traversing movement to the extent



band is not consequently strictly in one straight line. The terminations of the lines at the upper edge, independently of those projecting at every fifth and tenth, are not in the same straight line either. These deviate in a symmetrical manner; four lines between two long ones having their ends equal and straight, while the ends of the next four from a gentle convex curve. All the lines at this, which may be considered the reading-edge of the band, are terminated by singular hooks, suggestive of the curved handle of a walking-stick; they differ somewhat in size and character, but have all the same direction, and are probably due to the stopping, lifting, and reversal, of the cutting diamond; the appearance being as follows, under a moderate power.

As regards apparatus for measurement, I had, for objectives, the choice of a series by several makers (dry, as well as immersion, adapted to various media) up to Zeiss's L, equivalent to 1-24th; the lines of the band being well defined under all of them; and, for the eyepiece micrometer, either Jackson's form, the glass spring slip generally used with a B eyepiece, or a small spider line micrometer belonging to a Stellar spectroscope. The glass E.P.M., besides deteriorating the image to some extent, depends a good deal for its result upon an estimation to tenths of its graduations, and can hardly be susceptible of the accuracy which should be attained with a well-made "wire micrometer." That the instrument of this class, now referred to, is worthy of confidence, was confirmed by testing under the microscope the value and constancy of its screw action; and it was therefore adopted for the purpose in view, and provided by its

of a fifth of an inch, controlled by a screw of fine pitch, was added to the small micrometer in question between its screw-plate and draw-tube. By this means any given line on the ruled band, after being brought approximately into position with the stage movement, could be accurately bisected by the fixed wire of the micrometer. The objectives finally selected were a $\frac{1}{4}$ for the measurement of the principal subdivisions containing five spaces each on the close scale, and a 1-10 imm. for the close spaces themselves. These o.g. gave the most convenient decimal values: the former by suitable adjustment of the draw-tube giving 0.00025 mm. as the equivalent of one division of the micrometer divided head (50 divisions to one turn); and the latter 0.001mm. Both glasses were by Beck, and their magnifying powers, with the positive eyepiece employed, were 950 and 2,500 respectively. Of course the eyepiece could be changed at pleasure without altering the ratio of scale to image. At first sight it is a little startling to find, by the use of a comparison micrometer (decimals of the inch and metre) that a distance between the spider-lines, centre to centre, denoting this 0.00025 of a millimetre, may with equal accuracy be considered to represent 0.00001 of an inch. If a sufficient number of multiples of such short lengths be taken, the error would soon become apparent, for, at the same rate, a metre would be 40in. exactly; or, as the undergraduate remarked, after a brief acquaintance with limiting values, "everything is ultimately equal to everything else." But with these excessively minute quantities, the error is less than the best microscope can appreciate, the exact difference between

*The R.M.S. Journal for 1878, page 246; but was previously devised by Mr. Wenham, *II.*, page 237, June, 1872.

these two being less than $\cdot 000004$ mm. The fine movement of the microscope employed is on its main tube; its action propels or withdraws the nose-piece, and varies the distance between the objective and the micrometer at the eye end, thus possibly interfering with the value, as adjusted by the lengthening draw-tube, of the micrometer scale in terms of a given unit. It is not to be supposed that an object a centimetre long can be passed in review under a high power without some attention to the fine movement being required. It proved, however, by actual experiment, using a power of 1,000 diameters, with a total length of tube not exceeding 12in., that an alteration of the fiftieth of an inch in the distance from eyepiece to stage, requiring more than four turns of the fine movement, made no perceptible change in the ratio between the micrometer in the eyepiece and that on the stage. And, as nothing like a whole turn of the fine movement was necessary to change the focus from any one part of the ruled band to any other, any supposed error in measurement from this cause may be dismissed as visionary. All kinds of illumination were tried, the preference being given to that described in the R.M.S. *Journal* for August, 1881, page 666, using the concave mirror without condenser, at an obliquity of about 40° , and a thin metal plate attached below the stage, at such an angle that no rays from the lamp can reach the object, except by reflection from the inclined mirror. With the light so directed, each line of the band was evenly divided, longitudinally, into a dark half and a light half, giving much facility for the exact superposition of a micrometer-wire upon the centre of the image of any line. In examining the spaces seriatim, there was some risk of losing count, and as a means of reference, a scale of figures, photographed for me to the exact length of a centimetre, by Mr. J. Mayall, (who is known not less as a fellow of the R.M.S. than as a photographic artist), was pasted at the upper edge of the band, so that the principal graduations of the latter could be identified with a low power. Coming, at last, to the examination of the plate ruled by Professor Rogers, perhaps its most distinguishing feature is the perfect straightness and similarity of the individual lines. The stage micrometers commonly met with are so deficient in this respect, when closely examined with a high power, that it is impossible to obtain equal distances from different parts of the same two lines of the scale. But with the ruling of Professor Rogers no such inequality exists. The spider-lines at the eyepiece may be set to any interval of lines on his micrometer, and the scale will rigidly indicate the same distance at any other part of the band, whether above, below, or on either side, the position first selected. As to the actual width of the lines themselves, it is not easy to speak with certainty, for their apparent width is not quite the same under all methods of illumination. But as a mean of several observations, I make it to be $\cdot 001$ mm. almost exactly. After all these precautions for the study of this micrometer presented to me by Professor Rogers, perhaps a list of small, though definite, errata may be looked for; but I have not one to produce. It would be useless to encumber your pages with details of measurement. I have carefully verified the principal intervals of the band; and a large number, taken at hazard, of the 1,000 close spaces, but have detected no discrepancies whatever. The only possible criticism that occurs to me is that the projecting lines at the reading edge are perhaps needlessly long, and that if the "walking-stick hooks" could be transferred to the other side of the band, it would be an improvement. I believe the ruling to be as accurate as mechanical means can produce; and, though there is no means of deciding

whether the spaces are true subdivisions of the French metre, the perfection of the subdivisions themselves is a tolerably sure guarantee that the Professor took every care to verify his unit to begin with.

Thos. S. Bazley.

REVIEWS.

Easy Star Lessons. By R. A. PROCTOR. London: Chatto and Windus.

THE facilities for acquiring that knowledge of the Constellations, the absence of which called forth Carlyle's memorable lament that no one had ever taught him the stars, have been enormously multiplied in these latter days; and, certainly, no single writer has done more to popularise the study of the face of the sky than the author of the book now lying before us. The plan he adopts in the present work is a novel one; as the visible hemisphere for a given date in each month is split into four maps; a northern one, a southern one, an eastern one, and a western one. On what we may, perhaps, call the meridional maps, the zenith of the observer (the point directly over his head) is given for various latitudes on the Earth's surface; and, on all the maps, the horizons corresponding to such latitudes are marked. The selection of the localities seems to afford internal evidence that these "Lessons" are, or have been, addressed to students on both sides of the Atlantic; as we find New Orleans and other American cities predominant among the localities for which the aspect of the Heavens is delineated and described. Commencing with the Great Bear (as a constellation, whose chief stars never set in England, and whose configuration is too striking ever to be forgotten), Mr. Proctor goes on to instruct the incipient astronomer how to find the Pole Star—and hence the whole of Ursa Minor—from the two foremost stars in it. In so doing, he insists upon the manner in which all the constellations circle round the pole of the celestial vault, and points out very clearly how those in the northern sky are seemingly turned completely topsy-turvy in the course of six months when viewed at the same hour in the evening. Proceeding then to the other maps, he shows the position of the principal visible stars, with reference to the horizon and zenith, as also their alination inter se, and so leads the student, step by step, to a familiar acquaintance with the whole of the visible heavens. It must not be supposed, however, that nothing more is to be learned from Mr. Proctor's latest volume than the names and positions of the chief stars that make our night sky glorious: inasmuch as he incidentally contrives to impart a very considerable amount of information on various branches of stellar astronomy. In this way, the learner acquires some knowledge of the nature and phenomena of those strange bodies the variable stars, of Nebulae, of star-drift, and of the proper motions of the stars in general. In connection with this, we find a reclamation by our author of those diagrams of the strange changes in the configuration of certain constellations produced in the course of great cycles, which M. Flammarion has elsewhere published as original ones. With two things only in the entire book have we, in our critical capacity, any fault to find. The one is a slight pleonasm in connection with a reference to a "school atlas"—pretty evidently having its origin in the printing office; and the other is a diagram resembling a mass of small silkworms' eggs, which is jocosely described as representing 57 M. Vulpeculae, the so-called "Dumb-bell nebula." Nothing but a desire to be rigidly impartial induces us to mention a couple of such microscopic blemishes. Assuredly they will not prevent anyone who wishes to

obtain an accurate knowledge of the configuration of the stars from buying this simple and readable little volume.

First Steps to a New Selenography, in which it will be Recognised that the Moon was once an Inhabited World. By JOHN JONES. Dundee: John Leng and Co.

READERS of our XXXIst Volume may possibly recollect that on the 19th of October, 1879, Mr. John Jones watched the Sun with his naked eye for half an hour in a clear sky! and, as an absolutely necessary consequence, saw some very funny things indeed. Since that eventful period, our author tells us that "a time came, however, when we acquired possession of a powerful Wray refractor telescope, with which we began to explore the heavens, after the fashion of the Boyntons of science." Merely remarking en passant that we have not the most distant conception who "the Boyntons of Science" may be, we may say that, after (what 'Arry might describe as) "a general tootle" all over the sky, our author found that the Moon "obtruded upon" his sight in so prominent a manner that it seemed to say "Take a look at me," an invitation accepted on the spot. "Round went the tube, down went the eye, and instantly," exclaims Mr. Jones, "we telescopically gazed, for the first time, upon a scene of indescribable beauty." We all remember how, in the days of our childhood, we were accustomed to be told in a familiar game to "turn round three times and catch whom you may," and, on a cognate principle, "Round went the tube, and down went" the author's "eye," three times, before his great discovery dawned upon him. Not to keep the impatient reader any longer in suspense, we will give it at once, in Mr. Jones' own words: "Yes, there can be no mistake, the ring mountains of the moon are the skulls of an ancient ocean which once overspread that luminary." This is the sublime secret, that our satellite in its infancy had a coral (or corals), like the rest of us. Farther on, it is true, we are told that she possessed "mud-volcanoes," and "mud-islands," and on this muddy substratum did the coral reef arise. Then came a glacial epoch, when ice polished the corals up, and so on. The difference "Mares" (as our author calls them) on the Moon, are the continents; and Mr. Jones is anxiously expecting a meteor to bring him a specimen of a Lunar Coral! "Mare and mud. Such is the selenography of our author, and in this charming combination of mares-nests and mud-dle, we leave him."

The Structure of the Cotton Fibre in its British Technical Applications. By F. H. BOWMAN. D.Sc. Manchester: Palmer and Horwood. London: Simpkin, Marshall, and Co.

THE substance of this work was delivered in the form of lectures to the Mechanics' Institute of Bradford, in the spring of 1880, and its publication has been delayed because the author, at one time, purposed to add some chapters on the structure of wool, which, perhaps, plays a more important part than cotton in the manufacture of those textile fabrics which are known as Bradford goods. Mr. Bowman has, however, failed to find the requisite leisure, and his work is, consequently, limited, as its title indicates, to a description of the cotton fibre and its uses. The author has had the advantage of a scientific training, and is commercially engaged in the manufacture of cotton yarn; he is, therefore, so to speak, doubly qualified to lecture on the subject, and his work will probably become a recognised textbook in technological classes, especially as he has carefully described his method of working, and appended a glossary of technical and scientific terms. The first lecture points out the importance of technical knowledge, and describes the instrumental appliances necessary for examining the fibres of cotton, with

account of the botanical relations of cotton, and a dissertation on the arrangement of the ultimate cotton fibre. In the second lection, the structure of a cotton fibre is described chemically, and in the third the treated from the point of view of acturer. Mr. Bowman supplies plates of drawings taken at the microscope, besides illustrations of certain useful tables giving the results of experiments with various yarns, which will be of great assistance to the local student. One of the most important portions of the volume is that the author treats of the theory of and furnishes coloured plates representing appearance of different fibres dyed by colouring matters. The microscope, and, especially, of light in studying the appearances of dyes is fully explained by Mr. and a careful study of what he has to say help Bradford manufacturers to avoid the unpleasant results which times experience in cross-dyeing. edition, which will, no doubt, be before long, it would be well to printers' errors: "complimentary, is, perhaps, not it "catalytic" looks very bad in it is, so far as type and paper are well printed. "Polysepalous" is defined as a seed vessel having sions; millboard is not cardboard, and, "denticulated" does not mean "having teeth like a saw." these errors out because they are others, and because when they are the work will be a fair example of technical manuals which are ted.

Land of Work. By C. L. MATEAUX. Cassell, Petter, Galpin, and Co. We imagine is intended as a sort of New Year's book, to be children with an inquiring turn of mind it is so freely and well illustrated it might well serve as a picture-book contents are a series of light and papers on the more notable industries of the world, such as coal-mining, iron-furniture making, and wood-on clocks and watches, on glass and also on toys, old and new, all are described with tolerable and with a mixture of anecdote y that will help to impress the upon the memory.

also received the fourth edition of *of Civilisation and the Primitive Con-* Man, by SIR JOHN LUBBOCK, Bt., a well-known work which ed so many additions here and it has grown by about 30 pages. l the work at length some years need only add that it is the stan- on the subject. — *Handbook of m Illustrative of the Wild Silks of Indian Section of the South Kensington y THOS. WARDLE* (Her Majesty's Office) is a description of the s, and a catalogue of the objects, at South Kensington in the tion. The book is freely illus- a maps and engravings, and will idable value to those interested trade, especially as concerns the of Indian silks. — *The Preparation Cements and Glue*, by JOHN PHIN c: Industrial Publication Co.), and ics' Slide Rule, by F. T. HODGSON (lishers) are two little "Work which, however, are rather too ppete with similar books published e the Atlantic, and are in no sense — *The Engineman's Almanac*, for sheet almanac, published by W. Johnston, Edinburgh, which, as

its name implies, is for use in the loco. shed and driver's room. The centre is a very fair portrait of Mr. Michael Reynolds, and the four corners are occupied by drawings of typical locomotives. — *Letts's Diaries* (Letts, Son, and Co.) have made their appearance for 1882 in the various useful forms now familiar to all business men.

STEINHEIL'S IMPROVED PHOTOGRAPHIC OBJECTIVES.

SOME improvements in antiplanatic objectives have been recently patented in this country by Herr Hugo Steinheil, of Munich. Double objectives, it is known, can be readily constructed to give images on plane surfaces, but the distinctness of such pictures decreases from the centre towards the edge. According to Herr Steinheil any improvement of the image in this respect must be effected by a different construction of the objective to that generally adopted, and after making numerous calculations he has arrived at the following conclusions:— In the antiplanatic objectives which form the subject of the present invention the two combinations are very dissimilar in respect of focal length and errors, and they are calculated for two different purposes; first, for operating in the open air, such as for groups, landscapes, and the like, in which, on account of the reflexes, no more than two separated lenses can be used (4 refractions from air into glass or from glass into air), and consequently in which the lenses forming each combination must be cemented together; second, for operating in the studio, where large openings in comparison to the focal lengths are necessary, but where, on the other hand the lenses of the one combination may be separated from each other. In constructing a lens according to the first method it has, with a focal length of 240mm. (9.46in.), an opening of 43mm. (1.69in.) for both combinations. The front combination upon which the light falls consists of a bi-convex flint glass lens cemented to a bi-concave crown glass lens, which combination has a focal length of about 216mm. (8.5in.), and has strongly chromatic and spherical aberrations, and also produces strongly curved images in the same sense as a

errors of which are consequently neutralised thereby. The descriptions of glass used are:—

	Crown.	Flint.
For yellow rays =	1.51705	1.57710.
For violet rays =	1.53250	1.60229.

$$\frac{dn}{dn} = 1.6304.$$

The necessary elements for constructing the instrument with an opening of 43mm., and a focal length of 240mm., are:—

$$\begin{aligned} R &= + 64.1\text{mm.} \\ R_1 &= \pm 287.8\text{mm.} \end{aligned} \left\{ \begin{array}{l} \text{light flint } d = 4.93\text{mm.} \\ \text{crown } d_1 = 4.1\text{mm.} \end{array} \right.$$

$$\begin{aligned} R_2 &= - 98.4 \\ R_3 &= + 34.44 \\ R_4 &= + 72.1 \end{aligned} \left\{ \begin{array}{l} \text{light flint } d_2 = 3.28\text{mm.} \\ \text{crown } d_3 = 24.6\text{mm.} \end{array} \right.$$

Fig. 1 shows the above-described objective partly in elevation and partly in section.

In constructing a lens, according to the second method, it has for the same focal length of 240mm. an opening of 76.25mm. for the front combination. The rear combination consists of two lenses of unequal size separated from each other, the one being a flint lens of 46.4mm. opening, and the other a crown glass lens of 58.8mm. opening. The front combination, of which the first radius of curvature is very short, has a positive focal length of 156mm., and consists of a bi-convex crown lens cemented to a bi-concave flint lens, and has also strong, chromatic and spherical aberration, and gives a strongly curved image in the same sense as a simple positive lens possesses these faults. The rear combination, which is at a distance of about one third of the opening of the front lens, consists of a bi-concave flint lens and a bi-convex crown lens, the latter being at a distance from the former equal to about one fourth of the opening of the rear lens. This rear combination has a negative focal length of 777mm., and has also strong chromatic and spherical aberration and gives a strongly curved image, but in the contrary sense to that of the first combination, that is, in the same sense as the faults of a simple negative lens. The compound objective is therefore composed of a non-compensated positive objective and of an over-compensated negative objective.

The descriptions of glass used are the same as given for the first construction.

The necessary elements for constructing this instrument with the same focal length of 240mm. and 76.25mm. opening are as follow:—

Front lens combination—

$$\begin{aligned} R &= + 72.24\text{mm.} \\ R_1 &= + 240.8\text{mm.} \end{aligned} \left\{ \begin{array}{l} \text{crown } d = 14.7\text{mm.} \\ \text{light flint } d_1 = 5.35\text{mm.} \end{array} \right.$$

$$\begin{aligned} R_2 &= - 535.1\text{mm.} \\ R_3 &= + 103.5\text{mm.} \\ R_4 &= + 96.5\text{mm.} \end{aligned} \left\{ \begin{array}{l} \text{light flint } d_2 = 5.35\text{mm.} \\ \text{crown } d_3 = 16.1\text{mm.} \end{array} \right.$$

$$\begin{aligned} R_5 &= - 144.9\text{mm.} \\ R_6 &= - 60.96\text{mm.} \end{aligned} \left\{ \begin{array}{l} \text{light flint } d_5 = 5.35\text{mm.} \\ \text{crown } d_6 = 13.9. \end{array} \right.$$

$$\begin{aligned} R_7 &= + 103.5\text{mm.} \\ R_8 &= + 96.5\text{mm.} \end{aligned} \left\{ \begin{array}{l} \text{crown } d_7 = 16.1\text{mm.} \\ \text{light flint } d_8 = 5.35\text{mm.} \end{array} \right.$$

Fig. 2 shows this construction partly in elevation and partly in section.

CART AND WHEEL-MAKING.—XII.

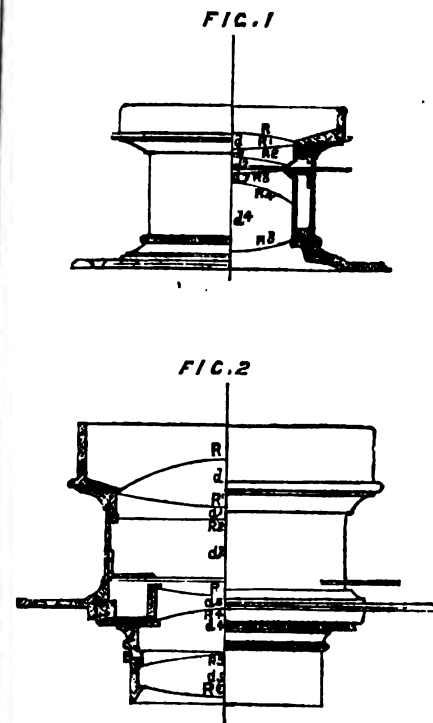
By J. C. KING.

(Continued from page 152.)

THE shape and size of body, and height of wheels may be, to a great extent, a matter of fancy with the cart-maker; but the shafts must be made suitable for the horse which is to be driven in the cart, and also suitable for the load which it is expected it will have to carry.

These essays being intended for those who may be disposed to make carts for their own use, as well as for the trade, it is necessary to state, as a fixed rule, the measures which should guide the maker in the ordering or selection of ready-made shafts, adapted for horses ranging from 11 or 12 hands high to 15 or 16 hands high.

To save long descriptions of many sizes of shafts, lengths, etc., for each different horse, the following compendious chart, invented by the writer and recognised by the trade as a guide for accurate proportions, will enable any-



simple positive lens. The second combination, which is at a slight distance from the first, consists of a bi-concave flint glass lens cemented to a bi-convex crown glass lens, and has a very long negative focal length, as also strong, spherical, and chromatic aberrations, but in the contrary sense to that of the other combination, the

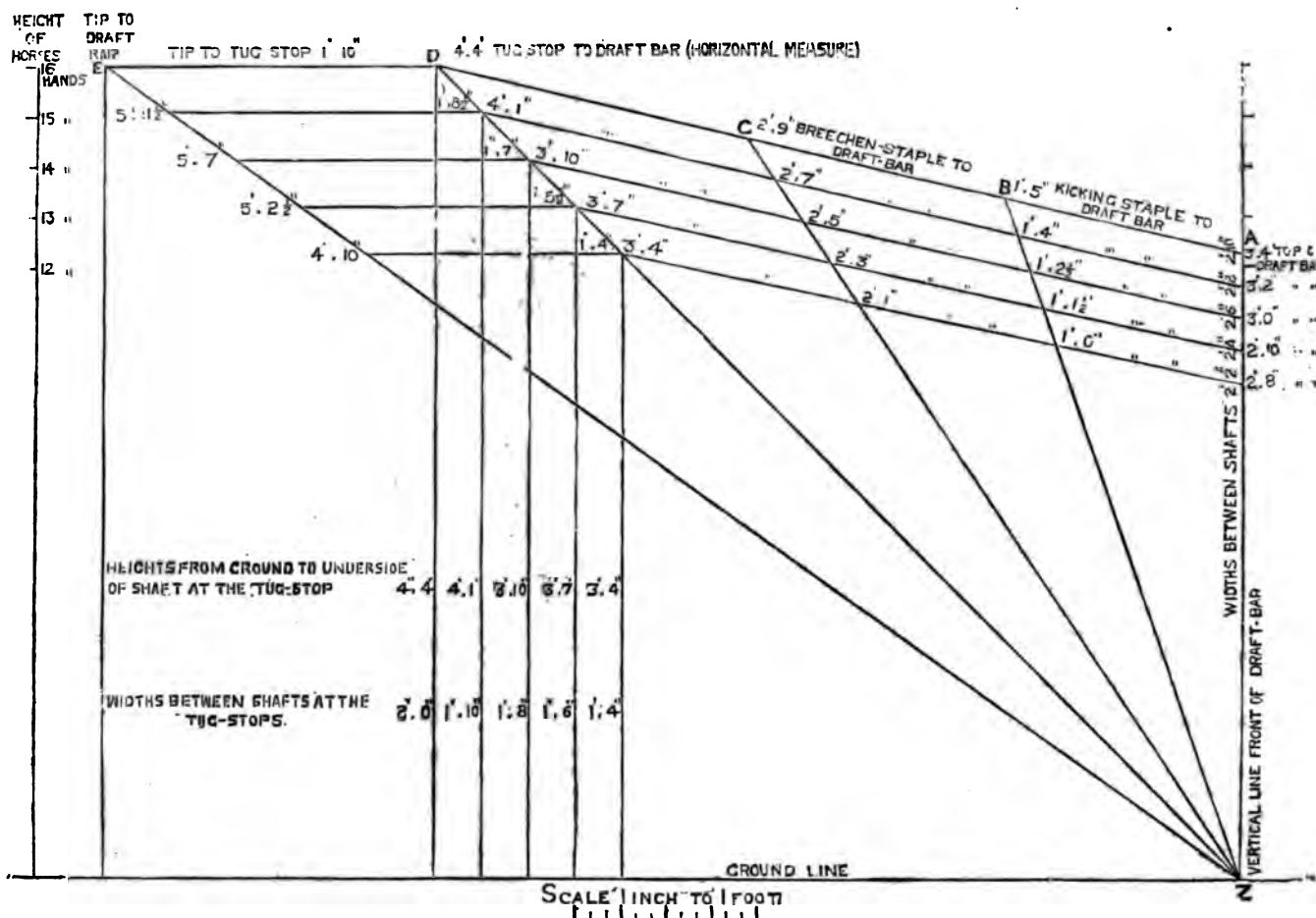


FIG. 22.

one to select or order shafts suitable for any sized horse—the added description of bent lancewood shafts serving to help the cart-maker to determine the requisite shape or alter when necessary. Besides the wheels of a cart, there are only the shafts and bars of wood-work, framed to support the body and connect the springs and axle to the wheels.

Any cart will carry riders and luggage, but any cart will not fit any horse, ranging in height from a 12-hand pony to a 16-hand horse, the difference in the respective lengths of the shafts being 1 foot 6 inches, and the difference of the widths at the middle of draft-bar framing being 8 inches; other intermediate measures and curves vary proportionately, as will be explained by the following technical description and illustration of shafts for a light cart, which are mostly of lance-wood or hickory, but lance-wood is by far the best.

Fig. 20 is a side elevation of a shaft with dotted lines, showing the fellow shaft upside

For shapes, called "rise" and "side-cant" are always measured from B to C, and 1 to 2 respectively of one shaft only, say 6 in. rise and 4 in. side-cant; all other curves and proportions may be left to the bender unless any special shape be required, when it may be relied upon to an eighth of an inch exactness.

When you receive your shafts from the bender you must expect them to measure more rise than then ordered; but when the struts and ties are taken off, the measure will be found right, or probably a little too much curve or rise from B to C; this may be taken out readily by bending the shafts forcibly to a reverse curve under a strong bench-cramp till you have sprung them to the right curve. They will retain that shape.

The technical names of the parts of the shaft are, "back-end" from A to B, "bar-part" at B, "belly" from B to C, "tug-part" at C, "point" from C to D, "tip" at D.

These technical terms will be found essential to know, in explaining any difficulties which may

the large end of the pole. The tapering point of the shaft is cut from the wider end, as this admits of the edgeway curves and turn-out of the point being sawn out of the wider part of pole, as shown by the curves, Fig. 21, 1 and 2.

The following is a brief description of the process adapted to bend lancewood shafts. Each shaft having been sawn out to the requisite side-cant and turn-out of point, is planed smooth and square, and is placed in a steam-pipe or chest, with as many others as it will hold, and thus exposed for two or three hours to a saturation of steam, which renders them pliant. They are taken out and laid on segmental templets of wood bolted down to the floor, powerful screws serving for cramps are used to screw down convex moulds to fit above the concave templets, with the shafts between them. Thus, several off-side or near-side shafts are bent at one operation. The requisite "side-cant" and "turn-out" of point is secured by wedging the shaft while in the moulds. If left thus moulded for one night, they will be fit for use next day; but it is quite necessary to brace them up to their shape if they have to stand aside till wanted.

These illustrations of shafts will show to a learner the many varying degrees of length, width, curves varying from straight to a segment of a circle—in some cases—each of which must be exact and proportional, to serve the purpose to fit the body, springs, axle, and at the same time fit the horse to be used in the cart.

It will save some columns of wearisome print and figures to put before the reader and the cart-making trade a chart, Fig. 22, which by a simple system of radiating lines shows every proportional measurement, as will be fully explained in our next.

(To be continued.)

THE PAMPHENGOS.

BY this name Mr. W. C. Hughes, optician, of Hoxton-street, Hoxton, introduces to public notice an improved apparatus for the exhibition of photographs on the screen as dis-

down on it, as they are packed after bending to shape; being cramped together at A and C, and held apart by struts at B and D.

Fig. 21 shows plan of one shaft, it having been sawn out to these curves, or but slightly bent in addition; the shafts need only struts or ties to maintain their shape in these curves, for they are made and packed together in pairs, unless a single shaft be ordered.

In ordering shafts, only four measures are necessary—width and thickness, say, 2½ in. by 1½ in.; giving always the maximum size of the shaft, the bender supplies the proportions; every other part of the shaft will be correctly made by the bender.

arise in dressing-up and framing the shafts and bars to suit the body and iron-work.

Formerly coachmakers bent their lancewood and ash shafts; now it is a special trade. A brief description of the process of bending will be useful for anyone desiring to bend timber, or alter or preserve the shape when once bent.

Lancewood—*Guatteria virgata*—is a West Indian tree, often called a cabbage-pole. When properly seasoned, the poles are sawn down the middle; these halves are thickened to the size of the shaft, flatways; the maximum thickness at the smallest end of the pole as far as the middle, and slightly less, about half an inch, at

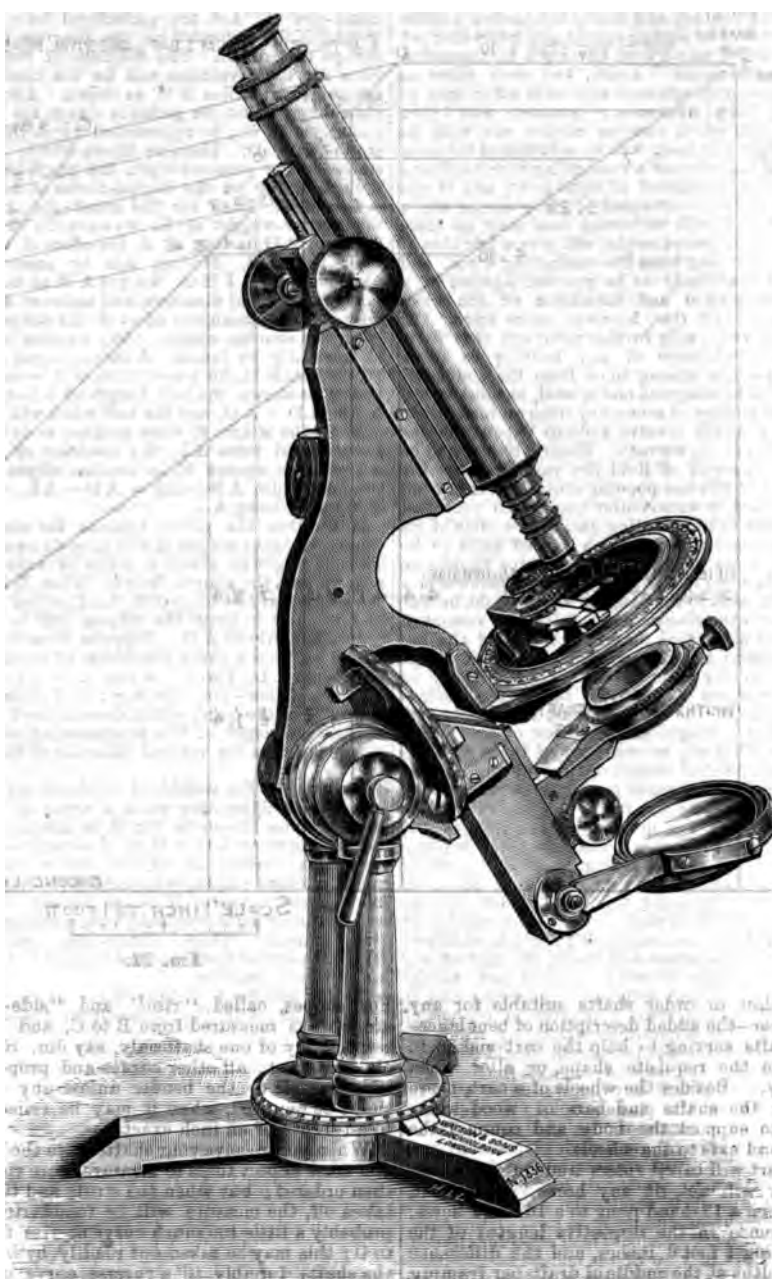
g views or otherwise. In designing this apparatus specially for photographs the question of necessary intensity of light has been considered and its difficulties overcome. It is well known that the vast field opened up by photography has been hitherto unavailable for oil lamps; but the ingenious combinations of four lamps in the one lamp (giving eight lineal inches in their totality) admirably provides light needed to overcome an unavoidable source of obstructive opacity, found in all photographed slides. This lamp is inclosed in a metallic cone, with apertures front and back for lighting and adjusting the flames. The glasses are in framed doors, and are easily inserted and withdrawn, these framed doors being hinged inside to fasten by a suitable clasp. The lenses themselves appear to have been the result of much investigation and experience, the lenses, as well as long and careful annealing, saving them against the risk of breakage so common to apparatus of this class. The whole is made, very compact and portable, and can be said to be the first of its order. The inventor invites to an exhibition on his own premises of the powers of the "Pamphengos," which produces a brilliant well-defined picture 1 ft. diameter on the screen.

In this particular season of the year such an apparatus can hardly fail to be an object of interest to those who are catering for the amusement of their families or friends.

CROSSLLEY'S NEW MICROSCOPE.

THIS new microscope is a practical endeavour to overcome certain drawbacks in connection with the application of the concentric ring tail-piece or lateral traversing substage.

In the principal stands provided with means of obtaining oblique illumination—Bullock's, Zentmayer's, Ross's, Tolles's, Bullock's, Beck's, etc.—every change in the oblique illumination necessitates a re-adjustment of the mirror, the lamp being attached to the tail-piece, as shown in our figure of Bullock's microscope in *ENGLISH MECHANIC*, Vol. XXXI., p. 567. In Bullock's substage (constructed in 1855, figured in the *Journal of the Royal Microscopical Society*, vol. iii. [1880], p. 1060), the radial movement of the substage is combined with a vertical movement of the mirror, by which the beam of light is constantly directed in the centre of the condenser, i.e., radially upon the object, which is very approximately the centre of substage motion in arc. This apparatus of Bullock's appears to us one of the best hitherto adapted to the microscope to provide oblique illumination, and we earnestly hope some enterprising optician will endeavour to develop its possibilities. In Mr. Crossley's new microscope the centre of the hollow trunnion-bar (the central axis on which the microscope is inclined) contains a right-angled prism, so fitted that the centre of the vertical long face is in the central plane of the object on the stage. The ring tail-piece is mounted on a disk to move freely on the front of the trunnion, and its lower end contains a right-angled prism set at right angles opposite the one in the trunnion, its face shown by the sloping end in our Fig. 1. At the lower end of the tail-piece another right-angled prism is applied with its long face, as shown in the Fig. (one of the faces of the right prism turned upwards, the other towards the object). The illuminating beam passes into the lower trunnion bar on to the total reflecting face of the prism; it is thence reflected on to the similar face of the upper prism in the tail-piece, and thence to the lower prism, again upon the mirror, whence it is directed to the object with or without the intervention of the substage-condenser. The beam of light thus rotates on a horizontal axis in the centre of the object, giving the whole range of obliquity in altitude by the mere lateral swing of the tail-piece. The system of illumination is wholly based on that commonly used with the instruments for the micrometer-wires. Application to the microscope is, however, novel, so far as we know; and we must attribute Mr. Crossley on the practical character in which he has appreciated a difficulty in the common forms of swinging tail-piece, and the ingenuity with which he has sought to apply a remedy. The general details of the construction of the stand do not here need definition, as we have repeatedly referred to the



main features of similar stands in the last four volumes of the *ENGLISH MECHANIC*. The stage was figured and described in Vol. XXXIII., p. 346. The new stand was made by Messrs. Watson, of Holborn, to Mr. Crossley's drawings. We must remark upon the defective system of fine adjustment adopted by Messrs. Watson, and also upon the flexure of the attachment of the stage. These defects we observed at the recent conversations of the Royal Microscopical Society.

ELECTRIC LIGHTING—ITS FIRE RISKS AND THEIR REMEDIES.*

By HENRY MORTON, Ph.D.

President of the Stevens Institute of Technology.

SOME very lamentable accidents have strongly directed public attention to the question of danger possibly accruing to life and property through the rapidly increasing employment of electricity as a source of light, and as the actual conditions of this danger, like the true properties of the agency from which it may arise, are but little known, a brief explanation of some simple facts related to this subject will be at this time seasonable and perhaps useful. I would propose, then, to treat this subject under two general heads, namely: 1st. The sources of danger; 2nd. The conditions of their prevention, or of security. The sources of danger in the use of the electric light are essentially two; from the conducting wires and from the electric lamps. As long as the electric fluid or electric energy, is conveyed by a sufficiently good

conductor it is perfectly harmless, resembling a river flowing in its natural channel, and powerless to rise above its banks; it is only when some easier channel into surrounding objects is offered or some partial obstruction of a certain character impedes its regular flow that trouble may arise. The conditions of these difficulties are, moreover, very peculiar. Thus, for example, if two electric conducting wires, forming the outgoing and returning paths of a powerful current, are placed near each other, but are separated by a bad conductor, as, for example, when both are tacked on to a board partition wall, the current will follow the wire from end to end, with no development of heat in the same, or tendency to leave the conductor or pass into any adjacent object. If, however, between the two conducting wires we introduce some imperfect conductor, such as a small wire, some metallic dust, or a film of water containing mineral matter in solution; then a portion of the current will be diverted into this "short-cut" from wire to wire and may heat the fine wire or the metallic dust or the wood wetted with aqueous solution, so as to cause the ignition of inflammable matter. Accidents of this nature have already occurred. Thus a telegraph or telephone wire having fallen across one or more of the conductors used for street lighting purposes has been fused, or, itself escaping, has caused the fusion of finer wires connected with it.

Again, two wires being the outgoing and return circuits of a powerful current, have been nailed side by side, without other insulation, on the same board of a floor, partition, or ceiling; and though used safely for a long time, while the woodwork was in its normal state, have developed a very dangerous activity when the wood between them was wet with dirty or impure water. In that case the water offers a circuit through which a cross

* From the *Sanitary Engineer*.

current is established which first heats the damp wood, then chars it, and finally establishes a series of minute arcs or electric sparks along this charred surface, which would soon develop a conflagration if left uncorrected. Again, two such wires as above, insecurely attached near each other, may be brought into momentary contact and then separated, in which case an electric arc, with its intense light and heat, will be established between them. In like manner a conducting wire itself may be insecurely connected at some point, and if the abutting ends are separated slightly during use, a similar "arc" with its intense heat may be there developed. These examples will give a fair idea of the danger arising from the conducting wires, and they are manifestly to be guarded against by a proper separation and insulation of the wires themselves. Of this, however, more anon. At present, I would only further point out that there is no risk whatever of any heating or other injurious action arising in or from the conductor itself when an adequate one is used, as must be the case from motives of economy; since an inadequate conductor would involve ruinous expense in the use of the electric current. Electricity is not to be regarded as a sort of fluid fire passing along the conductor; and some popular notions on this head are as absurd as were similar ones which prevailed in reference to illuminating gas, at the time of its first introduction, and which caused rules to be made in some places that no gaspiping should be allowed to come in contact with any wood-work.

Turning next to the dangers which might be expected from the electric lamp, it is to be remarked in the first place, that these in the case of the arc lights depend much upon the number of lamps operated on the same circuit. Thus if thirty or forty lamps are operated in series, the electro-motive force of the current must be sufficient to maintain a corresponding number of arcs; and, therefore, if by any means many of these arcs are closed out the electro-motive force of the current available for the remaining ones would be so excessive that their area might become excessively long, and even the metallic carbon holders and other parts of the lamps constitute poles between which the arc would spring, melting the metal work and establishing a very dangerous centre of combustion. To avoid this class of dangers two provisions should be made. In the first place some arrangement in the lamp itself by which, whenever the arc exceeds certain safe limits, the current will be automatically diverted from it and carried through a good and sufficient conductor; and, in the second place, some apparatus in connection with the electric generating machine by which the electro-motive force of its current should be varied automatically in correspondence with the resistance of the circuit, so that any diminution of such resistance, as by the closing out of several arcs, should cause a corresponding diminution in the force of the current generated. Numerous contrivances for both of these purposes have been already carried to greater or less perfection and efficiency, and it is manifestly possible by such means to secure immunity from risks of this sort.

The securing of adequate insulation for the conducting wires in view of the endless ramifications of telegraphic and telephonic systems, to say nothing of the other conductors found in all buildings is a problem of no small difficulty. One important general principle would seem to be the equal insulation of the return as well as of the outgoing wires, as well as of the machines, and the avoidance of all ground connection for any part of the circuit. Another general rule would be the separation of outgoing and return wires as far as possible from each other; and yet another, the continuous insulation of conductors leaving no vulnerable places even where danger would not directly result from accidental contact.

Fully to discuss all the details of this subject would be impossible within the proper limits of such a note as the present, and I will therefore only say in conclusion that, with well matured plans and skilful and intelligent provision, all these dangers may be provided against and electric lighting may be made as safe as that obtained by gas or by candles; but without such care and judgment the use of electricity on the grand scale either for lighting or for transmission of power, would involve serious additions to the risks which accompany so many of the conveniences which constitute a large factor of our modern civilisation.

COUNTERBALANCING ENGINES AND OTHER MACHINERY HAVING RECIPROCATING PARTS.—II.*

By Professor S. W. ROBINSON.

(Concluded from page 250).

Counterbalancing of Reciprocating Parts.

NOW let us consider counterbalancing the weight C, by a revolving piece, the connecting-rod still being neglected. Suppose a counter-

* From the American Machinist.

weight at K Fig. 8, diametrically opposite the crank-pin B. Let the centrifugal force of the weight K be indicated on the diagram by A G, always towards K. The diagram of centrifugal force for the revolution will be the circle to the centre A, and radius A G, as shown. Also in the same diagram, let the pressure due to the reciprocating piston, &c., be represented by A D, for the crank-pin at D. Then, as shown above, B F will stand for the pressure upon the pin when at B, though acting on the engine-frame at A. Make A I = B F. Then for the crank-pin at B, and the counter-weight at K, we have the two forces A I and A G, acting at A, the effect of which is their resultant. Finding this by means of the parallelogram A I H G, we get A H as the force, in magnitude and direction, and active at A, which represents the combined effect of the reciprocating parts and counter-weight. Any number of points H can easily be found. A curve, traced through all the points H, for a revolution will be an ellipse H J Q, as shown, the half length of which will be A J = A D - A G, and the half width will be A G.

But if the weight K were greater, so as to cause a centrifugal force A L, the resultant of A L and A I will give a point M, in another ellipse M N P, the half width A N being = A D - A L; and the half length being A L.

Now, when the piston remains the same, each counter-balance weight K will have its own ellipse. Thus, K might be given a series of values from zero up, and the ellipses drawn. When K is small, the ellipses will be longest in the direction of A D; and when it is large the ellipses will be longest perpendicularly to A D. Between these limits the ellipse becomes a circle, the radius of which is half the radius A D, Fig. 9. When K = 0, the ellipse becomes a line—viz., the horizontal diameter of the circle of the crank orbit, shown. But when K equals the weight of the reciprocating parts, the ellipse becomes the vertical diameter of the circle, Fig. 9.

By varying the weight of K, from zero up to equal the reciprocating parts, a series of ellipses, such as those shown in Fig. 9, is obtained. It is interesting to note that if K is negative—that is, acts with, instead of against, the reciprocating parts, we have ellipses overreaching the crank circle horizontally. Again, if K is greater than the reciprocating parts, vertically overreaching ellipses are obtained. These ellipses are indicated in Fig. 9, in dotted lines, and are probably of little or no service in practice.

If the resultant jerking force be represented by a line like A H, Fig. 8, it will revolve around A

when the ellipse is wholly within the circle, as the full line ellipses, Figs. 8 and 9, we notice the extraordinary peculiarity that the resultant force A H, Fig. 8, revolves around A in the opposite direction to that of the crank. Hence the shake, when K = half the reciprocating parts, is the same as though everything were removed from the crank, and a weight = half that of the reciprocating parts were centred upon the crank pin, and the crank set to revolving backwards.

As regards the intensity of shake generally, it is due to the resultant A H, acting at A, revolving backwards, and varying in length according to the proper ellipse. This shake is evidently a minimum when the ellipse becomes the circle, half as large as the crank circle, because the greatest value of the resultant for a revolution is here the least.

From these facts, it appears to be impossible to perfectly counterbalance a reciprocating piece by a single rotating piece.

Next suppose there are two pistons, &c., of equal weight, actuated by one crank pin, the pistons reciprocating in lines A D and A E, Fig. 8, passing through the crank-shaft, and at right angles to each other. Then B F is the pressure upon the crank-pin for one, and B I the pressure for the other; both, of course, active at A. Then the line of the crank A B is their resultant in magnitude, direction, and point of application, and it is constant for the entire revolution. It is evident, since the centrifugal force due to a certain weight K is constant, that a weight K may be so chosen that its centrifugal force shall just equal the resultant A B, and we have a perfect balance. When the radius A K equals A B, the weight of the counter-balance K must equal that of one piston, piston-rod, and cross-head, connecting-rod neglected, and in the inverse proportion for other radial distances.

So far, the weight of the connecting-rod has been excluded, and the force upon the crank-pin, due to the reciprocating parts, has been simply in a line parallel to the reciprocation; the obliquity of the connecting-rod having been neglected also.

The Connecting-Rod.

This case is peculiar, because one end swings or rotates around with the crank-pin, while the other slides or reciprocates with the cross-head. The forces made active upon the crank-pin will therefore be here due to both reciprocation and rotation. It is evident at once that the resultant action upon the crank-pin for different points in the revolution will be variable, the greatest intensity being in the line of reciprocation of cross-head. The least intensity will be nearly in a line at right-angles to this, and, though least for a revolution, it will still be considerable, and too great to neglect.

Also, there will be lateral forces made active upon the cross-head pin, sufficient in high-speed engines to throw the cross-head askant across the backlash in its slides.

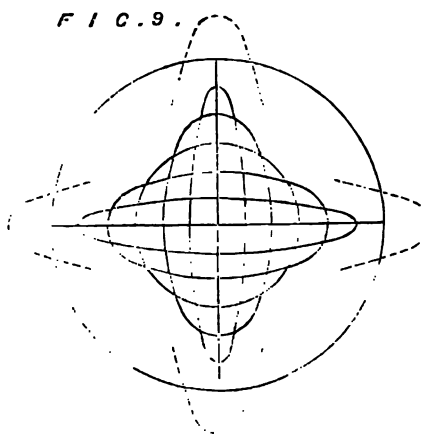
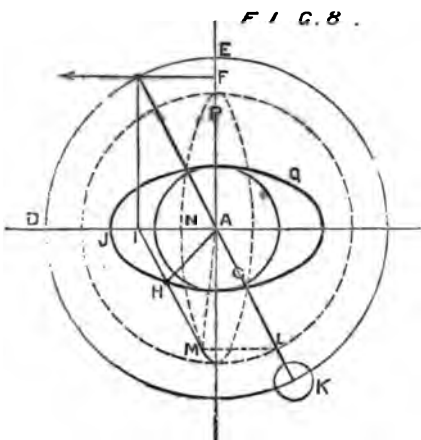
We therefore have three forces to consider, viz.: 1st, longitudinal, or in direction of reciprocation of cross-head; 2nd, lateral, both upon the crank-pin; and 3rd, lateral upon the cross-head pin. The intensity of these two last forces depends upon the construction or form of connecting-rod. The first two forces may be considered as components of a resultant force.

The first force is evidently the same as if the mass of the connecting-rod were all concentrated at C, Fig. 7; and the same rules and principles applied to the reciprocating force C, apply here. That is, at D, the force against the crank-pin is equal to the centrifugal force of the mass of the connecting-rod, if hung by its centre of gravity upon the crank-pin; and it varies as the cosine of the crank-angle, &c.

The second or lateral component of force upon crank-pin can only be found by a somewhat extended investigation, such as finding the lateral acceleration of every element of the connecting-rod, and referring the effect of all to the crank-pin. It will take us too far from the present object to stop for this now. The resulting formulas were given in the original paper, and results of calculation from them will be given now. Fig. 10 will serve us well as a help in explaining these results of calculation.

A pitman of very awkward proportions was taken for the basis of calculation; it being prismatic, overhanging at both ends, and having a weight upon it which could be shifted to any part of the rod. This weight is represented in Fig. 10 as overhanging the crank-pin B, to a distance x . Making x negative, places the weight to the left of B. The crank-shaft is at A, and the cross-head pin at C, sliding in the horizontal line A C. At K is a counter-balance weight, which for our present convenience may always be supposed to have its centre of gravity at a point directly opposite to the crank-pin, and at a distance from A equal to the crank radius A B.

The part B C corresponds to the ordinary pitman or connecting-rod. This pitman overhangs to a distance a beyond the crank-pin, and to a distance b beyond the cross-head pin, as shown.



in the same direction as does the crank for the case of any dotted over-reaching ellipse, Fig. 9. But

and stroke of cylinder of an engine, and for a given weight of W of a heavy pitman, together with that of the reciprocating parts C , the lateral jerking components AQ at A (Fig. 12), or the equal and opposite ones F_2 at C (Fig. 10), increase with the weight C ; also, that the counterbalance weight K increases with C , from which it appears that the engine will be subject to much less jerking action when C is made as light as possible, and the weight put into the triangular pitman W . Hence, in practice, the crosshead, piston, and rod should be designed first, and reduced to the minimum in weight. Then the pitman is to receive the whole additional mass necessarily added to gain the desired weight of "heavy reciprocating parts."

As a more definite example, take an engine of 14×24 in. cyl., 150 rev. per min., steam at 80 lb. apparent, and $W + C = 720 + 100 = 820$ lb. = K = counterbalance weight. Then $a/l = 444$, $AQ = -F_2 = 168$ lb.

Or, again, interchange the weights, so that $W + C = 100 + 720$, to see the effect of the more usual proportions. Then $a/l = 2.22$, $AQ = -F_2 = 1212$ lb.

In this example the engine will be nearly eight times as unsteady in position as in that of heavy pitman; also the pitman is made to overhang an inconvenient distance in the last example of over twice the pitman length proper.

If we cut off the overhang of pitman in the last example, it will nearly agree with proportions adopted in present practice. Then, if the circle of Fig. 8 be adopted, $K = \text{about } 1\frac{1}{2}(W + C) = \text{about } 400$ lb.; and the jerking action at crank-bearing, in all directions, will be about 1,600 lb., nearly tenfold greater unsteadiness than in the example of heavy triangular pitman. The radius of the center of gravity of K is supposed = crank radius.

Again, if the engine has no counter balance K , the longitudinal jerking force will reach the comparatively enormous figure of 3,280 lb.

The example of heavy pitman seems so important

Fig. 13: better because a tendency to rock is far less objectionable than a displacing force.

In the above investigation of a heavy pitman, the triangular form was chosen for convenience and simplicity of form. In practice, however, it might be modified somewhat for the sake of comeliness.

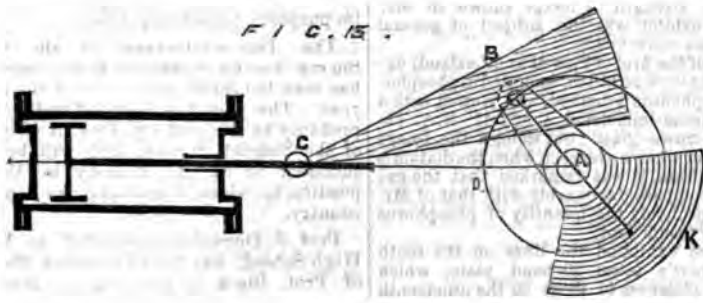
Outside Conditions affecting the Counterbalance.

I come now to consider very important conditions affecting the counterbalance weight, and which exist outside of the machine itself. To illustrate: suppose a vertical engine is to stand on a brick pier, built up through a basement story of a factory. This pier will probably be made small as allowable, to economise room in the basement.

Now this engine should be perfectly free from jerks in the horizontal, as these would shake the pier and destroy it. But vertical jerks of a very considerable intensity will act in direct line with the pier, and be powerless to disturb it, unless of intensity sufficient to lift the whole engine.

From these considerations it appears that as the lateral jerking affects F_1 and F_2 , notably F_1 should be zero at the expense of the longitudinal. That is, the ellipse in Fig. 8, should be reduced to a straight line running lengthwise the engine, or vertical.

Again, suppose the engine stands on a floor at same distance from wall and pier supports. The floor will easily spring vertically and vibrate; but horizontally it is stoutly stayed by the walls all round, so that the whole building must vibrate to and fro if the floor shakes any, as it evidently would not appreciably in its own plane. Under these conditions the same vertical engine should be counterbalanced in an entirely different manner, the longitudinal shake being made zero at the expense of the lateral. That is, the ellipse in Fig. 8 should be reduced to a line running crosswise the engine's center-line, so that the jerks will all come in the plane of the



that Fig. 13 is given to better illustrate it. The pitman is to be very wide at the crank end, and to overhang the crank-pin a distance = 444, and the counter-weight K is to = 820 lb., the pitman = 720 lb., and the crosshead, piston and rod, 100 lb., as mentioned in the example. In this engine the jerking effect in the direction of AQ is zero. The lateral jerks at A are 168 lb. up when the crank-pin is up, and down when the crank-pin is down. At the same time the jerks at C are 168 lb. up when that at A is down, and down when that at A is up. Under these conditions, if the engine were suspended free, it would have a slight tilting motion about the centre of gravity of the whole engine, the angle of this tilt being about a third of a degree of arc. Under these conditions, the centre of gravity of the engine remains absolutely fixed. A rocking effect of this sort is evidently less effective in disturbing the engine than a displacing force, as one tends to rock the engine, and the other to move it bodily.

But Fig. 13 is awkward and uncouth in the extreme, according to modern notions of what constitutes good engine design; too much so to be adopted with a relish, notwithstanding its great advantages.

It has been stated that the steam-pressure upon the piston, and its reaction upon the cylinder head, contributes nothing towards vibration of engine in any way; because equal and opposite, and in a direct central line. But the pressure of the crosshead upon the guides, being at its maximum at mid-stroke, and in the same direction for both forward and back stroke, will give cause for a tilting or rocking motion in the design of Fig. 13, and with a periodic time half as long as that due to the dynamic force concerned in the heavy pitman of Fig. 13. The extent of this will be about twice that above named, or about two-thirds of a degree of arc. But this is common to all forms of engine. But as regards the dynamic action of reciprocating parts, towards shaking the engine and destroying its foundation the advantage of Fig. 13, as compared with the ordinary construction, is better than as 168 to 3280, or better than 1 to 20, in favour of

floor. The problems already worked out above indicate how, not only to reduce the disturbing forces to a line in either the horizontal or vertical direction, but how also to make the length of that line the shortest possible.

What has been said of engines is also true of jigsaws, mortising-machines, and the like.

USEFUL AND SCIENTIFIC NOTES.

M. MAICHE has found by experiment that sounds from two separate sources can be sent and received simultaneously on one wire. He uses at the receiving station two telephones of different resistances, and at the transmitting station caused a musical box to be set going on a microphone of small resistance, whilst an induction telephone transmitter was spoken into at the same time. The musical sounds were reproduced in the telephone which had the least resistance, and the vocal sounds in the other, so that with the two telephones to the ears the music could be heard by one ear and the speech by the other.

THE coldest place on the earth is Verkovansk, in Siberia, lying in $67\frac{1}{2}$ N. lat. on the river Yana. The lowest mean winter temperature is 48.6 deg. below zero Centigrade. This, then, is the cold pole of the earth in Asia; the corresponding pole in America being to the north-west of the Parry Islands; and the line joining these two places does not pass through the North Pole itself, which is thus, in all probability, outside the line of greatest cold. It is noteworthy that Verkovansk, like Yakutsk, is on the main-land, a considerable distance from the Siberian coast, which possesses a comparatively milder climate.

A LITTLE glycerine added to gum or glue is a great improvement, as it prevents either becoming brittle. It also prevents gummed labels from having a tendency to curl up when being written on.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE second meeting after the long vacation was held at the Society's rooms, Burlington House, on the evening of Friday, Dec. the 9th, Mr. E. Dunkin, vice-president, in the chair.

After the usual business of reading the minutes and announcing the presents received, Mr. Rand Capron, Mr. Downing, and Mr. Lecky were appointed auditors of the society's accounts, which will be presented at the February meeting.

Mr. John McCance, of Rayner's-road, Putney-hill, was balloted for and duly elected a Fellow of the Society.

Mr. Common was called upon to read a paper on "Silvering Large Mirrors." He said that the chief difficulty in silvering large mirrors was due to their weight and the difficulty of handling them and turning them face downwards into the silvering solution. His own mirror was 37 in. in diameter and $4\frac{1}{4}$ in. thick, and weighed over 400 pounds. It was difficult to handle such a heavy mass of glass, and turn it over without doing some damage with the tackling and pulleys that were necessary to move it. The plan which he had adopted was to make use of a large sucker to hold the mirror. The atmospheric pressure was partly removed, and the sucker could then be attached to pulleys, and carried the mirror along with it. The sucker consisted of a shallow cylindrical iron box, which rested upon an india-rubber ring at the back of the mirror. The atmospheric pressure was removed by means of an air-pump, and a mercury gauge attached to the box showed the amount of exhaustion. He found that a difference of four inches of mercury between the atmospheric pressure and the pressure within the box was amply sufficient to lift the weight of the mirror. For silvering solution he made use of glucose and water and nitrate of silver, and got a very good film in about forty minutes, so that if the flat became dewed while he was observing, he had no hesitation in removing the film, and could resilver it and have it back in its place within the hour.

Mr. Waters asked Mr. Common whether he found his mirror work as well after being resilvered as it did the first time he used it.

Mr. Common said: When the mirror was first silvered in the autumn of 1879, I devoted it principally to observations of the satellites of Mars. They are not good test objects to give an idea of what a mirror will do, but I think that I have a better film with this process than I had before. I observed Saturn last year, and during 1879, and got a few observations of Mimas when near to the end of the ring. And on the first of this month I turned the instrument on Mars, and saw Deimos pretty plainly.

Mr. Stone read a paper on a new form of transit circle, with a prismatic object-glass. He said: I propose to make use of a prism instead of the crown glass lens for the object-glass. The light will enter one face of the prism, and after suffering total internal reflection at another face, will pass out of the back or third face of the prism, which must be ground with a concave surface; attached to it there will be a flint-glass convex lens, so as to form with the prism an achromatic object-glass in which the rays enter in one direction, and after reflection at right angles are brought to a focus. I have calculated the curves necessary, to bring three rays of the spectrum, C , D , and F , to a common focus at a distance of 100 in., and find that the curves for such an object-glass would not be inconveniently deep, and that there would be but little spherical aberration. The axis of the instrument would be placed horizontally east and west. The observer would consequently remain always in one position, and by merely turning the instrument round its axis, would be able to observe stars at any altitude. It is obvious that there would be many conveniences about such a plan, and that an observer would be able to observe more stars north of the zenith than with the present form of instrument.

Mr. Marth produced a copy of the *Astronomische Nachrichten*, and stated that a similar idea had occurred to Steinheil, who had had, he believed, a small instrument of 3 in. or 4 in. aperture constructed.

Mr. Christie, the new Astronomer Royal, said that there was one objection to such a form of object-glass, namely, the absorption due to the long course of the ray through glass. In making experiments with regard to a large spectroscopic, he had found that the light was about halved in passing through a thickness of three inches of glass.

Mr. Marth said: There would no doubt be great difficulties in making use of such a prism with a large telescope. The size of the prism would increase very inconveniently for large apertures. Mr. Stone's chief object seems to be to get rid of the difficulties of flexure. In 1862 I published a method by which the flexure of transit instru-

ments could be very accurately determined. I was not able at the time to get the instrument necessary for measuring the amount of the flexure, constructed, and I had to content myself with making the suggestions public; but I am glad to say that Messrs. Cook and Sons, of York, have now constructed such an instrument, and I find that M. Loewy, of the Paris observatory, has recently been working very much on the same lines. I hope that Mr. Wigglesworth, of the firm of Messrs. Cook and Sons, will shortly bring the instrument they have made and exhibit it to the Society.

Mr. Stone said the making of such a prism will be rather an expensive experiment, and it is not worth trying unless there is a fair chance of success. I don't think the loss of light will be as great as Mr. Marth and Mr. Christie seem to think. It must be remembered that the internal reflection is a total reflection, so that will cause no loss of light.

Mr. Common said about two years ago, when Mr. Christie made a remark about the loss of light with large prisms, I tried the effect of making use of internal total reflection at the surface of a large prism of clear glass made by Hilger, instead of a flat, for my large reflector, and I counted the number of faint stars that I could see in a certain area. I then took off the prism and substituted an ordinary silver-on-glass reflector and noticed that I could see several more stars. I then took off the silver flat and went back again to the glass prism, and found that there were several stars that I had discovered with the flat, which I was not able even to see when using the prism.

Mr. Ranyard: It is evident that, with a prism there is a certain aperture, beyond which no advantage will be gained—for example, if a thickness of 3 in. of glass only allows a quarter of the light to pass through, a thickness of 6 in. will only allow a quarter of a quarter of the light to pass through, so that a prism of 6 in. aperture, which should give four times as much light as one of 3 in. aperture if there were no absorption, will only be as effective as one of 3 in. aperture when the absorption is taken into account.

Mr. Stone read a paper entitled "On Some Systematic Errors in the Determination of the Semi-Diameter of the Moon, from the Greenwich Observations, 1750, 1840." He said that Messrs. Campbell and Neison had some time ago read a paper before the Society on the parallactic inequality, in which they insisted on a term of 46 years period in the expression for the moon's longitude. He had again very carefully gone over the observations on which they relied, and had come to the conclusion that the variation was due to systematic errors in the determination of the moon's semi-diameter.

Mr. Neison said: He had also very carefully gone over his work again, but was unable to find any error. He was glad to say that Prof. Newcomb was likely to come to their assistance, as he understood that he was about to undertake a similar investigation. The matter is a mere question of arithmetic, and we shall then see with whom Prof. Newcomb agrees.

Mr. Penrose read, and explained on the black-board, a paper on a method of finding the elements of the orbit of a comet by a graphic process.

The Chairman announced that a letter had been received by the Council from Dr. A. H. Murray, the editor of the dictionary of the Philological Society, asking for information with respect to the introduction of the word *perihelion*. Dr. Murray says: Can you help me to ascertain, for the new English dictionary of the Philological Society, who first introduced the terms *aphelion* and *perihelion*? I find Hobbs used *perihelium* (in Latin) in 1642. Perhaps a reference to some astronomical works would settle the question. I should be glad to know if they were used by Copernicus, Kepler, Tycho Brahe, or any of the earlier astronomers. I should be greatly obliged if you would ask the question at one of your meetings; we want to make the dictionary as complete as possible in its biography of every word.

Mr. Christie said that Mr. Wesley had taken some trouble to look up the early use of the words, and had found that Kepler, in his "Prodromus," uses the words *perihelia* and *aphelia*, as well as the words *perige* and *apoge*. Kepler also in his "Epitomes Astronomice Copernicanae" speaks of the words *apogee* and *perige* as used for *aphelion* and *perihelion* in the old astronomy. Probably the words *apogee* and *perige* date from a much earlier period than Kepler's time. Grant, in his "History of Astronomy," says that Hipparchus deduced the eccentricity of the solar orbit and also the place of the apogee. Mr. Wesley has therefore searched for the words *apogee* and *perige* in "Aratus" (De Phaenomena), in which work fragments of Hipparchus are preserved, but he has not been able to find the words.

The following papers were also announced and partly read:—W. F. Denning, "On observations of Venus in the spring of 1881. Radiant points

of shooting-stars observed at Bristol in the years 1878 and 1879." W. E. Plummer, "On the motion of the companion of Sirius." Prof. C. Pritchard, "Note on the variable star D. M. + 1° No. 3408." A. Marth, "On the conjunctions of the satellites of Uranus with each other, which may be observable from February to June, 1882." A. A. Common, "On observations of Mimas, 1881"; and W. F. Denning, "Note on the discovery of Comet 1881, c (Schubert)." The meeting adjourned at 10 o'clock.

ROYAL MICROSCOPICAL SOCIETY.

THE first *conversazione* of the Session of the above Society was held at King's College, Strand, on Wednesday, 7th inst., when a large gathering took place of the Fellows and others specially invited. Many objects of interest to microscopists were exhibited. As illustrating the more recent advance in microscopy, we may particularise the exhibit of J. W. Stephenson (Vice-President) of the well-known test-object, the *Sarirella gemma*, mounted in a solution of phosphorus in bisulphide of carbon. Some time ago Mr. Stephenson pointed out the fact that the visibility of minute diaphanous structure is, to a great extent, dependent on the difference of refractive index between the substance of the object and that of the medium in which it is placed. So far as it has been possible to verify this matter by experiment, it has been abundantly confirmed. For example: Taking the index of diatomaceous silex to be 1.38, and the index of air as 1.0, it follows that the index of visibility is .38; in balsam of 1.52 the visibility would be .14; in water of 1.33, .05 only. Dr. Dippel has suggested mounting diatoms in monobromide of naphthalene of index 1.6, with which the visibility would be upwards of .22. Experimenting with various media of still higher index, Mr. Stephenson has used a solution of phosphorus in bisulphide of carbon, which he estimates to have an index of 3.0; the visibility of silex mounted in that medium would, therefore, be 1.62. The very extraordinary strength of image shown in Mr. Stephenson's exhibit was the subject of general comment at the *conversazione*.

T. Powell (of the firm of Powell and Lealand) exhibited *Amphipleura pellucida*, mounted in phosphorus by Mr. Stephenson's method, and viewed with a new homogeneous-immersion lens of 1.47 N.A. (= nearly 152° in crown-glass); but though the image was far stronger than is ever seen when the diatom is mounted in balsam, it was remarked that the exhibit did not compare favourably with that of Mr. Stephenson—probably the quantity of phosphorus employed was insufficient.

E. M. Nelson exhibited the lines on the tenth band of Nobert's latest 20-band plate, which correspond in closeness to those on the nineteenth band of the 19-band plate, *i.e.*, 112,000 to the English inch. The objective was Powell and Lealand's 1.12th of 1.47 N.A. (= 140° in crown-glass), and the illumination was by means of the vertical illuminator of the same opticians.

Crossley's new microscope was shown in action by Messrs. Watson, of Holborn. The object exhibited was a fine frustule, of *P. angulatum*; viewed with mirror illumination, in the axis "dotted" structure was seen, and by the simple lateral motion of the swinging tail-piece and the rotation of the stage, the whole range of effects of oblique illumination could be observed.

Messrs. Beck exhibited a new 1.6th, which they issue at a very moderate price; but our reporter was unable to inspect the exhibit in consequence of the crowd gathered round it.

The President (Professor Martin Duncan, F.R.S.), treasurer (Lionel Beale, F.R.S.), secretaries (C. Stewart and F. Crisp), and many Fellows of the Society exhibited novelties in objects or apparatus. We learn that Messrs. Rees were unable to complete in time for the meeting the latest model of Wenham's new microscope, which was to have been exhibited by Dr. John Anthony.

SURREY SCIENTIFIC SOCIETY.

AS was announced in the ENGLISH MECHANIC of December the 9th, the Surrey Scientific and Literary Debating Society held its first ordinary meeting on Friday last. The broad principle of slavery was discussed with great spirit for fully an hour and a half, and afterwards the following programme for the next three meetings was announced:—8 p.m., December the 23rd, "Water"; 8 p.m., January the 6th, "Capital Punishment"; 8 p.m., January the 20th, "The Existence of the Luminiferous Ether." In each case a paper will be read on the appointed subject, and will be followed by a discussion. The first paper will be read by Mr. MacEvoy, the second by Mr. L. F. Mahony, M.D., and the 3rd by Mr. Molony. Any readers of the ENGLISH MECHANIC who wish to attend these meetings must apply to Mr. John Weale, hon. sec., 75, The Grove, Clapham-common, S.W.

LIVERPOOL ASSOCIATION OF SCIENCE AND ART.

THE tenth general meeting of this Association was held in the Lecture Hall of the Free Library, William Brown-street, on Thursday evening, 1st December. After tea and coffee had been served in the ante-room, Mr. Councillor Leigh-Gregson took the chair, and briefly explained the objects of the Association. Other business of a formal character having been transacted, Mr. W. H. Davies (who is well known to readers of the MECHANIC) delivered a thoroughly exhaustive lecture on "The Surface of the Moon," illustrating his remarks with lunar photographs exhibited by means of the lantern. At the close of the lecture a hearty vote of thanks was passed to Mr. Davies.

SCIENTIFIC NEWS.

FROM the *Science Observer* circular No. 20, we find that the elements of the new comet, discovered by Swift on Nov. 16, which we gave on p. 277 from the Dun Echt circular, differ in one or two places, possibly from some error in translating the telegram. The longitude perihelion should be 38° 11'; longitude node, 205° 45'; inclination, 134° 46'; log. perihelion distance, 0.14958. On p. 277, "184°" is a printer's error. Prof. Winnecke has observed the comet at Strasburg, and gives as the Ephemeris for Nov. 26, 6h. 3.5m. Strasburg M.T., R.A. 25m. 25.44s.; N. Dec. 62° 35' 21". The Dun Echt circular gives the R.A. as 5m., while the *Science Observer* circular print it 4m. 56s. There are several other small differences in the figures, which suggest that the telegram sent was not identical with the printed slip received from America. A comparison of the two circulars shows that the code answers its purposes remarkably well.

The Director-General of the Geological Survey having completed forty years' service, has been knighted, and retires at the end of the year. The post has been offered to, and will probably be accepted by, Prof. A. Geikie, chief of the Scottish Survey, who will be a worthy successor to Sir A. Ramsay in the highest position to which a geologist can aspire in this country.

Prof. J. Donaldson, rector of the Edinburgh High School, has been appointed the successor of Prof. Black in the chair of Humanity at Aberdeen University.

Prof. McKendrick has been appointed Fulmerian Professor of Physiology at the Royal Institution.

Meteorological observations, at an altitude of about a mile and a half, are to be made at the Paris Observatory by means of a captive balloon.

M. Tissandier is about to pursue his experiments with the electric directing balloon, and has established a private company for the purpose.

A "new use for electricity" is to stupefy bees, so that they may be safely handled. According to the *Times*, two connecting wires are attached to a honeycomb, and the bees are rendered inactive for about 30 minutes, while no bad results follow their "awakening." The Germans are credited with this application of electricity to the hiving of bees.

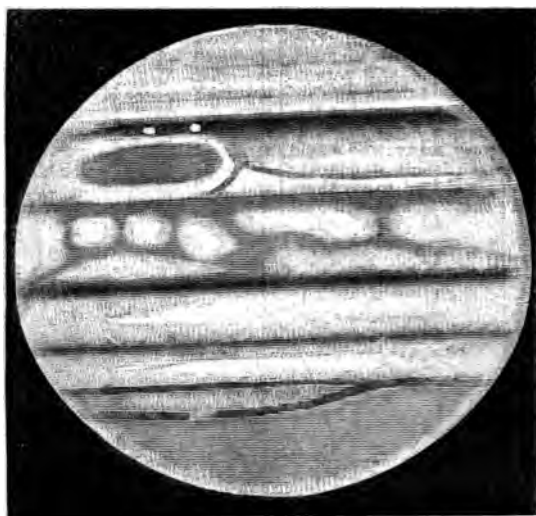
Some trials of De Cordova's fog-signal code were made recently on the Thames. The signals are made by means of three tones from ordinary whistles, which are numbered one, two, three, and which give a sufficient number of changes to answer all the usual requirements of signalling at sea. The system has been tried on some of the Cunard vessels and other large steamers.

The opposition in Germany to the Thomas-Gilchrist patents for making steel has been again defeated in the Berlin courts. The number of licenses now in force in Europe is 45. At Messrs. Bolckow, Vaughan, and Co.'s Works considerably more than 2,000 tons of Cleveland iron are every week run direct from the furnace in the shape of steel.

At a recent meeting of the Society of Telegraph Engineers, Mr. Stroh said that it was difficult to get suitable steel for magnets in this country, whereas French steel was well

spots on the dark belt immediately S. of the red spot; the *f.* spot of these was very bright and round, like a satellite. This dark belt was sharply defined on its S. edge, but seemed to gradually shade off on the N. side, leaving a light border to the red spot, which was bounded on the N.E. by a delicate copper-coloured streak, which, branching out from the principal dark belt, curved round the *f.* end of the red spot for some distance, and then turned suddenly to the west, and could be traced as a fine thread-like marking to the planet's

α Persei, γ and ϵ Cassiopeie, ϵ Orionis, β Aurigæ, ψ Ursa Majoris, α Cephei, Deneb, Altair, and β Tauri. These are stars to which I refer in estimating magnitudes. I would like to have estimations (other than those I possess) with which to compare my own. Also, if he would inform me—or say where I could get the information—as to the proper way of ascertaining the atmospheric absorption at varying altitudes. I hope that complying with my requests will not encroach too much on Prof. Pickering's valuable time. I ven-



limb. Two very distinct dark belts were seen in the S. polar region, and two in the N. (the most N. of these had a break in it, and joined its S. neighbour near the W. limb). Last evening the features just described were again observed, but less favourably, as the definition was not so good as it was on the 28th ultimo, when the steadiness of the air and the excellent qualities of the Calver mirror permitted far more detail to be seen than it was possible to represent satisfactorily in a drawing. Thos. G. Elger.

Bedford, December 6th.

JUPITER—MERSENIUS.

[19513.]—REFERRING to the great red spot on Jupiter, your correspondent, "M. A.," let. 19459, asks, "Whether other observers have remarked that the red spot is much fainter than it was." Perhaps the following extract from my notebook, under date Nov. 28th, may interest him:—"For several weeks past, I have noticed an apparent falling off in the colour and density of Jupiter's great red spot. It still assumes a red or fiery appearance, but seems, in some mysterious manner, shorn of a portion of its former brightness. Possibly this apparent faintness is an optical illusion, or merely due to atmospheric disturbances; but to whatever cause or causes attributable, it is (to me) too conspicuous to pass without remark."

The above, taken in conjunction with let. 19459, is certainly curious, and (if no diminution in the brightness and density of the red spot has actually taken place) the coincidence is somewhat remarkable.

Will Mr. Webb, Mr. Birt, or any of your numerous selenographical correspondents, kindly inform me whether any interior formation has been observed within a small crater on the south-eastern wall of Mersenius?

The following is from my notebook:—

Dec. 2nd.—Time 11.10 p.m. to 12.15 a.m.; aper., 34in.; powers, 80 and 122.

Examined Gassendi and surrounding region. Several minute objects—apparently hillocks—detected on floor of crater. . . . Small crater visible on south-eastern wall of Mersenius—with minute interior object—cone-shaped, and very clearly defined.

Remarks.—Definition fair.

* Well seen with both 80 and 122.

As no mention of the above is made in "Celestial Objects," or in any works on the moon in my possession—including several good maps—it may possibly have escaped previous detection.

Aconite.

VARIABLE STARS.

[19514.]—I THANK Prof. Pickering (19430) for his extreme courtesy. As the subject of variable stars is one in which I take the deepest interest, I would feel greatly indebted to Prof. Pickering if he would state his estimates of Vega, Capella,

to make them, because of the courtesy he has already shown me.

Professor Pickering remarks that the difference in the order of the stars at different dates is probably due to atmospheric causes alone. In regard to this I may say, that many of the sequences recorded in letter 19249 were not noted until the star had been looked at carefully half a dozen times (the interval between the separate observations being often more than one hour). If the results disagreed, I either made no entry, or marked the entry as doubtful; no result so marked was placed in the table published. I have no doubt, however, that weakness in my eyes causing me to see Mizar and Alcor as one, has made me think a little brighter than it really is; at the same time, I have no doubt, as far as my *new* observations are concerned, that it has increased (for I am not aware of variability having been alleged in regard to Alcor). Flammarion's results (as given by "F.R.A.S." in letter 19271) differ curiously from Professor Pickering's; I am pretty sure that no such large variation took place in the brightness of these stars in the course of last year, and can only conjecture that Flammarion's estimates are based on standards differing from those employed by Professor Pickering, or else they are uncorrected for absorption.

Mr. Espin's plan (19436) for estimating magnitudes seems good. Concerning my remark as to the filling up of gaps in a broken series of observations from the parts corresponding in another series: of course, if the two were placed sequentially and used as though a distinct whole, a great mistake would be made; we should be treating as identical two things of which the bases were most probably dissimilar. If, however, both series had been made upon a definite plan, and with definite standards (and I meant such alone), it would be surely possible to reduce them to a common system.

Mr. Espin's remarks about η Ursa Majoris confirm the conjectures I put forward in letter 19249 (paragraph G). It is certain that η and ϵ have alternated in brightness more than once. Such alternations imply a much greater degree of variability than Mr. Espin seems inclined to admit. In the table of variable stars in the "Outlines" of Sir J. Herschel, the periods of η and ϵ are given as "long"; the discoverer of their variability is there stated to have been Lalande. Argelander says:—" ϵ is certainly variable; though usually brighter than α , I have five times in three years seen it decidedly fainter than α ." He adds:—"I also regard β Ursa Majoris as variable." As regards ϵ and β , it is worth while pointing out that Yarrall assigns to each the magnitude 4. I suppose the magnitudes were estimated at the time the observations of position were made, and that, consequently, the dates 1865 and 1868 in the "Mean-year" column give the periods for which the magnitudes are true. If these entries be not misprints or mistakes, the entirely different appearance presented by the tail of the Bear through the waning of the middle stars, and the practical

disappearance of one of his Pointers, must be within the recollection of some. My own conjectures are: That each one of the stars is variable; that of each the period is long, and, probably, variable; and that each displays many small alterations of brightness—such as those found by Mr. Espin in the case of η . I hope that Mr. Espin will make his observations upon η known; and that when he communicates the list of magnitudes he promises, he will include estimation of the stars in Ursa Major.

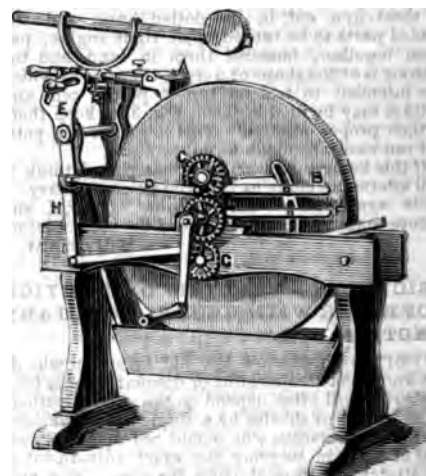
Mr. Read's letter (19410), the replies thereto, and Mr. Mills's communication (19458) suggest one thought—that it would be well for observers to render an exact account of the sensitiveness of their eyes to colours of different kinds. It is quite possible that Mr. Mills's eyes may not be specially sensitive toned. At all events, it is rash to say that the entries referred to are *necessarily* exaggerated. Eyes differ as much in sensitiveness as in hue; difficulty in distinguishing tints and colour-blindness are not identical.

May I ask Mr. Chambers why Dubhe and ϵ Ursa Minoris do not appear in his list of red stars? As regards the paragraph respecting the former in your "Scientific News" of this week, I have often suspected that the colour of these stars changes, but never thought the changes periodic. On Dec. 10th it seemed unusually red. Respecting β Ursa Minoris, Argelander says:—"I have repeatedly had an opportunity of convincing myself that it is not always equally reddish: it is sometimes more or less yellow, and sometimes very decidedly red."

Would "W. C. E." please say how he explains the phenomena observed during the passage of the Earth through the tail of the comet of 1861? Glasgow. S. Maitland Baird Gommill.

WATSON'S PATENT TOOL-GRINDER.

[19515.]—THIS illustration shows the apparatus fixed to an ordinary grindstone. A slotted standard is fixed by two bolts to the end of the frame in an inclined position, and carries a shaft, upon each end of which are keyed the carriers H. The carriers have vertical slots in their upper ends, and the one on the side of the stone where the gear-wheels are has a prolonged arm with stud at the lower end for connecting rod. A second shaft passes through the centre of these carriers, upon the ends of which are keyed brackets E, having curved or eccentric slots, and one of them a prolonged arm with stud for connecting rod D. The brackets are keyed to shaft with their eccentric slots in opposite direction. Through these slots and through the vertical slots of carriers



a loose shaft is passed, upon which are keyed the tool-holder A and an adjustable weighted lever. The tool-holder is free to move across the stone, which may be done by hand or otherwise. The gear-wheels are for giving to-and-fro motions to the carriers H and the brackets E. They are free to move partially round the centre wheel, towards or from the apparatus. This motion is given by the levers B and F, and is for the purpose of adjusting the tool in a transverse and longitudinal direction.

The method of using the apparatus is as follows:—The tool (not shown in the photo.) is fixed in the holder by an adjustable nip lever, and brought to bear upon the stone by the weighted lever, the amount of pressure being regulated by bringing the lever forward over the stone. The tool is adjusted as the grinding proceeds, square or askew by raising or lowering the lever B, and a more or less acute edge is obtained by raising or lowering the lever F. If the tool requires to be ground with a curved edge (e.g., an axe or edge), the gear-wheel C is put into gear which gives

point connection with the main line, easily be managed."

From beginning to end contains a which are a perfect disgrace to the he unfortunate signalman who made ake in consequence of the officials not onable care" to provide him with protection, now awaits his trial upon manslaughter, whilst those who are able escape scot-free. I ask, is this

should be remembered that had the tem and the signal and point-levers ally interlocked, as so very strongly y by the Inspecting Officers of the de, the signalman could not possibly ie mistake. In my opinion, a great been done, and at the Assizes I trust be acquitted.

Clement E. Stretton.
rg-street, Leicester, Dec. 9th.

IDENT AT RED HILL AND NTINUOUS BRAKES.

It will be remembered that upon the the Brighton Company's 4.35 p.m. in from Eastbourne came into collision with part of a South-Eastern goods ; upon the main line without any tail

ger-train was running at about ten to an hour, and the driver had no notice il he saw the light of his own head l back from the train in front; he at he Westinghouse brake, and the reus "that the train stopped dead as engine struck the trucks, and no ever was caused to any of the vehicles ger train." The value of an efficient about a train is here most clearly hat would have been a serious accident of a safe brake rendered perfectly

use of the accident is that the South-pany have not provided proper sidings, luding remark of Colonel Yolland attention of the public, who, he a no idea of the unnecessary risks to are subjected, because the railway not thought proper to provide accom- d thus causes practices to be neces- ed which are objectionable and

of Trade are not authorised to require iding accommodation should be pro- s station, or to forbid that such a ode of working should continue to be his remark of Colonel Yolland's will y the true facts of the case before the at is the use of inspecting officers rs unless the means of obtaining , which they recommend, are adopted ? anies continue to take but little trouble that which is necessary for the public may rest assured that Parliament will e to pass compulsory legislation to do that which they ought to do for cerests.

Clement E. Stretton.

DYNAMO-MACHINES.

I MAY state, with reference to my own t I have made a few hasty experiments h I will give below. It was intended ternal resistance; 0.03ohm in field- l 0.007ohm in armature. I have tried facing," or depositing a thin layer of the surface of a copper printing-plate, ts work excellently, in about a quarter aniel battery would require, perhaps have also tried it at depositing copper ed wax surface, which it did to the . per square foot per 24 hours, and the xcellent quality. I dare say I shall ore to say about it after a little while, been in regular work.

can hardly be wondered at if inventors want to make hay, &c. They must a number of trials, and the results of such magnitude, and so important to at it is only reasonable they should get nation. If a dynamo is capable of er amount of work for less money than ither to employed, it is hardly fair to calculate how many per cent. the e profit. The inventor is, above all, I ed to a share of the profits.

th "Hybernian Celt" in his assumpt- ators will be forthcoming with suffi- ge, skill, and perseverance. I firmly time cannot be far off when dynamos be as common as sewing-machines; ne, should like to see "ours" as the whose columns most knowledge would -knowledge that would make these achines better known, both theoretic-

cally and practically. *Engineering* has con- tained a series of articles on electric light, with description of dynamos, which I should have much preferred to see in "ours."

But I think amateurs can only expect such information as they can glean from professional papers and occasional scientific papers on the subject. And there is already so much information in the shape of drawings and accounts of lengths and thickness of wire as would enable any amateur to start an experimental machine, especially as the same ironwork would permit different sizes of wire to be put on.

Anglo-Dane.

PURE ZINC-DYNAMO MACHINES.

[19523.]—THE only way in which pure zinc could be obtained by electrolysis would be using an alkali solution, a platinum anode, and force enough to throw down the zinc at one pole and release gas at the other. The metal would then probably be spongy. When "Quæstor," 19501, p. 329, says "books on electrolysis forget to tell you these little things," he forgets that it would be wholly impossible for any writer to meet beforehand all the manifold requirements of every reader. All that can be done is to give sound information as to general principles, and leave minor details to the intelligence of the reader. In my book, for instance, I said nothing about zinc deposition, because it is really a matter of no practical moment. But the principles I give, p. 309, as to depositing alloys, do furnish exactly the information required. Pure zinc could not be obtained from a solution containing any other metal except the earth and alkali metals, nor from a zinc anode if the solution contains any iron capable of uniting with its alien ingredients. Together, these principles practically shut out everything except a pure solution and platinum anode.

As to "Quæstor's" final inquiry whether I can give any wrinkles about dynamos, I fear it will be some time yet before information such as is desired will be forthcoming. Electricians are slowly acquiring knowledge, but it is very difficult to obtain. The theory is not yet constructed. As things are, the practical machines have been arrived at purely by tentative processes. Each maker works out his own and modifies it to suit his own purposes. There has been little definite comparison, and makers need not seek it, because each is pretty well occupied and cares very little for anything but his own operations. Real experiments must needs be very costly, and probably but imperfect after all, if not misleading, for two or more machines can only be compared fairly if they have all been definitely constructed for the same aim.

It is a very serious task to work out a design for a dynamo machine, and to do so for all sorts of purposes and applicants would be impossible. My own opinion (and I speak with some knowledge) is that it is waste of time and money for anyone to attempt to make such a thing himself. The conditions are very different from ordinary electric apparatus, and the bells and telephones to which "Hybernian Celt" refers disparagingly. These are within reasonable ambition. Aid can be fairly asked and safely looked for. But to make a dynamo would mean an enormous amount of work under very unfavourable circumstances where perfect engineering appliances are absent, and the aid required by anyone who wants to start work without a considerable knowledge is such as no one can reasonably expect, unless in the usual way of business. For instance, can it be supposed I should spend three or four days working out a design, for nothing except the probability that "Quæstor" would spend, say, twenty pounds to result in an abortion. The thing cannot be done till someone makes up the heavy parts for sale as parts of steam-engines are, and furnishes plans, and this is not likely to be done while all the essentials are subjects of current patents.

As far as I am concerned, I shall do what I can as soon as I can, and hope it will be soon. I have been overtaxed with one thing and another, and, worst of all, with weak health, and thus have not been able to keep up my old style of work. But soon it must be resumed, because my book is out of print, and as two thousand copies have been taken up without advertisement, I think it is to be assumed that the public have approved of my work, and ought to be provided with a second edition. In that I shall, as in my first, endeavour to give the most advanced knowledge; but it will be a heavy task to include the vast expansion of the application of electricity which has occurred in the last five years, and, in fact, the subject of dynamo-machines would call for a volume in itself if fully treated.

I should suggest to intending makers to confine themselves to the Gramme ring between permanent magnets. As to talking about machines to work twenty or thirty Swan lamps, it is absurd. The machine, badly made, would cost twice as much as one could be bought for.

Sigma.

THE LEYDEN JAR FOR MEDICAL PURPOSES.

[19524.]—IN p. 197 there is an account of the use of the Leyden jar in medical cases, and Dr. Morton, of New York, is mentioned as the discoverer of it. In one sense this may be so, but I used the jar many years ago in something of the same way. In olden times it used to be one way of giving shocks by galvanism to draw our conductor along a file. What improvements have been made since then! Well, I thought I would try if something of the same kind could not be done with a jar and the common machine. I had a very good one—one turn of the handle would charge a 4oz. phial, so I arranged one so that it could be charged and discharged as fast as I could turn, and the shock sent through any part of the body. If it was wanted not to feel the shock, I introduced a glass tube filled with water, and a wire going through a cork at each end. The further off the wires were from one another, the less was the shock felt. By the mere current from the conductor, I could magnetise, or the contrary, a needle.

Edwd. Thos. Scott.

SNAILS.

[19525.]—A good many of the readers of the "E.M." are fond of the microscope, and the tongues of the small water-snails are well worth observing, forming as they all do, in a variety of shapes, a kind of rasp, with which the vegetation on the sides of aquarium, for instance, is easily taken off. My object is simply to draw the attention to the curious and beautiful sight of a snail eating. It is easily seen on the sides of an aquarium by means of a lens 2 or 3 in. focus.

Edwd. Thos. Scott.

IMPROVING GASLIGHT-CARBON SUBSTITUTE.

[19526.]—PASS ordinary gas through some chloro-chromic acid, and burn with a porcelain burner; this will produce a perfectly white light, of wonderful power. Any further information I shall be most happy to give.

I find that coke mixed with sulphur—just enough sulphur to make it into a firm rod, and baked—makes an excellent substitute for carbon. The proportions are two parts coke to one part sulphur. I have a battery made that has been working eight months, and is now quite strong.

Albert Smith.

THE BERLINER VIOLIN.

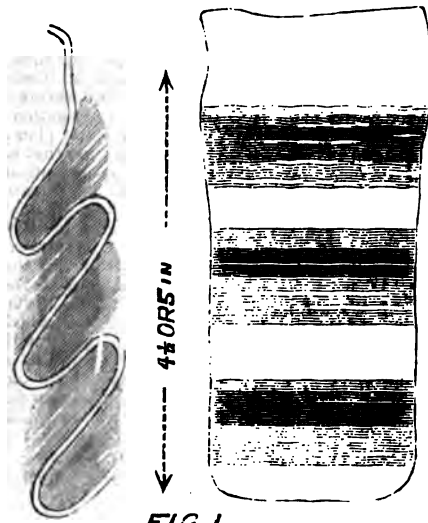
[19527.]—WITH all deference to so great an authority as our valued contributor, "Fiddler," I must say that I cannot agree with him in some of the remarks he makes (in letter 19467) on the above violin. He appears to imagine that a great downward pressure of the bridge on the belly of the violin is necessary for the production of a full tone. That this is by no means the case I have proved by experiment. He moreover says that an iron neck would hardly stand the strain of the pressure necessary to keep the bridge as compact to the belly as it should be. This is theory. Now for facts. I have an old fiddle of Danish build, which (up to a week ago) was not worth the nail it hung on. I saw the letter by "Essar," and I took down that fiddle, and straightway ripped up the finger-board, made another (from a piece of well-seasoned mahogany), after Berliner's pattern, fixed it on, strung up, and drew the bow across the strings. Result: a miserably weak but very pure tone; it was like a violin with a mute on. Then I took a piece of pear-tree, 1-16 in. in thickness, and made another bridge. I cut as much away as I dared in the way of ornamental holes, stuck it in, and tried again. To say that I was surprised at the result would be but feebly to express my feelings. I was astounded: the tone was so rich and full. I have now, to insure perfect contact between bridge and belly, glued them together. (with, I think, a slight improvement in the tone of the E string). I can hardly follow "Fiddler" in some of his remarks; notably, when he says that the neck would be only hinged to soundboard, and that the lift of the bridge would raise the neck. Can it be that he is in the same fix with "Manchester" (query 45138), i.e., foggy about "Essar's" description? I hope my little bit of experience will be of some use to some of "ours."

Gloworm.

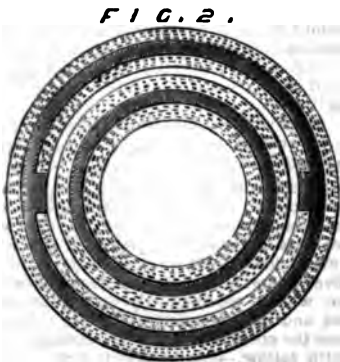
THE DE MERITENS SECONDARY BATTERY—THE FAURE BATTERY—THE GRAMME MOTOR—ELECTRO-DYNAMIC CO.'S MOTOR.

[19528.]—A WISH has been expressed in these columns for an account of M. De Meritens' secondary battery. While at the late Electrical Exhibition at Paris, I not only examined it and witnessed several experiments, but had the privi-

lege of bearing an account of it from the lips of the inventor. Each cell or couple consists of a box about 4in. by 5in. by 6in. deep, containing sulphuric acid diluted to one-tenth, and in this are the two lead plates. These are made of a strip of lead about 2in. broad and 9in. or 10in. long when straight, and about 3-32in. thick (5 or 6lb.), folded as in sketch. In each fold is a bundle of thin lead-plates or leaves. I regret that I did not make a note of their thickness, but I think they were about one-quarter that of common tea-lead. I do

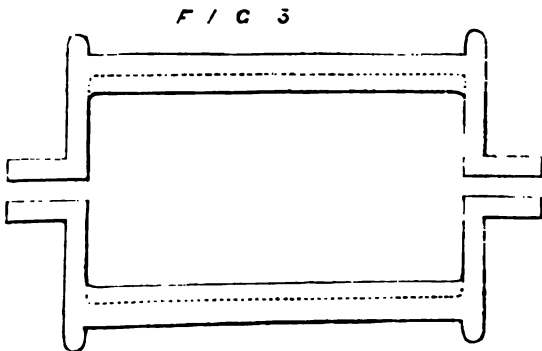


not remember the decimal of a millimetre, and only saw the rough edges of the bundles. These leaves lie close to each other, with no red lead or other substance between. The side edges of the whole are seared with a hot iron, and the ends of the thick plate form the poles. No felt or flannel



is used; the plates merely hang opposite each other in the dilute acid. M. de Meritens relies on large surface and low resistance; 44 couples gave a current which I saw measured as 64 Webers.

I asked the representative of Faure's "accumulator" if his lead dissolved at all, and was told that it did not; but on asking why thinner plates were not used, the reply was that they would waste away in use. Faure's plates are 9in. square, each box contains six or eight plates, and weighs 50lb. Charged



for eight hours with a 12 Weber current, it gives 30 Webers for four hours. Twenty-eight elements charged for four hours light one Swan lamp for four hours = 15 Bunsens. It seems that if one has to drive a dynamo

steam or gas, and then carry the Faure batteries to any distance, losing 2 or 3 per cent. (compound interest) per day, and then bring them back, one might as well use Bunsen's or Grove's at about the same expense and trouble. I forget Faure's price, but it is monstrous.

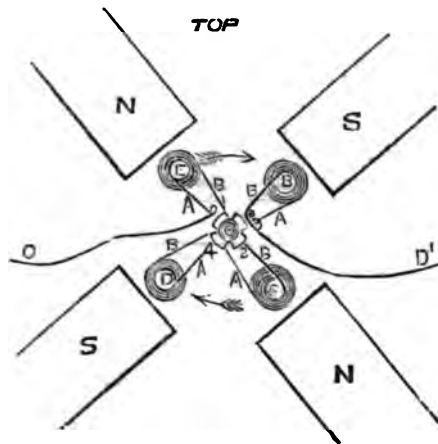
Gramme exhibited a very neat motor. It consists of an ordinary Gramme ring, about 4in. long by 3in. in diameter, revolving in a cylindrical electro-magnet, wound parallel to the axis, like a Gramme ring, but having two poles, whose faces are flush with the wire. The coil is wound with 22 B.W.G., and the magnet with 19. The motors of the Electro-dynamic Co. have been described, but I inclose a sketch. The magnets are wound with 20 B.W.G. four layers, the Siemens armature is wound with about 24 B.W.G. Fig. 3 shows a section of the casting through the poles of the magnets, the dotted lines showing the thickness of the shell elsewhere. Fig. 4 is a transverse section of the whole, full size, or nearly so. An ordinary commutator is mounted on the spindle. This will drive a light sewing-machine with four Bunsens.

It appears that in both these motors the field magnets are rather too small for the armature. I have not sketched the Gramme commutator, as it would be hopeless for anyone to attempt to make it who does not thoroughly understand the ordinary Gramme. A. Trotter.

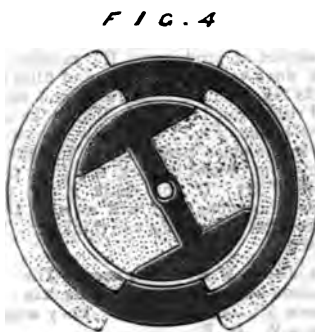
REPLIES TO QUERIES.

*. In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[44818].—Dynamo-Electric Machine.—The apparatus required for practical purposes, I should recommend: Take four powerful horse-shoe magnets, firmly fix to a wooden frame; C is an axle driven at the rate of 800 to 900 turns per minute; the axle carries two brass circles, upon which, at right angles, are fixed four round bars of



pure, soft iron, B, C, D, E, equal in length to the distance asunder of the poles of each magnet; Upon each of these is coiled insulated copper wire; the ends of these wires are connected with four semicircular pieces of brass tubing, fixed upon the axle C, but insulated from it, and from each other



them; to collect those currents and convey them to the lamp, you must connect 1 and 2 strips of brass together, and 3 and 4 together, taking care the connections do not touch each other; then you must connect each wire A from each armature to the connections of the strips of brass 1 and 2; and the B ends connect in like manner with 3 and 4 strips of brass, and you must lay two springs, C and D' to press on 1 brass strip, and the other on 3 brass strips. The armatures must revolve as closely as possible to the ends of the magnets without touching them, in order to obtain greater power.—RICHARD PEARSON, 58, Melton-street, Middlesbrough.

[45110].—Gelatin Films.—These, in their improved form, are no more trouble than gelatin on glass, the results are in all respects equal to other photographs on glass. An ordinary sidecan easily be altered to carry films which require to be held round, but with more margin or bearing than plates for the 1/4in. size, 3-16in. hold or clip, for 1-in. size, a 1/4in. "New wine is, however, better put into new bottles." A camera which is made specially for the films, weighing no more than an ordinary camera, will carry and expose from one to one hundred films without other apparatus. I shall be glad to send you full particulars regarding the working of the films, and the 100-fold repeating camera.—A. PUMPHREY.

[45177].—Fret-saw Machines.—There are plenty of them in back numbers; but get No. 695, p. 470; No. 821, p. 557; No. 574, p. 31; No. 530, p. 258; No. 542, p. 567. Get the lot if you can, as they are full of other useful information, and I think you will find something to suit. I cannot go back further than Vol. XXI., and the last two references above are in that volume.—T. K. L.

[45178].—Ochilled Extremities.—Defective circulation, and as you say you are "subject" to the annoyance, evidently constitutional. May possibly be ameliorated by exercise, and carefully clothing the parts. Camphorated oil is good for chilblains, but if you can remedy the circulatory weakness you will prevent them.—TEMPERATE.

[45179].—Corns.—What does "Chiropo" mean by the "morbid secreting action of the skin after a corn has been extracted"? Corns are formed by the simple process of dead skin accumulating through the mechanical pressure of the boot and the heedlessness of the wearer. If the pressure is removed, corns will of themselves wear off in the ordinary washing and rubbing, and they may be very quickly removed by the simple expedient of shielding them from pressure and cutting away the dead skin. There are no corns on the top of the foot, because there is no irritating pressure, and the skin is just as capable of producing "morbid secretions" there as elsewhere. The use of the term "extract" leads to the surmise that the querist imagines corns have roots.—NUN. DOB.

[45189].—Constant Flow of Liquid from a Cistern.—This can only be managed by fitting the outlet with a cone plug, so connected to a lever and float that as the depth of water decreases, the outlet is enlarged by the gradual withdrawal of the cone plug.—NUN. DOB.

[45191].—Moulding.—I have waited to see if any one could give a better suggestion than mine; but as the query appears to be going to the U.Q., I venture to suggest that "Arques" would find brown and light yellow paper boiled to a pulp would answer; or perhaps cuttings of leather, especially "skins" as distinguished from hides, and what I believe is termed "basil." The mould must be waxed. How would what is called "bois durci" do? That is a pulp of sawdust and cellulose, but I believe it is forced into the mould by very heavy pressure. Plaster of Paris will not do for a mould for iron, though it answers well for lead; it is not quite clear why, but founders say it is no use trying it.—NUN. DOB.

[45195].—Portable Turkish Bath.—The simplest form of (so-called) Turkish bath can be made with a small lamp, a chair, and a blanket. You light the lamp, put it under the chair (not a cane-seated one), and cover yourself completely, except the head, with a blanket which reaches the floor. A cold sponge bath and a brisk rub down with rough towel completes the operation.—T.P.

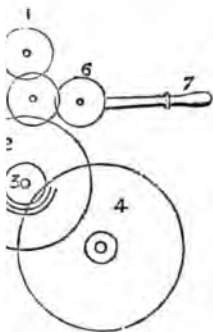
[45209].—Ostrich-Feather Dyeing.—The aniline dyes give good results with feathers of all kinds.—T.P.

[45230].—Rusted or Corroded Steel Ornaments.—"D. P." can clean his ornaments by well greasing the rusted parts, and then scraping the rust off; then get them up with flour-emery, and oil, using a brush driven by steam power if possible. If not, a hard fettling brush will do, and finish with lime or crocus, using a softer brush. I should advise "D. P." to have his steel ornaments nickel-plated, as they look just like steel, and never tarnish or rust, and have a brilliant appearance. When you have anything soldered with spirits of salt, scour them in strong washing soda and hot water, as it is very disagreeable if ever it comes in contact with the skin.—B. R., Sheffield.

inding Cutlery.—Razors are with a gritstone 3in. diameter and running in water to prevent ark. A 4in. emery wheel would be, and probably not broad enough e razor.—B. R., Sheffield.

or Sharpener.—I once had a e same kind. It did very well of the knife or razor was pretty acted as a burnisher.—EDWD.

ie.—You do not say what you for taking a return cut when owing arrangement will suit you, somewhat dangerous game; but I e reversed by somewhat similar racturing of the wheels:—1. is the

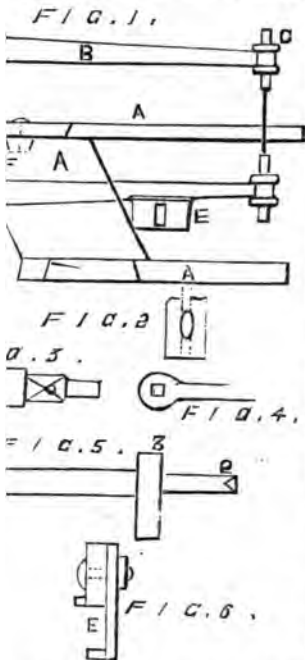


1. wheel and pinion; 4. Leading take a quadrant of a boiler-plate or two shifting studs to carry five intermediate wheels—a pair of 40 I o—the quadrant to radiate from stud, to be lifted by the handle 7; engaged with 1 and 2 by pushing 5 is disengaged with No. 1, and 6, and the motion reversed; the pt in position by a pin through the leadstock. This arrangement will but not for screw-cutting.—JACK

n Buckets.—If you advertise your "Address Column" of this journal the name and address of a firm who &c., necessary for the manufacture. I could not give you practical regards galvanizing, but the pro- s possible as follows:—The articles a bath of acid until cleaned of all hed, afterwards dried in an oven, through a bath of molten zinc, on h is a thick layer of sal-ammoniac.

toxicide of Nitrogen.—I would at" to buy his gas already prepared taining 50 or 100 gallons) from any it cannot well be made on a small t DENTIST.

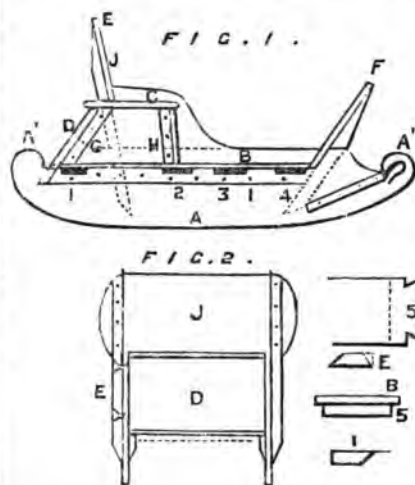
st-Saw.—The sketch will give you



is the framework of wood; B, should not have it less than 18in.

long, made out of a piece of coach-hooping, 1 1/2in. wide, full 1/2in. thick, and tapered to C to 1/2in.; D is a gudgeon, see Fig. 3, 1/2in. iron, turned down to 1/2in. each end for journal, then turned down and squared to 1/2in. This is put through a square hole at D, and a pin driven in at the other side; wood bearings will do, or one half let into the table, and two wood caps. Upon the lower limb of saw-frame is a piece of sheet-iron 1/2in. thick, E, and end view of arm and that is shown in section at Fig. 6; this is guide-bars for the eccentric to work in to vibrate the frame. Fig. 5 is a piece of iron, or preferable steel, 1, the other end is turned down for eccentric to be turned and keyed on 3; the eccentric 4, the mandril, turned for centre for turning the same, and is useful for driving by, and may be turned or cranked again to pass through hole in the driving-plate of lathe, so that all that appliance is fixed and at hand any moment, and no part can be lost without the lot. Fig. 4 is end of saw-frame, with a square hole 1/2in. The holder for saw, Fig. 2, 5-16in., iron wire screwed and squared to fit hole, adjusted by two thin nuts, the ends of same to be drilled up about 1/2in. with a full 16th hole, and a hole through the side larger, for a taper-pin to be put through to jamb end of saw, see Fig. 2, the eccentric to be about 1/2in. throw. The mandril is passed through the slot in E, and driven between the centres, the eccentric working between the bars E, Fig. 6; the frame, of course, to be fastened upon the lathe-bed.—JACK OF ALL TRADES.

[45381.]—**Sledge.**—The following sketch will perhaps suit "G. M. S." It may be built of mahogany, oak, pine, spruce, or ash, but I should prefer elm, rock elm or birch; the runners 7ft. 6in. long, 1 1/2in. deep by 1/2in. thick. A, A', A'. Space between 2ft. 6in. from A' to A', to be shod with half-round iron, 1/2in., put on with 1 1/2 No. 9 or 10 wood screws, and in fact I should screw for the whole. B is the floor 7in. from the bottom, supported on the fillet I; G and H, fillets to support riser and seat; E, fillet to stiffen runner sideboard and back; F, the same for footboard or apron; D, Dickey, or receptacle at back reaching under the seat for storage of luggage; C, the seat, 9in. wide, sideboard 1 1/2in. from the top of runner, rising 2in. at side for cushion; 1, 2, 3, 4 are stretchers 2ft. 6in. long by 1/2in. thick, the ends to be shipped into a



dove-tail, and let into the fillet to carry floor, leaving a 1/2in. mortice over the top in the same hole, to pass portions of flooring—the same tenons being driven in tight will keep the dove-tails in their place, and will make the affair very rigid; the other portion can be screwed to the fillets E', showing the section of E below the seat and upon runners; 5, section of stretchers; B', mortice, the bottom half dove-tailed; I', section of fillet for floor; all fillets 2in. by 1in., chamfered one edge; the seat will rise about 14in. high, the hooks at end A' for trace-hooks. Fig. 2 back view, the stretchers to be put in the place here shown, to take the weight from front of seat to back A', 18in. from apron to front A' 2ft. If you chalk it out upon floor to these dimensions, you will be able to judge, and make what alterations you think fit.—JACK OF ALL TRADES.

[45390.]—**N.E. Engines.**—The engines in question have cylinders 17in. by 22in., and coupled wheels 5ft. 6in. diameter. They weigh about 40 tons.—W. B. P.

[45391.]—**Boiler Composition.**—I tried soda for a long time, but it gave me a deal of trouble with the brass fittings on boilers. A friend, who had used Stigzelius antipetren for some time, advised me to try it, which I did, and have used it ever since (four years). It has given me no trouble, and can use the boilers longer; all the cleaning

they want is a wash out; but it costs more than the fluid that "Labor Omnia Vincit" uses. Perhaps he will state what expense it takes to clean his boilers, and how long he has used it, and what effect it has on his pistons (if any), as I have used fluids, and found they damaged my piston-rings.—STRAHEARN.

[45407.]—**Re-lacquering Telescope.**—Whilst quite recognising the talents of our friend Mr. Lancaster, and they are many and various, I fear he also possesses with them a somewhat sharp style of writing, not always quite as courteous as it might be. Now, as to a remark in his reply on page 331, wherein he states, "as to the tube, don't spoil it as 'Sunlight' recommends." I have yet to learn that I have given any advice that would spoil the tube; but the real fact is that Mr. Lancaster no doubt thought that I meant to say polish it as it revolves on the lathe; but there he was wrong altogether: the fact was that I had in my mind the plan I always have used myself, and when I state that at one time I had the entire control of large optical works, where the best possible work was turned out, and every modern appliance used, I may perhaps be allowed to have some idea of how a tube should be finished; but the real point is this: I have always found it by far the best way to polish a tube in the lathe with the rotary action up to a certain point. Then, if you have a back-gear lathe, slip the back-gear in, which holds the work firm, and commence to finish with strokes in the direction of its length, and, as a portion is finished to one's mind, then throw out the gear and turn the work a portion of a circle, and again lock the lathe as before. Even with single gears the same plan was used by the aid of a locking-wedge which fitted the speed cone. I have repeatedly found this a far better way of holding the tube to finish than the usual plan, and, as it holds it firmly, and allows the hand to take the entire diameter, I could always get tubes finished far quicker this way than in any other. But to an amateur I still think that the lacquering would be found a rather difficult job—at least, to do it sufficiently good to suit me. I have not the least doubt that Mr. Lancaster spoke hurriedly, and that he will see I really did not mislead the querist; but the space of a reply does not admit of the fullest details and minutiae being given.—SUNLIGHT.

[45409.]—**Piston Lubricant.**—If "J. C.'s" engine is a high-pressure one, I should certainly recommend the use of castor-oil, and in my opinion it is more economical than tallow; but for condensing engines it clogs the valves (especially if they are of indiarubber), and does not allow them to "seat" properly. I have often had the vacuum fall 3in. or 4 in. from this cause alone in marine engines. For toothed-gearing use soft soap and blacklead mixed.—A. BUTLER, Bow.

[45409.]—**Piston Lubricant.**—I have never used castor-oil for cylinders. I find nothing suits my present engines so well as mutton suet, which is at once pure and cheap, and lasts as long as anything I ever tried. Paraffin-oil is used sometimes, but I never found any cheapness in it. For wood and iron wheels working together I should use blacklead and tallow mixed; for iron wheels, I should use the spent oil from the machinery, mixed with a little tallow.—LABOR OMNIA VINCIT.

[45412.]—**Photography.**—I am sorry to trouble Mr. Lancaster again, and "Sunlight" again, but their replies have no reference to query. I want to know how to use, not make, swingback camera and rising front. I have one, but can't understand why front should be raised to put picture out of centre. Also how to convert dry-plate negatives into transparencies by nitric acid.—PHILO-PHOTO.

[45514.]—**Power of Field-Glass.**—If Mr. A. Bartlett desires to increase the power of his instrument, it would need lenses of shorter focus—not longer, as he seems to think. But probably changing the eye-lens would not be all that he would find necessary. This query needs the advice of a thoroughly-practical man before any alteration in the instrument is attempted.—ORDERIO VITAL.

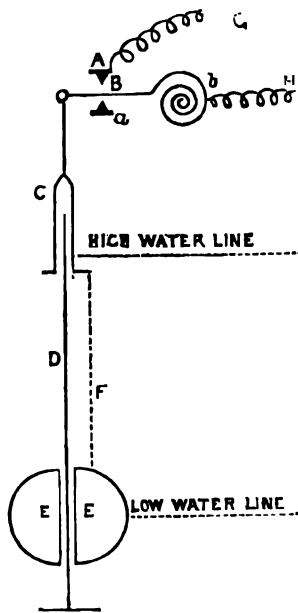
[45517.]—**Brush Dynamo-Machine.**—Pressure of business prevents me giving a full and plain description at present; but I will do my best in the course of a few weeks.—G. F. C.

[45420.]—**Electric Bell.**—I have fitted up at the works with which I am connected an arrangement of water-level indicator similar to what you want. It is in connection with an electric bell, which rings when the tank is full or empty. There is a dial, which shows at a glance the height of the water in tank, which in this case has a depth of 9ft. 6in. I have also fitted another to a well 180ft. deep, with 28ft. rise and fall of water. If you think my arrangement will suit you, I shall be happy to lend you drawings gratis, if you will advertise your address.—LABOR OMNIA VINCIT.

[45420.]—**Electric Bell.**—(To W. J. LANCASTER.)—The bell is at present in use to

when tank is full by a float and wire round V wheel with weight, then a pin in wheel with wire from pin to bell, so as the float rises the wheel turns round and the pin pulls wire. I thought the same float with wheel would do again by making the pin touch a contact spring, but I do not understand you by connecting one wire with gas or water-pipe. I have got a gas-pipe (compo) in same room as bell, also close to tank. (Would the rain water-pipe do?) I am not anxious for the bell to ring when the tank is empty. Please explain it a little simpler to me; also, how I can stop the bell from ringing in room without going to tank, and oblige.—J. C.

[45420].—Electric Bell.—You can easily accomplish what you desire by an arrangement such as that sketched below, with a slight modification, enabling you to get a stay at the top of the vertical rod, in consideration of its unusual height. For so short a distance, it would be better to use two

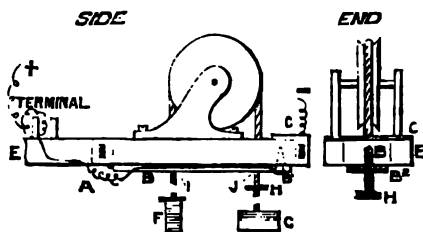


wires; they should be well insulated, taped and tarred, costing, say, 16s. per 100 yards; and where they pass under garden-walk, should be protected by a tube, to prevent the pressure of traffic over them from causing injury to the insulating coatings:—

- D Upright guide-rod, firmly fixed to bottom of tank.
- E Hollow copper ball, with tube through it to slide over D.
- C Cap, or tube, with flange, to slide over D at lower end, and attached at top end to
- B Lever arm mounted on spiral spring B', the centre of which is fixed to a rigid square pin.
- A' Two ends of a brass plate, projecting from a support at right angles to B.
- F A light chain, connecting C and E, the length of which regulates the water-levels at which the bell will ring.
- G and H Terminal wires, attached respectively to A' and B'.

At low-water, the weight of E will bring B into contact with A'; and at high-water, its buoyancy will bring B into contact with A.—R. T. LEWIS.

[45420].—Electric Bell.—Perhaps this arrangement might suit "J. C." D E, wood-frame; B, contact-lever; A, hinge to contact-lever; B', contact screw (brass); B'', contact lever (end view);



F, counter-weight and stop to prevent weight from passing through lever; G, float; H, stop for same; C, piece of metal (tin) for B' to contact on; carry wire to contact screw, as shown in sketch, along the lever. Now for its action. When the water gets below a certain point it would leave the float suspended, which should by its own weight lift

the contact-lever at point I, and make contact at B' C. On the contrary, the counter-weight F should lift lever at point J, and again contact at B C. To insure success the float should be as heavy as possible, and the lever as light and counter-weight heavy enough to lift lever. The holes in contact-lever should be large enough to clear rope or chain. Pulley should not be less than 5 or 6 in. in diameter. For wires use gutta-percha throughout, and use two wires, as distance is not far.—WALLINGTON.

[45422].—Clock-Cleaning.—30-hour case clock. It is not put together right. Directly the tail of the hammer leaves the pin, the lever should fall into the stop; and when the clock stops striking, the warning pin should be at the top of the wheel. You must ease the plates and give or take a tooth until you get it right. See that the little wheel that carries the locking-plate is on the right square. You can find this out by shifting it; take the pulley to pieces and cut off old pins, drill fresh holes, and put in new pins; 8 day: Have you got the large wheels on their right side? Before you take them out you should mark them, give it a little more drop. This is done by putting a piece of cardboard under the bridge (escapement) below the screws.—A FELLOW WORKMAN.

[45423].—Omni-cycle.—To G. Brooke Pechell. This machine is a first-rate hill-climber, and the power of taking any length of stroke is a great luxury to those who do not object to the goose-step style of tread entailed by the foot returning on exactly the same line in its ascent that it followed in descending. The front steering, with all its necessary hamper, is a great drawback to those who care about the convenience of the open-front and its greater safety in case of an accident. But the chief practical drawback of the Omni-cycle, to those who do not object to either the tread or the front wheel, is that it cannot move backwards. This makes it, at all times very inconvenient to handle in close quarters, and sometimes very unsafe for street-work. Not very long since a friend of my own had a narrow escape. When passing through a town on his road, the horse in a cart before him turned restive and backed; but the Omni-cycle could not follow suit, and the wheels of the cart getting mixed with its wheels, the rider had to be pulled off over the back of the machine before it and the cart could be disentangled. Another drawback to the Omni-cycle is that if any of the oil or grease necessary to lubricate the machine gets on to certain dogs which form a part of it, then these dogs will not bite, and the machine will not move. But the mechanism is most ingenious and effective while all goes right, and I should imagine that the maker would ere long find some means of removing what are the principal practical objections to those whose fancy (unlike my own) can tolerate the drawbacks and restrictions always imposed by front-wheel steering.—D. H. G.

[45424].—Problem.—The present value of £1 for 10 years, at 5 per cent., is 77.2, which, multiplied by the rent of £250, gives 1,930. The present value of £1 for four years, at 5 per cent., is 3.55, which, multiplied by the rent of £300, gives 1,065. Therefore B. and A.'s proportion is as 1,065 to 1,930. These two added together will make 2,995. Now, if we multiply £1,050 by 1,065, and divide by 2,995, we get B.'s share, which is £373 7s. 5d., and A.'s share must be £676 12s. 7d.—W. E. W.

[45425].—Electricity.—Thanks to Mr. Lancaster and Mr. Sutcliffe for their attention; but if Mr. Lancaster will do what he promises in his letter, stating what battery-power will be required (Daniell's), I should esteem it a great favour.—R. T. B.

[45425].—Electricity.—Would not one of Bailey's or Harding's engine counters suit you? They are very much used in Lancashire cotton mills. The first-named firm make one in combination with a clock, so that you can compare the number of revs. in any given time with the number that ought to be made when the engine is running full speed. The case can be locked up, so that the works cannot be tampered with.—LABOR OMNIA VINCIT.

[45426].—Slow and Quick-Speed Governors.—The quick-speeded governor is supposed to be much more sensitive than a slow-speed one. Where the governor allows the engine to run away it is not worthy of the name, and that is usually the reason why you have seen the levers, catches, &c., which are intended to shut off the steam at once in case the speed of the engine is much exceeded. With a throttle-valve properly proportioned and fixed close to the cylinder, and a properly-constructed governor, the engine will not run away, unless something breaks down. I like a good slow-speeded governor best; there is less wear and tear.—LABOR OMNIA VINCIT.

[45432].—Bluing Watch-Screws.—Have you got one of Cohen's drilling machines? If not, get one—they are advertised in this paper. Make a chuck to fit in place of drill (see Fig. 1).

Shellac your screw in the chuck and polish with polishing sticks, which can be bought at any tool

F I G. 1.



dealers—is the dozen, I think. Put on the blue pan (see page 310—45343).—A FELLOW WORKMAN.

[45433].—Diminishing Strength of Hair-spring.—Never heard of acid; heard of lowering the temper, but I always draw them. I take hold of the end with my pliers, lay it on a piece of brass, and draw it under a graver about $\frac{1}{16}$ in. or inch.—A FELLOW WORKMAN.

[45437].—Incandescent Light.—As platinum fuses about 350° below the temperature you have given, you would find it a very difficult task to raise the heat of the wire to the temperature you have given; but you can raise its temperature to 2,000°, and get a very nice light, when in an exhausted tube with the least trace of nitrogen in it. The wire, however, must be of a very much smaller gauge than 0.1 in. This would require a current that, in its own fluctuations would, in all probability, fuse the wire. Get No. 30 wire, alloyed with iridium, if you can, then coil it, as in my lamp; this will give you the best result you can obtain with an incandescent lamp requiring but little battery power.—W. J. LANCASTER.

[45442].—Casting Fly-wheels with Wrought-iron Arms.—I find by experience a little red-lead, or redding mixed with turps, put on the part that goes in casting, a first-rate plan; if iron is the least rusty, get it red-hot, and tap some off first.—WORKING FOREMAN.

[45442].—Casting Wheels with Wrought-iron Arms.—Anneal the arms by keeping them at a red heat for about half an hour, and, when cooled down to black-hot, dip the ends in coal-tar; shake off surplus, leaving only a thin coat of hard black varnish. Well vent the top moulding-box above the junction of the arms with the rim and boss; or, preferably, in addition to venting, put a riser over the ends of each arm. Cast the rim separately first, and, after a short interval, the boss. Use a mixture of two-thirds good scrap and one-third remelted pig; or, if a larger proportion of a new iron is used, it should be melted twice. The metal for any casting should be just hot enough to run it perfectly; if too hot, you risk straining the mould, and produce a rough casting, without any corresponding advantage. You ought to make sound castings by this method; but, if you should experience any further difficulty, write again, giving full particulars of your failure.—OAKLAND.

[45445].—Repairing a Compass.—You can easily remove the glass with your penknife by either cutting into the thin part that is bevelled over, leaving enough to burnish down again; or gently lift it all the way round until the glass will fall out. Then the little pin should be unscrewed, and, with some emery-paper on a small smooth, should have its point made quite sharp again. Then screw into its place again, and put needle into the pin, and note whether it is still sluggish, or that it moves freely, and oscillates a number of times before coming to rest. Then put glass in, and burnish the thin rim down again with your knife, with the smooth back of knife, until the glass is firm. If you have a lathe you can soon do it, and also roll any lenses in for telescope; but, if you have not a lathe, don't attempt to burnish lenses in: you will get them untrue.—W. J. LANCASTER.

[45446].—Microscope Magic-Lantern.—If you have a lantern of any kind, then you can easily adapt a simple arrangement to show physiological slides to a large room full of students. You will see, on the last page, that I have made just the thing you require, and I fancy it would pay you better to buy than to make. However, I shall be only too pleased to help you in any way I can. The combination is one specially constructed for such work as yours. With my latest lantern it gives a very beautiful 3ft. disc, with plenty of illumination. The little combination is made up of two achromatic lenses, each 9-16 in. diameter, and constructed to give pure colour and crisp definition from centre to margin. You could for your work make one of my metal chimneys, described in our some time back, to go on to a Silber burner, then make an ordinary micro body with a condensing lens, 3 in. focus, and about 1 $\frac{1}{2}$ in. diameter, then make place for slides, and use one of the lin. objectives: this will give you a disc about 12 in. to 16 in. diameter well illuminated.—W. J. LANCASTER.

[45446].—Microscope Magic-Lantern.—Thanks to "Sunlight" for his reply; but I would be glad of a little more definite information. For the purpose of narrowing the question, I will put

ny reader, from his own experience, up or gas-burner which will give luminated, 2ft. disc, to show clearly es of the ordinary kind, by means condenser, and a fin. microscope addition to this, information as to gement of lenses, and what other equired between the condenser and ill be thankfully received. Perhaps , when giving details of his oxy-roscope arrangement, will say if mp which will throw a satisfactory , or if there is no use trying any- the limelight, even for such a small . GREGORY.

atch-Cleaning.—After you have ring and the going fusee, remove ently ease the upper plate until you he escapement; the escapement is e same way, viz., after you have pper plate on, set up about quarter half, not more. Get a medium brush ut 8d.—A FELLOW WORKMAN.

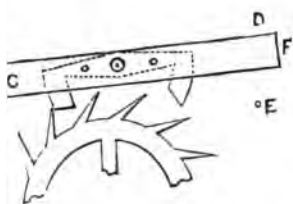
rtificial Light.—I have been ng out for a reply to this query, and rided by "Sunlight" seems to be I, for one, shall be pleased to have of it, which I hope our obliging ht," will give.—W. B. LOIDIS.

tificial Light.—For your purpose with bichromate cells, quart size, etter than anything else you can nt a light for a few seconds only, ement will work for a month with d for a few seconds for each picture. , are not successful, and are a fumes, &c. You can make the ls yourself, and the lamp, and if to make one, I shall be pleased to do it.—W. J. LANCASTER.

tificial Light.—I think "Pyro" lectric light more satisfactory for rk, and if he makes the batteries sif the cost for material would not 18-cell bichromate battery, 3ft. 6in. f wood properly insulated, with the cs attached to a frame for lowering ly when required for use (as made ould be the best form of generator. ; a similar apparatus myself, and to give "Pyro" any further par- g ENGINEER.

rying Watches.—I find watches ary quality fitted with these liable to variation than when the f watch has a good gold or steel is due, I think, principally to their over compensated; they are put on ng any attention to adjustment for erature; in fact, they are put on atch a scientific appearance and only (of course this is not the case with an adjusted balance); some- be out of poise, but generally the ts. With reference to lever escapement- ing": if you look to guard-pin in . will see it is bent away from roller; in and see that the lever has right side. If not, this shake may be nding banking-pins or guard-pin, requirements of the job on hand. on.

rying Watches.—If you want a alance to keep time, you must nail A watch will not keep time where as not got control over the balance; want to carry it. Put in a stiff a long hairspring. See that the ce are tight. I have just sketched



&c. Place your balance, or roller, hold of escapement at F and try the ould be just a little; then try it at ; also when the ruby-pin, B, is smment there should be the same oving the balance slowly with the ur left hand, while you continue to of the escapement with your method you will find out where it ubt, will be able to alter by means ins.—A FELLOW WORKMAN. P.S.— e of the teeth of the escapement-

wheel get ruptured in cleaning, the escapement will touch the back of the tooth.—A. F. W.

[45451.]—**Clock Trains.**—Why not write to the French Novelty Company, in Oxford-street, London?—A FELLOW WORKMAN.

[45453.]—**Caoutchouc Tubing.**—Don't do anything with it. No painting or anything else will make the tubing usable. Better throw it away and purchase some of the black tubing, not the white kind, then you will not be troubled with smell, not only annoying, but injurious.—W. J. LANCASTER.

[45456.]—**Condenser.**—Possibly the air-pump bucket has got choked with dirt; or if you have a foot-valve with a grating, that may be choked. Is there no leakage through the slide-valve into the exhaust? If the valves and pistons are tight, then the cause is in the air-pump or injection-cock.—LABOR OMNIA VINCIT.

[45456.]—**Condenser.**—This is most likely due to a leaky piston. If time allows examine same, and repack all glands. "Condenser" does not say whether his condenser is common jet or surface.—A. BUTLER, Bow.

[45457.]—**Injector.**—You don't say what class of injector yours is—whether lift and force, or force only. If it is made by Gresham, or Sharp, Stewart, and Co., it would have a wheel to regulate the water-supply, placed about the middle of the outer case. But it seems to me that it is an old one, and the steam-cone is worn with use.—LABOR OMNIA VINCIT.

[45458.]—**Pumps.**—Is "One in Trouble" sure his plungers are not striking on the bottom? If this is not the case, probably you will find your delivery-valves have too much "lift." The back-water on up-stroke of plunger will cause the noise in this case. Give your valves less "lift."—A. BUTLER, Bow.

[45458.]—**Pumps.**—To "SUNLIGHT"—I had all the wood cogs taken out not long ago and cloth put round them. Then I had the brasses stripped and new indiarubber put on valves. It made the knock no better. How should the air get out of vessel any more now than the first two years? I can find no leak. If it does get out, how would you advise me to get more in, and oblige—ONE IN TROUBLE.

[45458.]—**Pumps.**—Have you cleaned out the ends of the suction-pipes well? If you had said whether you were pumping water or sewage, I might have advised you with more certainty. Possibly the teeth of the wheels are badly worn just where the pumps commence the down stroke. Why not put the indicator on the pumps? There are several things that will cause a pump to make the noise you speak of, such as shortness of air in air-vessel, a leak in suction-pipe, the suction-ends choked, the valves choked, &c., &c.—LABOR OMNIA VINCIT.

[45459.]—**Mirror.**—Do not use fluoric acid, but a little putty-powder, rubbed with a cork or leather: a fine cork is best.—ALBERT SMITH.

[45459.]—**Mirror.**—Whatever you do, don't get hydrofluoric acid about the house. There is hardly anything worse to have about. I have seen lads' hands that have been bad for months through dabbling with this acid. You can remove the candle's image in a much simpler manner without leaving a worse mark behind, as you would do with the acid. Now, then, get from the chemist's some of the finest putty-powder he has got, then make a piece of wood, say, 3in. square on its face, and having a piece on the back to hold it by, then glue on to the face of the wood a piece of the thickest cloth you have, and, when dry and smooth, sprinkle all over it some of the putty-powder with a few drops of water. Now lay the mirror flat on the table, and commence polishing the stain, and in a few minutes you will have completely removed it. You can finish it with dry powder, but be careful in handling that you do not get any grit on the polisher; then all will go well.—W. J. LANCASTER.

[45461.]—**To Mr. Lancaster.**—The zinc sulphate cell, I now can tell, was the one usually called the sulphate of mercury cell. The plate of carbon is, as you say, at the bottom of the cell, then there are four little uprights in the corners, on the top of which the zinc-plate rests, and usually there is a little button on the top of zinc plate to take it out by. Now this cell is charged with sulphate of mercury—you will know it as the mercuric sulphate, and if you have none of it you can readily make some. Take 2 drachms of mercury and 3 drachms of sulphuric acid, 1.845, heat gently until you have driven off sulphurous anhydride. Get rid of this into chimney or out of the window, then increase the heat until you have left a dry white powder, keep this, and use it as often as the little cell requires charging. Gaiffe uses the chloride of silver cell as well as the sulphate of mercury, and, supposing your Gaiffe to be the pocket kind containing chloride of silver

cells, then if all the chloride is reduced you must make another plate of chloride. Take out the silver plate containing on its surface the remains of the chloride, clean it, and melt on to it another layer of the chloride, and connect up as before: then charge the cell with a solution of chloride of zinc. You know how to make the chloride, I suppose. The argentic chloride is made by precipitating with a chloride in a solution of silver, such as the nitrate. The chloride goes down as a flocculent precipitate, and should be allowed to sink to the bottom, then the clear liquid either decanted or the chloride filtered out and washed. Then heat it until it melts, about 260° to 270° C., and pour it on to the silver plate. Shall be pleased to give you further information if you cannot clearly follow above, and now, as you are an M.D., can you tell me how many commissural fibres join up the optic thalami? I mean the two tracts, first, the number in the middle commissure and those of the fornix which go to both of the thalami, neglecting those that go to the hippocampus. I shall be much obliged to you for an answer.—W. J. LANCASTER.

[45463.]—**Electric Light.**—A Faure, or a series of them, will not help you in the least; better get about 40 quart Bunsen cells: these would give a very decent light for five to six hours. You can make a lamp to burn this time quite automatic, and you can depend upon getting a light; but if you attempt to use 20 or 30 Faures to go for three or four hours, you will find them to be an endless source of trouble, and at the best almost a failure.—W. J. LANCASTER.

[45464.]—**To Mr. Lancaster.**—The simplest shutter you can make is to cut out a piece of tin like a fan, and cut a hole in the centre of it close to its edge; the tin should be four times as much in its arc across the centre of hole as the diameter of hole, then it must be so arranged that it is held up when bottom part closes the aperture of diaphragm; then by liberating a spring it will fall and pass over the diaphragm; this is easily made. But if you would like one that you could regulate the exposure, and do not mind a little trouble, I shall be pleased to tell you how to make one.—W. J. LANCASTER.

[45465.]—**Double Stars.**—On p. 314, "rotation of the line of nodes," should have been "rotation of the axis major."—H. K.

[45467.]—**Bull's-Eye Lantern.**—I think your lamp is too near the lens; try it further off.—ALBERT SMITH.

[45467.]—**Bull's-Eye Lantern.**—The lens is too far away from centre of flame; take it fin. to lin. nearer to flame and it will give you a clean round disc.—W. J. LANCASTER.

[45467.]—**Bull's-Eye Lantern.**—The lamp flame is too far from the lens. The proper place can best be determined by experiment; but probably 2in., or perhaps rather less, would make its action more satisfactory. You will find a slight alteration in position have great influence on the character of the emerging beam of light.—ORDERIC VITAL.

[45467.]—**Bull's-Eye Lantern.**—The effect you name is caused by the lens being just its focal length from the flame when in a given relative position to the wall, and hence the image appears of the flame as you mention. The common bull's-eye, such as would be in a small lantern, would not produce a clear disc of flame, from several reasons. If you placed the light nearer the lens than its focal length, then the cone of rays should be a divergent one, and, theoretically, should be a clear disc of light. This is one reason: That in the lantern is fitted with two condensing lenses; one, nearest the light, first bends the rays and renders them less divergent, whilst the second lens again bends them inwards, and renders them convergent. I am afraid you will be able to do but little with the lens you have.—SUNLIGHT.

[45471.]—**Double Object-Glasses.**—I have added a postscript to my letter in reply to this, but I may also say that according to Coddington's formulae, the amount of error for several different forms is as follows:—

First lens, equi-convex—second con-	} + $\frac{5}{108} \cdot \frac{y^2}{f}$
vexo-plane	
First lens, plano-convex—second equi-	} - $\frac{9}{108} \cdot \frac{y^2}{f}$
convex	
Both lenses, convexo-plane or plano-	} + $\frac{1}{6} \cdot \frac{y^2}{f}$
convex	

—ORDERIC VITAL.

[45471.]—**Double Object-Glasses.**—Probably there will be little appreciable difference in the action of the combinations recommended by "W. G. P." and by myself. I gave a form containing simple and easily-obtainable lenses; but if expense is no object, let "Query" try the pair given by my esteemed brother correspondent. But really I think this subject is occupying more space than it is worth, for with the best-arranged lenses it will only be (to my mind) a disappointing affair.—O. V.

[45472].—Sewer-Pipes.—Messrs. Spon publish a set of tables by I. Shone, C.E., which will show you at a glance all that you require. The price, I think, is 1s.—LABOR OMNIA VINCIT.

[45475].—Turning Face-Plate for 5in. Lathe.—If the plate is cast-iron, you will have to run very slow in order to turn it. You will not be able to do it without back gear in a 5in. lathe, unless you can reduce the speed of the mandril.—LABOR OMNIA VINCIT.

[45475].—Turning Face-Plate.—“W. J. C.” may try this if he has a pulley or crank-shaft the size of the largest speed on his mandril, so as to get a very slow motion; a lap is not needed. But because he can take so very light a cut the tool in all probability does not get below the hard skin of the casting, which instantly grinds off or breaks the point. Some castings are so intensely hard that it is necessary to grind or face them with a chipping chisel before they can be turned-in, unless there is lathe-power enough to take a good cut. Begin by bevelling the outer edge with an old file or grindstone, so as to get a clean face of pure metal. Have but little clearance to the tool, so as to secure a strong point, and advance it very slowly; but it is a tough job without back-gear.—O. J. L.

[45476].—Securing Face-plate of Lathe.—Let me tell you that you have a pretty tough job to turn the face-plate all over, as the great difficulty is to get the driving-band or strap to hold. A way I have tried on several occasions is to get a friend to pull the driving-wheel slowly round by hand whilst I put the cut on. Another way is to rig up a temporary slow-speed shaft with wood pulleys. But all these makeshifts are but poor substitutes for buck-gear, which gives the slow speed and extra power needed, and at the same time, from the speed the strap runs over the first pulley, there is no tendency to slip. You might, perhaps, as a last resort, use a plan I tried once on an emergency, which was to take a narrow strap over the mandril pulley and then down to the crank-shaft, round which it went one turn and then up again to the mandril pulley; to keep all tight a pulley and weight was used to take up any slack. It was a clumsy way, but for a short job answered very well.—SUNLIGHT.

[45477].—Winter's Ring.—To Mr. LANCASTER.—If you have the last Vol. or two of the “E.M.,” you will find drawings, &c., of the Winter's Ring. If you have not access to them let me know, and I will send drawings and full description. The ring is made of mahogany, with an iron wire in the centre of the wooden ring, and running all round the ring and down a stem to the prime conductor. If you have not the “E.M.” let me know, and I will at once send sketches and tell you simplest way to go to work.—W. J. LANCASTER.

[45478].—Dipping Brass.—I have always found nitric acid the best for dipping brass; it gives it a fine gold colour.—ALBERT SMITH.

[45478].—Dipping Brass in Mixture of Hydrochloric Acid and Alum to Impart a Gold Colour.—If “C. S. B.” instead of using the above, will dip his brass into nitrous acid sharp, and then into a large tub of hot water or a solution of bicarbonate of soda in water, I think he will be highly satisfied with the results. The brass should not be in the acid many seconds, or a black stain will be the result, but may be dipped several times, being first well dried with a cloth or sawdust.—A WOULD-BE PIER.

[45480].—Photographing Microscopic Objects.—This is easily done on the sensitive gelatine film or plates, by illuminating the object with a lamp in the outer side of a dark room, and on the inner side the objective, and a board or frame to carry a film or plate. The objective must have an arrangement to adjust the distance from the object with considerable nicety. The sensitive medium may be slid along the table on any suitable stand, by hand. The degree of magnification will depend upon the relative distances of the objective, the object, and the sensitive medium. An ordinary camera is little good for the work. After obtaining the focus on a piece of paper or ground glass, the next point is to prove if your objective will work to the visual focus; if not, you must try, first, a simple subject, taking a series of pictures on one or either side of the visual focus, and then the degree of alteration required is once more all will be plain sailing. Or get a short-focus lens made for photo work, in which the visual and real foci are coincident.—A. FUMFELLY.

[45480].—Photographing Microscopic Objects.—The plan I have always used is to take the camera and place it in a horizontal position, and remove the eyepiece and arrange it so that the range of the plate camera is in a square to be a piece of brass in the camera, and to a square rubber cone such as that used in the microscope, and then an

general arrangement. You should then have a piece of extra fine ground glass for the focus screen (I grind my own to suit my own ideas of density). Now place a slide on the stage of the microscope, and, with a lamp, project a beam of light through the entire system. Focus accurately, and then alter the distance between the micro. lenses and the focus screen to compensate for the want of correction for bringing the actinic and visual rays coincident. Trial alone will prove this; but, say, push it in 1-16in., and try a plate. With a microscope with a good coarse adjustment it is easy to find out the required alteration after focussing by making a cardboard division plate and pointer. With each power a separate adjustment will be necessary. All being ready, the object accurately focussed and compensated, as I have just described, place the plate in the camera, and give the exposure by placing a candle in the position of the lamp, and burning in it a short length of magnesium wire. The result will be a negative, from which you can print in the usual way. In my case I have to take from the negative a transparency for the lantern in addition.—SUNLIGHT.

[45483].—Lantern Optics.—To “SUNLIGHT” or Mr. LANCASTER.—To project a spectrum with the lantern you have, you must have a vertical slit, say, 3in. long and 1/4in. diameter; this should be made of tin, and be put into a slide, and put in lantern close to condenser; then focus the image on to a screen, say, 3ft. away; then, with a bisulphide of carbon prism, split up the beam of light into a spectrum. You will have either to move the lantern round, or move the screen until the spectrum is upon it. There are lots of beautiful experiments you can do with the lantern, and you will find enough in back numbers to last you for months.—W. J. LANCASTER.

[45483].—Lantern Optics.—To “SUNLIGHT,” or Mr. LANCASTER.—The best plan for a makeshift is to first prepare a slit, which is easily done by gumming on a piece of tinfoil to a glass plate, and then cutting out a slit, say 1/4in. long, and 1/4in. wide. Now remove the focus lens from the lantern, and in its place fix up the glass plate, with the slit on it placed vertically. To fix this, a little dodging is needed, but there are lots of plans that may be employed. If you have a small retort-stand, it is very easily done by securing the glass plate, which may be a shell cover 3 1/2in. square, to the upright rod with a couple of rubber rings. Having got so far with the focus lens, accurately project the image of the slit on the screen, and then close in front of the objective place the prism, when the spectrum will be projected at an angle, which will need moving the screen to correspond, and hence the reason for placing the slit vertically; in some cases it is handy to project the spectrum on the ceiling, where a class of students can readily see it. With such a lantern very many optical experiments can be performed, and I would refer you to Mr. Lewis Wright's papers on “Optics with the Lantern,” which you will find commenced in No. 315, Vol. XXXII., p. 201.—SUNLIGHT.

[45485].—Rouge versus Putty-powder.—Use the rouge for polishing specula, and the putty-powder for polishing lenses, and stick to the pitch. Be clean, and the pitch won't stick to you. I never found pitch-polishers particularly nasty; it depends a great deal how one goes about the work. There are lots of things troublesome to people who have not love for work and plenty of patience. Don't use gutta-percha, it will not answer in place of pitch.—W. J. LANCASTER.

[45487].—Electro-Motor for Revolving Vacuum Tubes.—Make an electro-magnet, the one to lift 10lb., in answer 45431, Dec. 9th; then make a brass wheel to revolve over the top of electro-magnet, and screw on to the circumference of the wheel eight plates of iron as armatures; these must be put at equal distances apart, and should be 1in. wide, and as long as the distance between the outside of two cores in electro-magnet. Then you must make a commutator, with eight projections, so that the circuit will be closed as the armatures approach the electro-magnet, and the second they are over the centre of magnet, then the circuit should be broken instantly. If you cannot understand exactly how to do it, I will make a few drawings, as no doubt there are others who would like to make a rotator simply and well.—W. J. LANCASTER.

[45488].—Variable Cut-Off Motion.—If I may be allowed to offer an opinion, I think you will find a cut-off plate working on back of main valve to answer as well as most. The main valve must have a steam-port at each end, and two cut-off plates, to be moved by right and left-hand screws on cut-off valve spindle, which should have a square on the outer end to slide through a suitable bearing. Then by means of a train of wheels put in motion as the governor rises or falls, you can make the cut-off automatic. Further particulars, if desired, with pleasure.—LABOR OMNIA VINCIT.

[45488].—Variable Cut-off Motion.—To my which is the best cut-off motion is somewhat difficult, in view of the many forms in the market. One form I incline to, as not requiring a second eccentric, is as follows:—On the back of the main valve are fitted two sliding blocks, coupled by a hollow sleeve, so that they both move together; through this hollow sleeve runs a small shaft, with a right and left-hand screw on the ends inside the valve-chest, whilst one end is prolonged outwards to a hand-wheel working over a graduated plate, a collar being in the stuffing-box to take the end thrust. On the screw are nuts of ample area, sliding on a feather cast on the cover of the valve-chest, or in any other convenient way secured against rotating. The action is as follows: As the main valve moves, the expansion-blocks are carried, by friction of the blocks, due to the steam-pressure on them, with it, until the one end comes against the adjustable nut on the spindle. As the main valve still goes on the steam is cut off pretty sharply, leaving the other steam-port wide open, ready for the return stroke. By setting the hand-wheel outside the valve-box, any grade of expansion can be got. I have found this a better form than the usual one worked with an eccentric, as it gives a very sharp cut-off. The link and sliding-block plan acts well enough, but it involves a second eccentric and other parts in motion, all of which are not needed by the plan I have described, and which I shall be pleased to further describe if you do not fully understand.—SUNLIGHT.

[45489].—Turning Granite Rolls.—I have had such work under my notice before. On a recent occasion I found that the best tool for the purpose was one made from special tool steel, manufactured by Messrs. M. Eadon and Son, the well-known steel makers. With it and a slow speed no difficulty was found in turning pillars 2ft. in diameter; and with a good lathe and tool of this steel you would have no trouble to turn them up.—SUNLIGHT.

[45491].—Silicate Solution.—Use silicate of soda.—ALBERT SMITH.

[45492].—Telescope.—I do not think the removal of the diaphragm will seriously affect the performance of the instrument if the interior be well blackened. As to the means of doing this, numerous receipts will be found in back volumes.—ORDERIC VITAL.

[45492].—Telescope.—Remove the diaphragm altogether, and make the tubes to slide true into little spring tubes, keeping all quite straight when drawn out; then, at the end of each of the sliding tubes, which will cut off all beside object-lens, when you look into the end which should contain the eyepiece, if you carefully make the diaphragms the right size, then you will not require any black inside the tubes at all.—W. J. LANCASTER.

[45497].—A Cheap Perfume.—I should suggest a cap and a pipe to carry off the unpleasant smell.—ALBERT SMITH.

[45500].—Reflecting Telescope.—Perhaps Mr. Lancaster will allow me also to reply to this. I should not on any account recommend the use of a metal speculum. It would probably prove quite as long and difficult a task to figure such a speculum as it would one of glass. The correct figure of a glass mirror, when once obtained, is permanent, and may be silvered any number of times without injury; but with a metal one, if the face became tarnished, it would need refiguring. Metallic specula may now be considered as things of the past.—ORDERIC VITAL.

[45507].—Cleaning off Useless Negatives.—If they are placed in very hot solution of soda (carbonate), the films will slip off whole, leaving the glass fit for use.—B. C. T.

[45509].—Making Wood Fireproof.—Give it a good coating of silicate of soda coloured with any colouring material.—ALBERT SMITH.

[45511].—Gelatin Films.—I do not find them as rapid as the dry plates quite, but they are decidedly handier for some purposes. The only drawback is that the focus-screw requires alteration to meet the altered position of the film. The plan I adopted was to have cut a dozen plates of the required size, from a plate of glass of the exact same thickness. These were then, with one exception, put away and labelled, the one taken for use then had an opaque border secured to it, which in my case was of paper, saturated with black varnish, which also served to attach it to the plate of glass. By careful measurement the focus screw was then set back to correspond exactly with the altered position of the plan of the gelatin film. This is the chief drawback. But against this there is withal an absence of frilling, which is a decided gain.—SUNLIGHT.

[45512].—Turpentine.—Place some oil upon paper, and warm until the essential oil has evaporated, when the smell of turpentine will be very marked. The nitrous acid test I use in the following manner:—I take a glass vessel and place upon

mes of strong nitric acid and some sr. Round this some watch-
ced, containing two drops of oil,
covered with a bell glass. This
otto of roses when mixed with oil
ALBERT SMITH.

sin.—Try spirit, and a little heat.—

wer of Field-Glasses.—Instead
object-glasses, which would be some-
d would not give you the desired
uld get a pair of eye-lenses fitted
alent focus, and then, by increasing
power, do what you wish. The
depends on the eyepieces or eye-
object-glasses in this case, as in
ject-glasses with the existing eye-
dly be perceptible. You might
lens increase the power to some
tent. But as the power of magni-
eased the light is correspondingly
LIGHT.

nnecting Rod.—I have referred
t," but cannot find the paragraph
the length was taken from the
gudgeon to the centre of crank-shaft
e, the rod would be too short unless
d too much end clearance. The way
the length would be to place the
ally and the beam the same; then
om the centre of the gudgeon to
k-shaft, and that will give the re-

When the beam is horizontal a line
ly through the crank-shaft should
hind the centre of the gudgeon in
hat at two points the vertical line
rough the centre of gudgeon, not
roke, but when it is near the quarter
is way the centre of oscillation is
tely on each side of the vertical line
tion equally.—SUNLIGHT.

and Thresher.—To "SUNLIGHT."
would be a pleasure to help you, I
be unable to do so except I either
ine or an accurate drawing of it, so
e new parts in properly. What I
r would be the best plan, would be
e new parts, so that they would at
h the question from the moment the
f are abstracted from the straw in a
the machine now in general use
wer. I don't like the idea of patch-
existing machine and driving by
when the whole could, I am of
apted to the existing parts. And by
of a Jacob's ladder, there would be
ce of easily applying such. I should
help you out of the difficulty, but I
ave additional data and some idea
he present arrangement of machine,
no doubt what you want could be
INLIGHT.

ag-Pulp Balls.—Have you tried
d think glue, with a small quantity
of potash added, would suit you.—

POWERED QUERIES.

and titles of queries which remain un-
answered are inserted in this list, and if still
repeated four weeks afterwards. We trust
ask over the list and send what information
benefit of their fellow contributors.

* Abroad, p. 122.
Launch, 123.
Race on Cold Roll's, 123.
r Planes, 123.
hucks, 124.
line, 124.
Brown Snuff, 124.
Press, 124.
t Battery, 124.
er Brake, 124.
en, 124.

* Brass—Driving Power, p. 218.
* Cable of 1865 66, 218.
* Ring Metal from Founder's Ashes, 218.
* Rollers, 218.
* Impose Lathe, 218.
* in, 219.
* Ornamental Pottery, 219.
* Marble to Stain Black, 219.
* n, 219.
* Machine, 219.
219.

waterproof varnish, take four ounces
cha; dissolve in one pound rectified
l two pounds of linseed-oil varnish,

QUERIES.

[45521].—Condenser for Steam-Launch.—I am
going to have a launch built about 40ft. long, and wish to
try some system of condensing the waste steam from the
high-pressure engine. As the boat is for use on the sea,
would any practical reader say if it would answer to pass
the steam from the engine exhaust into a box or wide
pipe, closed at both ends, having in this box or pipe coils
of pipe through which cold water circulates, below this
condenser, and communicating with it by two pipes, or
other communication, a tank is placed containing fresh
water; this tank contains the water for use in the boiler,
and into it runs the water condensed in the upper box.
The circulating water to be obtained by placing the level
of the top condenser containing the coils below the level
of the sea-water outside the boat, and having a pipe
through the bow of the boat, alongside the stem, and
below surface of the sea, which would lead the sea-water
into the coils, and another pipe to take away this water,
after it has passed through the coils, back to the sea
again. There will be a pipe from upper condenser to
funnel, to take away any steam which escapes condensing.
The object of two tanks is to expose the steam to the
coils containing the circulating water, rather than in case
of one tank, to have these coils covered with fresh water,
and the motion of the water in one tank during rough
weather would not give free access to the steam from
engine. Both condenser and tank together must not be
higher than 18in. at most, by, say, about 14in. broad, and
in order to be that, they will need to be placed in lowest
part of boat; the tanks may be 8ft. long if required.
Engine to have two 4in. by 6in. cylinders; pressure on
boiler 60lb.; draught of boat at bow, say, 3ft.; stern, say,
2ft. 6in. I should be much obliged if any of "ours"
would give their views, and, if possible, drawings, if they
think this arrangement practicable, giving dimensions of
condenser, length, and diameter of coils, best material
for coils. (I understand copper pipes are not
advisable, owing to galvanic action). Would the con-
denser cause the puffing noise to cease? I propose to
have as well a pipe leading from sea to the fresh water
feed-pipe, which conveys the water from lower tank to
pump. This, in case of water supply failing. Will the
water from sea circulate satisfactorily when launch is
going ahead?—EDITHURON.

[45522].—Expansion.—I wish to find the points of
the piston—at the valve where the slide-valve cuts off and
exhausts the steam in a locomotive. Can any reader
explain the most simple way?—MORTON.

[45523].—Model Steam-Gauge.—Will "Sun-
light" inform me how to make a small model steam-
gauge?—B. R., Sheffield.

[45524].—White Metal Bearings.—Would some
reader tell me what is used for making good hard white
metal suitable for bearings?—GEORGE.

[45525].—Injectors.—Will someone kindly give the
rule for calculating size of steam cone for any given size
of steam-pipe?—LABOR OMNIA VINCIT.

[45526].—Bicycle Route.—Will some of your
cycling correspondents kindly tell me the best route from
Vauxhall Bridge, London, to Sheerness in the Isle of
Sheppey, mentioning a few of the towns, &c., through
which one ought to pass, and the distances, hills, &c. f—
J. HALE.

[45527].—Fontaine Engine.—Will someone give
details of the Fontaine locomotive spoken of in last
week's "E.M."?—N. W. EALING.

[45528].—Screens for Magic-Lantern Dis-
play.—To E. B. FENNER.—Is there any fear of
this composition cracking or chipping off every time
sheet is folded up and shifted for next lecture? Or,
will the recipe, once done, last for some time?—H.
BOOKER.

[45529].—Bone Mill.—I will feel obliged if any of
your readers would advise me as to the best construction
of bone-mill rollers, self cleaning? And, also, the best
manner of applying springs to the back rollers to avoid
breakage where iron or other material harder than
bones enters? A sketch would be of great service.—Oa-
SERVES.

[45530].—Acceleration of the Moon's Mean
Motion.—Will your courteous correspondent, "A
Fellow of the Royal Astronomical Society," kindly in-
form me in what volume of the *Philosophical Transactions*
do the Rev. Richard Dunthorne's calculations respecting
the acceleration of the Moon's mean motion appear?
I believe that the said calculations were published some
time between the years 1750-55, but of this I am by no
means certain. Thanks for replies to last queries.—
ACONITE.

[45531].—Pianos.—To Mr. DAVIES.—I have a high-
priced Hopkinson pianoforte which has scarcely been
used, and not once tuned for five years. It has fallen in
pitch almost a full tone, and the wires seem rather rusty.
Could I do anything at it to prepare it for the profes-
sional tuner, and thus reduce the expense—such as
rubbing the wires with plumbago, pulling up the wires
gradually and from time to time, &c.? Any suggestions
would be received with thanks.—BASTIAN.

[45532].—Colours of Express Engines.—As I
am about to colour some drawings of locomotives, I
shall be glad if any reader could briefly state what are the
prevailing colours of the express engines of the nine
principal English railways? And, also, how picked out
or relieved?—C. R. K.

[45533].—The Road Locomotive Act.—Would
any correspondent kindly give particulars as to the
following?—I inquired some time back as to the laws
relating to a steam-tricycle, and was told that any
machine driven other than by animal power came under
the Road Locomotive Act, which was that speed was not
to exceed three miles per hour, and a man was required
to walk 100 yards in front with a red flag. But now
there is a tram driven by compressed air between Strat-
ford and Epping Forest which goes about ten miles per
hour, and has no man to go in front. Why does not this
come under the Road Locomotive Act? Is there any
special Act made for them? And, would not a steam
tricycle come under that Act?—J. L. B.

[45534].—Condenser.—Thanks to "Sunlight,"
"Snowball," and "W. S." for kindly answering my
query; but I ask leave to trouble you a little more by
explaining the vacuum-gauge, which is attached to the
condenser? And, if not asking too much, how an indi-
cator is worked, and where from? I know the above
will be of practical use to more than one novice.—
R. T. B.

[45535].—L. Y. R. Tank Engines.—Will Mark
Tapson, or "R. N. H.," kindly say if the six-coupled
tank-engines, mentioned and illustrated in letter 19474,
have superseded the large four-coupled bogie tank-
engines, with driving and leading-wheels coupled
(5ft. 8in.), and cylinders 17½in. by 26in.? Will
either also say in what particulars, internal and ex-
ternal, the four-coupled and six-coupled classes differ?
Also, what engine was in the Blackburn collision?—
CENTAUR.

[45536].—Large Transit at Greenwich.—Can
any of our astronomical readers favour me with a sectional
sketch and general description of this fine piece of astron-
omical work, showing general form of instrument, together
with size of o.g. and focal length of same, with power of
eyepiece in general use for observing transits of 1st mag-
stars with it? As I am about constructing one, I should
like to carry it out on the same form as the Greenwich
instrument.—A LOVER OF SCIENCE.

[45537].—Crank-Pin Running Hot.—Will any
reader of the "E.M." tell me how to keep my crank-
pin cool? I have had a new steel pin put in, 1½in. longer
than the old one; it is 5in. long and 4in. diameter, and
makes 36 strokes per minute. And, although the pin is
a new one, and only been running a few weeks, it looks
more like a rasp than anything else, or as if it had been
struck with a chisel point. I have tried sulphur and soda,
but I cannot get it to run cool. I am driving about 70 in-
dicated horse.—CRANK-PIN.

[45538].—"Refulgent" Lamp for Magic-
Lantern.—I have a magic-lantern on which is a brass
label marked, "Patent Refulgent Lamp for Magic-
Lanterns." In the lamp I burn paraffin with two
1½in. wicks side by side. When the lamp is well
filled with oil and trimmed properly, it gives off an
immense quantity of smoke, soot, and noxious vapours.
Has anyone had experience with this sort of lamp?
Mine gives a very poor light indeed, hardly strong
enough even for light transparencies. Can someone tell
me what is the matter with it? And, how I could make
it go better? I do not know who is the maker. The
lenses in front are about 1½in. in diameter, and the con-
denser about 5in.—JOHN HALE.

[45539].—Cracked Driving-Wheel.—We have
cast a driving-wheel to attach to side of mill water-wheel
twice, and each time it has, when cooled, cracked at the rim
at the same place—viz., adjoining one of the arms, and
opened ½in. wide. We say the toothed rim (which is 7ft.
6in. diameter, 5in. wide, with about 2½in. bevel) is too light
for size and too large a circumference to cast in one piece.
The pattern maker says the arms should be heavier to
make it right. Which is right? Or, what do you say is
the cause of the cracking? The pig-iron used was soft.
Size of wheel as follows:—7ft. 6in. diameter; toothed
rim 5in. wide by 1½in. on inside, and 1½in. on outside
edge, with 2½in. bevel; t-eth, 2½in. p.ten; depth of cogs,
1½in. on outside, and 1½in. on inside. The boss—top
diameter, 13in.; bottom diameter, 16in.; depth, 6in.;
with a 9in. core, arms at base 6in., and at inner edge of
rim 3½in., including flange at bottom of arm, which is
4in. wide at rim, 4½in. at centre, by ½in. thick. Explan-
ation of cracking will much oblige. The wheel is not a
split one.—A. B.

[45540].—Model Locomotive.—Many thanks to
"S. R." and "E. L. P." for answering my questions,
and, as latter kindly offers to advise me further in the
matter, I give size of engine:—Boiler, 18½in. long, 6½
diameter, heated with charcoal, cylinders 1½in. bore,
2½in. stroke, 8in. single driving wheels—engine is fitted
with link-motion. I find a great difficulty in keeping up
steam if I let engine stand till there is 30lb. of steam on,
and then set it in motion; in three minutes the pre-sure-
gauge finger is round to nothing again. I could not say
what the engine would do in the way of pulling—it goes
at a great speed when blocked up; but if put on the
ground it hardly has power enough to propel itself along.
—J. HUNTLY.

[45541].—Launch.—Would "Sunlight," or others,
assist me in building a launch? I am making an engine,
single cylinder, 4in. bore and 5in. stroke. I think this
will drive a 20ft. boat at fair speed. Now, in this
country, I cannot find a boat-builder who understands
the shape to be built, and I know nothing about it my-
self, except that carrying capacity is not much object,
and I want the best model for speed and safety. Could
you give me a sketch, with measurements, that a boat-
builder could understand sufficiently well to make the
boat a good shape? For a 20ft. boat do you advise
having the screw set into the deadwood or having the
rudder cut away as shown in "E.M." of Nov. 4th?
How can machinery be put in the boat so as fires can be
attended and boat steered by same person? Boiler is for
salt water, and, to be perfectly safe, I think it should be
of copper. Will you advise me as to size, pressure, and
internal arrangement? In issue of Nov. 11th you advise
"One in a Fog" to use a "Cochran." Would you
advise the same for my boat? And, if so, could you give
me the maker's address and probable cost? As it will be
eight weeks before I read reply, and I cannot send any
other query, I should be obliged for all the light you can
spare on this subject.—CANADIAN SUBSCRIBER.

[45542].—Precipitating Copper by Electri-
city.—I have here (in the Urals) a conglomerate rock
containing about 3 per cent copper, existing principally
as carbonate; it is a very refractory ore, and so un-
smeltable, that I had recourse to one of the many wet
processes, and the only one practicable here—viz., dis-
solving in dilute sulphuric acid and precipitating with
iron. This I found too costly, sulphuric acid being
expensive out here; but, last summer, I went through a
number of experiments on a small scale, but used the
electric battery for precipitating. The experiments were
highly successful, enabling me to use the acid repeatedly
and doing away with the iron, also lessening the process
of refining. By these experiments I was induced to go a
step further. I procured a 4 H.P. electric machine

similar to those used in electro-plating, but found it precipitated too small a quantity to pay. I tried both large and small precipitating surfaces, weak and concentrated solutions, copper plates to both positive and negative poles, also, copper and platinum, &c.—the best results were obtained by the latter. The solution, besides containing sulphate of copper, also contains iron and alumina in large quantities. Before I can make the process a paying one, I should require a machine, or a series of machines, capable of precipitating 1½ tons per day, consuming not more than 15 or 20 H.P. I should be very glad if any of your kind readers could advise me on the above or give me a hint!—*USAL.*

[45543].—**Electrical Terms.**—On p. 196, paragraph about sheathing Iron Ships, describing a method of sheathing with zinc, the iron is said to be the positive plate and zinc the negative. In the textbooks it is said that the metal which is most attacked is the positive in the cell, but it is the negative pole in the circuit. Are there any other terms which more correctly define the relative electro positions of the metals? In the case cited, confusion is caused to the learner, who naturally says that the zinc is the positive, because it is worn away and deposited on the iron.—*KARAOUE.*

[45544].—**Tait's Thermic Ventilator.**—Will "An Old Subscriber" (letter 19478) be good enough to explain whether there is not some error in the sketch, p. 304? The "fresh cold air" appears to be sent up by the flame, and out by the "discharge." How any portion of it enters the room, except mixed with the products of combustion, is not discoverable, or how the tube acts at all, except by warming the air of the apartment which comes in contact with it. A simple effective warmer of a bedroom through the night would be a matter of much importance to—*BROSCHEIT.*

[45545].—**Fretwork.**—I intrusted a letter-rack, which has cost me considerable trouble, to a person who undertook to polish it. He has returned it smeared all over, and the interstices clogged with common knotting composition. Can I soak the various pieces in any solution which will remove the composition?—*H. H. W.*

[45546].—**Testing for Free Acid.**—Will some one of our chemical readers kindly tell me a simple and ready test for free sulphuric and nitric acids, in presence of salts of lead, lime, and arsenic? I wish to get at the percentage of free acid present. Great exactness is not necessary if the test is only rapid.—*YARBUM.*

[45547].—**Legacy.**—An aunt of mine died in Halifax, Nova Scotia, eighteen months ago on the third of this month, leaving me \$20 dollars (£40). Could "Speranza," or any other legal reader, kindly say if there is any law as to the realisation of the estate in a certain time, as the money would be very useful to me just now, and I have written to the solicitors, but can get no reply?—*V.*

[45548].—**Useful Drilling Apparatus.**—I should esteem it a great favour if someone would explain how I could add a screw-feed to the drilling apparatus illustrated on p. 468, Vol. XXIX.—*THE MECHANICAL MASON.*

[45549].—**Angles of Teeth of Milling Cutters.**—As there has been no information on the above in the last fifteen vols., I am sure it would be very much appreciated if someone would give us a few remarks and illustrations on their cutting and clearance angles, giving the proportion of pitch and depth of teeth to diameters. My remark refers to cutters used in a 4in. or 6in. centre-lathe for general work in steel, wrought and cast iron, and brass. Will "J. K. F." or "J. L." help us?—*THE MECHANICAL MASON.*

[45550].—**Slow-Combustion Stove.**—I shall be thankful for a hint how to manage a slow-combustion-stove with extended feeder which is supposed to burn with coke only for 30 hours, but it does not burn more than six to eight hours, after which time it gets choked with ashes, while the fuel is not half burned through. I had 6ft. of stove-pipe first, but have now lengthened to 10ft. to give more draught. I have also used coke broken very small, and tried coke broken moderately small, but the result is always the same. There is no grating for the ashes to fall through, but the fire is simply laid on the fireclay bottom of stove and lit through the stokehole.—*INQUIRER.*

[45551].—**China Painting.**—Will Mr. Bamford, or someone else, kindly say whether I can make Roberson's "medium" used in china and other painting? And, if so, what it is made of? Also, any other "medium"?—*PAUGUL.*

[45552].—**Tait's Thermic Ventilator.**—I have noticed the letter of "An Old Subscriber" (19478), and am myself very much interested in finding some simple and efficient means of warming a bedroom. Now, it seems to me that the apparatus sketched and described in the letter referred to, though it may act as a very good ventilator, will not act as a warmer unless made on a scale very much larger than to use one, or even two, Bunsen burners. The amount of heat which would be delivered into the room by the arrangement described, say using two Bunsens, would, I think, certainly be less than would be obtained by simply having the burners burning by themselves, say in the centre of the room, as, of course, some of the heat gets carried away by the discharge-pipe of the apparatus. Would a bedroom of average dimensions be sensibly warmed on a cold winter's night by burning two Bunsens in it? I think not—at least, not to such a degree as to make it practically more comfortable. Would "An Old Subscriber" kindly say what sized room he warmed? And, what temperature he maintained in the room, with corresponding temperature outside the house? He would very much oblige—*CONSTANT READER IN ITALY.*

[45553].—**To "Clerkenwell Clockmaker."**—Will you please say whether it is usual to harden the "pivots" in such a clock as you were kind enough to describe some little time ago? And, if so, how is the warping of the arbors prevented? There can be no doubt that the polish would be more durable, and, consequently, the friction less, were the pivots hardened, but I have failed to succeed, except in the upper portion of the train where the arbors are thin. Also, kindly state what you consider the right size (Lanc. wire-gauge) for the "pivots," beginning at the "great wheel" upwards? I, and I am sure many others, are looking forward with

much interest to your promised article on Chime Clocks.—*J. H. B.*

[45554].—**Experiments with Induction Coils.**—Will one of your contributors describe some of the experiments that can be made with electric coils?—*W. R. CRAIGIE.*

[45555].—**Rising of Planets and Stars.**—How can the time of rising be found when declination and southing only are given?—*RELTUB.*

[45556].—**Russian Vapour Bath.**—Could anyone give a description of this vapour bath, so that I could construct one?—*R. E., Montreal.*

[45557].—**Chemical Paper.**—How can paper be prepared, so that on wetting it bursts into flame?—*S. P. F.*

[45558].—**Crossley's Transmitter.**—Will Mr. Lancaster kindly tell me the respective sizes and quantities of primary and secondary wire needed for an induction coil to be used with Crossley's carbon transmitter?—*NEW SUBSCRIBER.*

[45559].—**Steam Canoe.**—I am making a steam canoe (screw) 17ft. long, 4ft. beam, with two slide-valve cylinders. I want to get up a speed of at least 5 miles an hour, working at a pressure of 60lb. per inch. What sized cylinders and what size boiler should I require? Any suggestions will oblige.—*SUNBEAMER.*

[45560].—**Polarised Light Applied to Pebble Spectacles.**—In conducting some experiments on polarised light, it occurred to me to examine my spectacles (which are of quartz) by the polariscope. Placing the lens between the polariser and analyser, when these were crossed, and turning the lens so that no light was given, that is to say, so that the lines of vibration of the quartz lens were parallel to the polariser or analyser, and I find, taking a pair of spectacles as in diagram (lines across) and drawing the lens in the diagram in the direction in which the undulations from the reflecting polariser are, these lines take the position shown for darkness—that is, when these lines are parallel to polariser or analyser, there is no resolution of forces giving light. In another pair, these lines are as in second diagram. Now,

left  right lens

the question arises, seeing that the elasticity in the quartz differs in different directions, is, whether this varying elasticity, and so refractive power, has any practical effect upon the crystal as a lens of a spectacle? And, if so, whether it is injurious to the eye for constant use? Will one of your contributors give this a little consideration, and favour me with a reply?—*H. G. B.*

[45561].—**Saturn.**—In connection with Dr. Royston Pigott's observation of Encke's division in the ring of Saturn (p. 290), I should like to know whether it would be considered impossible for it to be seen with a good 4in. refractor? I was not sufficiently "up" in Saturn to know about it, but lately I have remarked to many persons who have come to me to see Saturn that there was an exceedingly faint line in the outer ring beyond Ball's division, which was very plain. I drew their attention to it as showing that that ring was really more than one. Some thought they saw it, but this may have been only from my remarking on it. I feel it difficult, however, to think that it could have been only fancy on my part.—*BROCKWELL.*

[45562].—**Chloride of Silver Battery.**—A person out in China would be glad of full instructions how to make above? And, how to melt the chloride of silver?—*W. H. J.*

[45563].—**Medical.**—To Dr. EDMONDS.—I have read, and have also been informed, that heart disease is only produced by rheumatism and rheumatic fever. Will Dr. Edmonds kindly state, when writing again, if this statement is true? Will he, also, kindly inform me what are the real causes of valvular disease of the heart, if any, apart from the result of rheumatic fever? Will he also inform me what condition of the heart produces so many sudden deaths? I ask these questions out of sympathy for one who is supposed to suffer from valvular heart-disease.—*G. FRYER.*

[45564].—**Speed Indicator.**—Wishing to construct a speed indicator to ring a bell or strike a gong, will any of "ours" kindly answer the following query?—What speed and weight of balls ought governor to be to raise lower brass about 1½ in. to 2 in.? Dimensions are as follows:—Spindle 16in., length of ball arms (from centre of ball to pin-hole of suspension) 10in., connecting-links 5in., connected with ball arms midway. The shaft from wheel I wish to drive it makes 78 revolutions per minute.—*ROBERT RANGER.*

[45565].—**Photographs in Natural Colours.**—Will some readers acquainted with the researches made with respect to obtaining colour-d photos direct, give me some information as to who have specially made it their study? And, with what success? Also, into what branch of chemistry or science from which success is most looked for? What is the position held by scientists with regard to this desirable discovery? Is it deemed probable? Or, is it looked upon as an impossibility? Are any now making it their special study? What phantoms of success have been obtained? And, how? Any, but especially all, information in reply to the above queries will be most thankfully received by—*F. YELWOOD.*

[45566].—**Warped Wood.**—I had a rather expensive chest made, and the lid (probably from the wood being not seasoned) has turned up at the corners in front. How can I remedy the defect?—*WERN.*

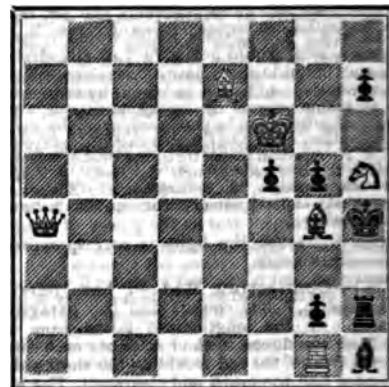
[45567].—**Musical Box.**—I have a musical box playing six airs, but I find that the spindle running through the barrel always sticks to the cement with which the barrel is filled. After taking out and cleaning and oiling the spindle, it works all right for a week or so, and then sticks again. What is the cause? And, how can it be remedied effectually?—*ALBERT G. R. THEOBALD, Collegal, India.*

CHESS.

ALL Communications for this department must be addressed Chess Editor, 22, Chancery-lane, W.C.

PROBLEM DOCKXXII.—By J. K. H.

Black.



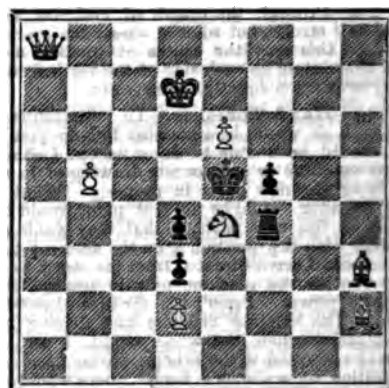
White.

White to play and mate in two moves.

PROBLEM DOCKXXIII.—By B. M. NATH.

(From the Philadelphia Times.)

Black.



White.

White to play and mate in two moves.

SOLUTION TO 718.

(The Black Knight on R 2 and White Pawn on K1 being removed.)

White.	Black.
1. R to Q B 3.	1. Anything.
2. Mates acc.	

SOLUTION TO 719.

White.	Black.
1. R to B 2.	1. K to Q 5 or (A).
2. Kt to B 5 (ch).	2. K moves.
3. Kt mates acc.	(A) 1. K to Q B or (B).
	2. P moves.
2. Kt to B 7.	(B) 1. P moves.
3. Kt to B 5 mate.	2. K moves.
2. Kt takes P (ch).	
3. Kt mates acc.	

NOTICES TO CORRESPONDENTS.

CORRECT SOLUTIONS TO 718 by J. W. P., S. L., A. Schmucke, and W. W.; to 719 by J. W. P. (a little gem, well illustrating the power of the Knight), S. L. (a well finished and artistic problem), A. Schmucke, and W. W. (not difficult, but excellently constructed).

A. S.—You will see from the above solution you had discovered the author's intention.

J. II.—Your other problem is somewhat too obvious. Many thanks.

PRODUCE a bright surface by filing a piece of metal. Apply a drop of nitric acid and allow it to remain a few minutes. Wash with water. The spot will then look a pale ashy gray on wrought iron; a brownish black on steel; a deep black on cast-iron. This is a sure test. The carbon present in various proportions produces the difference in colour.

COMMON resin oil, melted with a little gallipol oil and spirits of turpentine, answers well to pre serve polished ironwork bright; judgment must be used in mixing so that a coating may be put on that will adhere firmly, not chip off, and yet admit of being easily detached by cautious scraping.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 2d. for the first 24 words, and 2d. for every succeeding 8 words.

All sorts of Instruments and Apparatus exchanged for others. Good value allowed.—Dr. CAPTAIN, Science Depot, Chelsea-street, Tottenham Court-road. Established 1862.

Gas Fires, two complete (patent), quite new; catalogued price 37s. each. Will exchange for fifty shillings in Hardware goods wholesale.—W. B. SLATER, Sunderland.

Howe's Treadle Sewing Machine, excellent working order; exchange for 70s. in hardware goods, or offers. Cost 47 10s.—W. B. SLATER, Sunderland.

Pair of very handsome Single Needle Telegraph Instruments, by best makers, been valued at 27. What offers?—"BETA," Belbroughton, nr. Brierleybridge.

I would exchange my 52in. Bicycle, in capital order, for a good Book-case.—A. HAY, Kestring-road, Leith.

Exchange Engine for anything useful, or what offers? Cylinder, 5in. by 24 bore, horizontal flywheel, 2 feet diameter.—WILLIAM DAWSON, 28, Wellington-street, Oldham.

Exchange large Medical Oil, Battery, stoppered bottles, &c., perfect value 25s. For suitable offers, address F. BARNHAM, Charlotte-street, York.

"English Mechanic," complete 16 first volumes, bound, for good Violoncello, or offers.—G. Gower-street, W.C.

Tomlinson's "Cyclopaedia of Useful Arts and Manufactures," 25 2s. numbers, clean, uncut. What offers in exchange?—"MECHANIC," Kingston, Warcham.

Exchange Musical Box, playing 8 airs, slightly out of order, for a Watch or offers.—E. SCAMMELL, 8, South Mall, Cork, Ireland.

Zenocatos Papyrograph, complete, prints 2 sizes, cost 25 10s.; exchange for Electrical Ap. &atus, Scientific Apparatus, or offers.—W. MITCHELL, 6, Mansfield-place, Edinburgh.

To Microscopists.—Sample tube of remarkably pure gathering of Diatoms, Gomphonema Gemmatum, sent in exchange for 3 good Slides; 1 ounce bottle for 12 Slides.—W. MITCHELL, 6, Mansfield-place, Edinburgh.

Achromatic Telescope, 3in. object glass. Will exchange for magic lantern or other instruments to value of 25. Offers to COMMISSIONER BALS MOORE, 88, Hope-street, Glasgow.

Large powerful tone 10-keyed Melodeon, patent action, a splendid instrument, new and perfect, cost 21. What offers? mutual approval.—JAMES BOUTNEY, Wellington, Somerset.

"English Mechanic," Vols. 11 to 15, bound, clean, perfect. What exchange?—DALLS, 287, Crystal Palace-road, S.E.

Cylinder for 2 H.P. steam-engine, for chemical or electrical apparatus.—H. Y. JONES, Junr., Brockwell, Gloucester.

Splendid Magic Lantern and Slides, cost 25. Exchange.—E. B. FENNELL, Pallas-green, Limerick.

Eleven numbers "English Mechanic," 19th May to 26th July, '76 inclusive: "Science Gossip," January to April, '76, July, '76, to December, '77. What offers?—H. M. B., 8, Lorne-road, Oxtou.

A Melodeon Organ, plays 6 tunes, cost 23 8s., fine tone, for a good Magic Lantern and Slides, or offers.—W. SANDERS, Parish Clerk, Dickleboe, Norfolk.

Two large 8-air rosewood Musical Boxes, fitted patent lever winder, adjustable speed fan, jewelled actions, cost 25 10s. Will exchange for Microscope, Model steam Engine, Gun Forfeit Lens, some Watch Tools, and parts of Lathes, or offers.—RAN, 69, Woodchester-street, London, W.

Splendid model of Water-tube Steam Boiler, cost 25 making. Recently on view Royal Polytechnic. What offers?—"ALPHA," 50, Quay-lane, Exeter.

Musical Box, 12 airs, cost 118; good as new; in-laid case, patent winder, lock and key.—MASON, 14, Great Crown-court, Maymarket.

Bunsen Cells, 25 quart size, 10 new zincs for ditto, 2 Daniell's copper cells, 12 by 4, suitable for electro-plating. Exchange for 3 good Slides; 1 ounce bottle for 12 Slides.—STAPLETON-road, Bristol.

A few gold and silver English Watches, new and second-hand. Exchange anything useful. No cards.—7, War-rington-road, Prescott, Lancashire.

Chemical Chest, worth 40s. Exchange for Dynamo-Electric Machine or Lathes. Take good offer. List on application.—X. Y. Z., Baron grove, Oxtou, Berkshire.

Two iron Lathes Heads, 6in. centre; good. What offers? Cash or exchange.—TAYLOR, Millwright, Bomesy.

Concertina, powerful tone, 30-keyed, steel notes, chromatic action, not soiled, and perfect in mahogany case, cost 210. What offers? Mutual approval.—JAMES BOUTNEY, Esq., Wellington, Somerset.

Engine Cylinder (new), 8 by 3 1/2, metallic piston and rod, slide valve and rod, stop valve, all fitted, and steam cocks; cost 25; for Lathes Parts, same value, or offers.—F. HODGKINSON, 8, Doggett's-square, Broad, near Chatham, Kent.

New 1 H.P. Horizontal Engine, well made, I will sell. Exchange for anything useful. Offers.—J. COATHMAN, 361, Bolton-road, Darwen.

Lathes Heads.—A good and strong pair of 3in. Centre H-adaptors, back-gear, 3 face-plats, hand-rest, and 4 centres for same, for good exchange.—J. COATHMAN, 361, Bolton-road, Darwen.

Collection of 480 Cornelians, Agates, Shells, &c., some polished; the lot in exchange for Ovals, &c.—B. M. SHARPE, 97, High-street, Lwystoff.

Almost new flat-bottomed Boat, twelve feet long, to be exchanged for offers.—Address, NAUTICUS, Knockholt Lodge, Greenhithe, Kent.

Gas Tube Lamp, bronzed on brass, height 28in.; cost 25; suitable for the hall or parlour. What offers?—mutual approval.—JAMES BOUTNEY, Esq., Wellington, Somerset.

What offers for 8 years' "English Mechanic," from January, 1874, up to date? Also "Mechanical Engineering," in 10 divisions, by Scott Burn, together or separate.—G. HALL, Eopley, Alfreton, Notts.

For exchange, a Shocking Coil and Battery, with handle complete. 5s. D.D., a Model Slide-valve Engine, three parts finished, all brass with two cylinders. Also two volumes of the ENGLISH MECHANIC, Nos. XXXII. and XXXIII. 2s. for Photographic Chemicals for dry-plate work, or offers.—THOS. KILGOUR, Barnaby, Gullibro, Yorks.

"Mechanics," by Twicken, Tate, and Magnus. Hume's Trigonometry, Madden's Algebra and Key, Young's Arithmetic and Key, &c. &c. What offers?—"ALPHA," 50, Quay-lane, Exeter.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 4d. for the first 16 words, and 6d. for every succeeding 8 words.

For Sale.

Electrical Wires; silk, cotton, indiarubber, and gutta-percha covered. Bell and handle cords.—W. RICHARD, Derby.

"The Night-light Clock." Illustrated and described on page 370, No. 848. Price, carriage free, 5s. 6d.—F. ROBINSON, 13, Greek street, Soho, W.

Photographic Apparatus. Cheap complete sets for amateurs. Instructions free.—HUNTER and SANDS, 20, Cran-bourn-street, London.

Band Primo.—A Tutor for all Band Instruments. "A Book which every Bandman should have." Price 5s., P.O.O. T. BARNSON, 114, Heaton-lane, Stockport.

Fret Saws, 2s. 2d. per gross.—LE RICHE, Smithford-street, Coventry.

Harmonium, 15; 7 stops, walnut case, full compass, ivory keyboard; bargain.—S. COLLIER, King's-cross.

Lantern Photographs, 10,000, with readings, from 6d. plain, to coloured.—A. PUMPHREY, Emily-street, Birmingham.

Lantern Photographs for Hire. List and sample picture for 8d. in stamps.—A. PUMPHREY, Emily-street, Birmingham.

Triplex Lantern, Achromatic Lenses, full size, best light, limelight excepted, 42s.—PUMPHREY, Emily-street, Birmingham.

Complete Limelight Apparatus, equal to 200 candles, 9s. List of Apparatus 3d.—A. PUMPHREY, Birmingham.

Chromatope, with 5 designs and Eidotrope, complete from the manufacturer, 10s.—A. PUMPHREY, Emily-street, Birmingham.

Harmoniums, second-hand: returned from hire. All prices.—VENABLES and Co., 187 and 189, Essex-road, Islington.

Pianos, second-hand: returned from hire. Extensive showrooms.—VENABLES and Co., 187 and 189, Essex-road, Islington.

Hunter's Piston Lubricant, and for heavy machinery; a trial solicited.—JOHN HUNTER, Bathgate, Linlithgow.

Silver Cream rubbed on will renovate perfectly old electro. Genuine silver; 13 stamps.—ASSAY Office, Liverpool.

Lathes, 3ft. and 4ft. back gear, by best makers (Britannia Co.)—Apply, SAND ROAD, 4, Duke-street, Little Britain.

Lathes.—Very strong Bench Lathes, back gear, with cap bed, best make (Britannia Co.), 2ft. 6in.; price 21.—OSMO, Black-quay, London.

Lathes.—Several Lathes, suit guniteers or amateurs, nearly new; Sandford, Little Britain. Price from 25 10s.

Fret Saws.—A new and very effective Fret Saw, to fasten on any table, and turn by hand; price 15s.—MAKERS, BRITANNIA COMPANY, Colchester.

Fret Saws.—Strong iron tripod stand with turned flywheels, 17s. 6d. Best value.—BRITANNIA COMPANY, Tool Makers, Colchester.

Lathes of every description. Circular one stamp. BRITANNIA COMPANY, Lathes Makers by appointment to the British Government.—Address, Tool Department, Britannia Works, Colchester. See advertisement. See ENGLISH MECHANIC, April 25, 1881.

Transparent Prize Medal Cement, the latest chemical discovery. Unites glass, china, stone, ivory, wood, leatherwork, pipes, sticks, and precious stones, equal to Eay's Casingline. Bottle, with instructions how to make it, free for 3 stamps.—Prof. CALDWELL, Great Harwood, Lancashire.

Soda-water, Lemonade, and Ginger Beer Machine. Easy terms, two years.—Particulars, N. G. WILCOCKS, Back-street, Bath.

Extraordinary Bargain.—Taken for debt, 500 solid silver Rings, to be sold for 1s. each, regardless of cost. Any pattern, handsomely engraved, stamped sterling silver, post free, 13 stamps, 3 for 25. Send size.—MORRIS and MORRIS, Market-street, Torquay.

Electric Bells from 5s. Leclanche Batteries 3s., pushes 1s., telephones 2s.—MILLAR, 126, Chapel-street, Salford.

Artificial Teeth by experienced dentist; exchange to value; letter at 81st.—J. 234, Fulham-road, London.

6h.-p. Horizontal Engine and Boiler for sale, on view at Lister Works, Holloway-road.

Mineralogical and Geological Specimens. Amateurs and the trade can be supplied with the above on exceptional terms. Large assortment.—GEO. G. BLACKWELL.

Crystallography.—A few Splendid Specimens of Benjoinite (Octahedrons of Antimony Oxide) for disposal cheap.—GEO. G. BLACKWELL.

Bunsen Battery, new designs; square cells; great power; unqualified for electric light experiments; Casap. Quartaire, 44.—GEO. G. BLACKWELL.

Leclanche's Batteries. Specialities in glass Cells, Stone-ware Cells, Porous Pots, &c.; very cheap.—GEO. G. BLACKWELL, 25, Chapel-street, Liverpool.

Drawings Made, copied to any scale. Every description of machinery designed for engineers, manufacturers, amateurs, &c. Inventor assisted (mechanically) Terms, 1s. per hour for drawings.—DELY, 6, Albion-hill, Leices ter.

Hard-up and Out of work.—To be sacrificed, a small organ, entirely new; suitable for small chapel, church, schoolroom, or chamber.—F. RICHARDSON, 107, Clifton-street, Brook's Bar, Manchester.

Magic-Lantern Slides, beautifully designed, brilliantly coloured Slides, 12s. 6d. dozen. List sent.—24, Duke-street, Brighton.

Beautiful Cloth Dress for 7s. 6d., or 7 1/2d. yard; navy blue, claret, or olive brown.—G. F. FRYER, Kirkgate, Wakefield.

New Cloth Ends, 50in. by 3in., 3d. each, 50 at 2 1/2d., 100 at 2d.—G. F. FRYER, Kirkgate, Wakefield.

Metallo "E" Violin Strings, superior to gut or silk, three post-free, 1s.—PARKER and SMITH, Plymouth.

Magnesium Ribbon, burns like the electric light, 4d. per foot, forwarded free.—L. ROWLAND, South John-street, Liverpool.

Working Drawings by Practical Draughtsman at moderate charges. Send particulars or rough sketches of requirements to H. BUCK, 111, West High-street, Salford, Manchester.

Portable Forges, new, for amateur smiths, W with foot. Heat iron up to 2in. square; powerful blast, GALLOWAY and Co., Wear Belongs Works, Sunderland.

Magneto-Electric Machines, 12s. 6d.; Chromate Batteries, 5s. 6d. Induction Coil, 10s. 6d.—Mr. Manufacturing Electrician, Chapel-street, Salford.

Stylographic Pens.—Vulcanite, complete, 1 pneumatic filler; warranted; free, 15 stamps.—J. L. S. SULLIVAN, Sussex-road, N.

Boiler Compound, Morgan's Improved; prove scale, corrosion, and honey-combing. Eight years' test.—H. MORGAN, Engineer, Gloucester.

Stocks and Dies from 8s. set. Incandescent Lamp from 6s.; list 1 stamp.—F. M. BUCKLEY, 21, Flaxbury-passage, 1

34in. Browning Reflecting Telescope, price 27.—H. KNIGHT, Weybourne, Farnham.

Small Gramme Machine, for hand or power, 2 bobbin.—J. H. KNIGHT, Weybourne, Farnham.

For Sale, a half-horse Vertical Gas Engine, of Otto and Cronley's; equal to new.—J. M. S. SPECTOR, New Inn-yard, Shore-ditch.

100ft. Glass, cut to size, packed, delivered to 14s. 6d.—HOLMES, Essex-road.

Perambulator, superior make, bicycle wheels, complete with hood, apron, and strap, 35s., a great bargain, may be wanted.—C. 115, Prad-street, Paddington.

Photographs, Scottish Scenery (extraordinary value) 7in. by 4in., 6d. each.—FINLAY, 128, Kentrev-street, Glasgow.

Back-gear screw-cutting slide-rest Lathes, 3a centre, treadle, with few tools for iron and wood, 50in.—4s. 180, Phyllis-street, Liverpool.

1 horse-power double cylinder vertical Engine, Cast-iron, ports cast in.—S. S. JACKSON-street, Oldham.

H.P. Rider Hot-Air Engine, nearly new, is sale cheap, only been used a few times.—MILLER and Co., Steam Launch Builders, Creek Works, Middle Mal, Haze-smith, London.

Lathes and Wood-turning Tools, almost new, 3a centre, 2ft. 6in. bed, 44.—L. FORSTER, 43, Milton-street, Newcastle.

One Patent Mangle; nearly new, a bargain, in complete. 25 10s.—Apply to Geo. KIRK, 17, Prospect-park, Exeter.

Set of 8 Perambulator Wheels, with indurated tyres, two 3in. and one 1 1/2in. with axle to fit, quite new, 2s. three.—PHILIP CANNON, Piper's-row, Wolverhampton.

Marking Ink (The "Perfect"), the most useful jet-black ink yet introduced; no fading; large bottles 7s. 6d. stamps.—A. SMITH, Essex-road, London.

Organ Pipes, Obos, C to G, 44, voiced, 13 1/2d. D. class, C to G, 44, 23 1/2d.—W. WALSH, 21, Balcones-street, Hackney.

Moustache Raised in a few days. Send 14 stamps to HARTLEY and BARNARD, Newtown, Waterford.

Molison's Patent Harmonograph, in polished mahogany case, complete 21s. Stamp for specimen curves.—J. M. S. SWANSON.

Shop Window Attractions.—Two large Show Fronts with moving heads and transparent eyes, one 1s. 6d. cheap; one 2s. very cheap.—D. BLACKBURN, 73, High-street, Lew. Sussex.

Microscopic Objects for mounting. Send dozen preparations and price list of special series post free 5s. shilling.—R. PHILLIP, 6, Laurel-grove, Park-road, Hall.

An invaluable Phosphoric Tonic Restorative of nerve and brain from overwork; a splendid building rest 12 stamps.—H. M. MATTHEWS, M.G., Great Corn-street, W.C.

Lathes.—A 3 1/2in. all iron Lathes, very little used also a number of tools, including amateur chuck.—F. M. S. LAUREL, Thorne-street, Aspley.

Double-barrel Air Pump receiver and accessories. 70s.—REVOLTA, 2, Claydon's terrace, Kensington, S.W.

Good Horizontal Engine for Sale; 4in. cylinder 3in. stroke, only 30s.—CHAS. THOMSON, Aspley House, Birmingham.

Curragraphic Copying Ink Pencil, price 10s. 1 extra postage.—G. H. HAMILTON, Somerset-building, New Waterford.

Lathes, 30in., planed stout bed, 3in. centre, and mandril on strong iron stand, with 3-speed fly-wheel, by maker.—BRITANNIA COMPANY, Colchester. Cash price, 24 1/2d.

Lathes.—Strong 3ft. planed bed, 3 1/2in. centre, and mandril and centres, improved treadle motion, with hand pulley, price for cash, 25. Maker, Britannia Co. Ltd. and others. May be seen, 27, New Oxford-street (opposite R. H. L. London. Exchanged if not approved.

40in. Meteor Tricycle, cost 116 a short time ago. Taken in exchange with 1000. With patent seat, Splendid machine for up hill post on lady or gentleman. Price 25.—PHILIP CANNON, Piper's-row, Wolverhampton.

50in. Special Express Bicycle, all bright, new, including detachable cranks, alarm-bell, uprider, roadster, cost 27 1/2s.; too small for me. Price 24 10s.—PHILIP CANNON, Piper's-row, Wolverhampton.

Hæmorrhoids.—Spencer's Pills give immediate and permanent relief. Boxes 1s. 6d. post-free.—D. L. D. Dymott road, Grantham.

A very fine 18 1/2in. Equatorial Reflector, 300ft. with driving-clock, micrometer, position circle, &c.—G. G. CALVER, Wilford, Chelmsford.

The Britannia Company's 15-guinea Screw-cutting LATHE is on view at 16, Bear-street, Leicester-square.

Lathes, 4in. 3ft. bed, standards, treadle, &c. 2 metal, 1st. rest, face-plats, chucks, tools, cheap.—R. BUCK, 3, Park-street, Leeds.

Half horse-power Horizontal Engine Castings, 3 separate parts, ports are cast in cylinder. Design sent on application.—West Gorton, Manchester.

Splendid sets of Engine Castings, on 4 standard columns, 1 horse-power and 1 horse-power. Design sent on application.—West Gorton, Manchester.

Complete Slide-valve Cylinder Castings, 4 parts cast in. 2 1/2in. by 3 1/2in., 4 1/2in. by 5 1/2in., 5 1/2in. by 6 1/2in.—West Gorton, Manchester.

Drilling Machine Castings for amateurs, 3s. 6d., including set of bored whorls. Writing copy stamp.—A. DORRINGTON, West Gorton, Manchester.

Chest of Tools, splendid assortment, sent 25 1/2s. a bargain.—"ALPHA," 50, Quay-lane, Exeter.

"English Mechanic," April, 1881, to Dec. 1881. "The Theatre," 1881; "Le Sommeil Paradoxique," 1881. All clean and unbound. Cash only.—J. M. S. SULLIVAN, Sussex-road, N.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, DECEMBER 23, 1881.

EXPERIMENTAL RESEARCHES WITH FLUIDS.*

OUR knowledge of the properties and motions of fluids is not so extensive that we can afford to neglect any experiments which throw even the smallest light on the subject; but when we are presented with a record of original researches, which

took up the study of the properties of fluids as a cognate matter to the undulatory theory of light which he was engaged in investigating before symptoms of impaired eyesight rendered it advisable to seek some other study. It appeared to him that there was an immense amount of work to be done in researches on the motions of fluids, before the theoretical principles of hydrodynamics and acoustics could be fixed upon mechanical principles with any great precision, and accordingly he set to work, without any preconceived opinions, to make a number of experimental investigations which may, he hopes, enable some highly-skilled mathematician to produce a more perfect work, for he modestly calls his book a "primitive sketch." The conclusions at which Mr. Stanley has arrived may or may not be correct, but there can be only one opinion as to the merits of his work, which may be quoted as an example of what can

privately mention that Mr. Stanley divides his matter into "propositions" which were primarily intended only as a sort of scaffolding upon which to erect his ideas, to be removed when the book was completed. Like others, the author found that that meant very considerable labour, and he has accordingly left them with the intimation that they mean only "some things proposed." In the limits at our disposal, it is utterly impossible to give any full idea of the contents of the work, but with the assistance of some of the engravings, for the loan of which we are indebted to the author, we expect to be able to show that in this volume of 550 pages there is material for several separate treatises, and not improbably the germ of a few important discoveries. Altogether there are seventeen chapters, the first treating of the properties of fluid matter, and opening appropriately with the dictum of Sir John Herschel, that

FIG. 1.

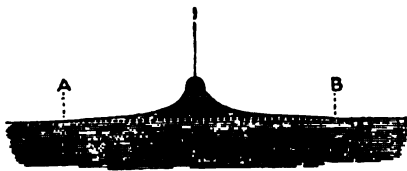


FIG. 2.



FIG. 3.

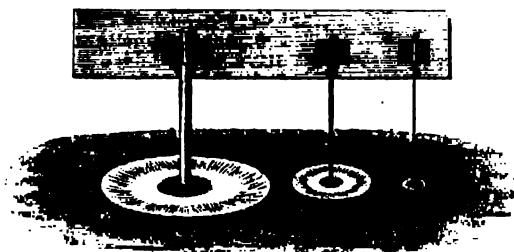


FIG. 4.



FIG. 5.



FIG. 6.

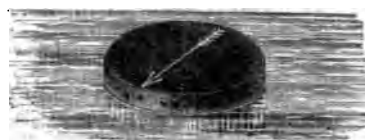


FIG. 7.

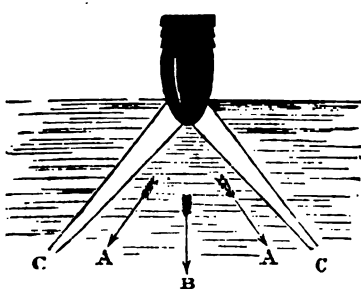


FIG. 8.

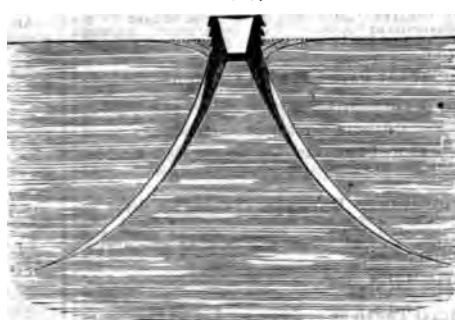


FIG. 9.

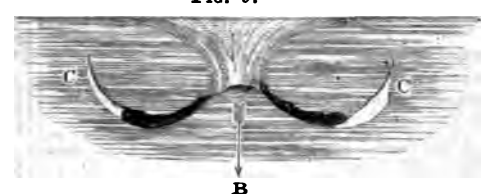


FIG. 10.



FIG. 11.



for novelty and for variety are unexampled, it is only just to the author that his conclusions should receive the attention to which his labours entitle them. The author of the in several respects remarkable book before us is best known to our readers and the public by his treatise on "Mathematical Drawing Instruments," a recognised textbook on the subject, and he tells us that he

be done by a man who labours at his subject *con amore*. For the present, Mr. Stanley holds back his experiments upon sound-motions in fluids, in order that he may test them with such aid as the telephone and microphone, together with the phonograph, can give him: hence, the first chapter in the present work is left in a sense incomplete, owing to the withdrawal of a "proposition" relative to conditions of static in comparison with motive equilibrium of molecular motions in fluids. Here we may appro-

"if there be one part of dynamic science more abstruse and unapproachable than another it is the doctrine of propagation of motion in fluids." Modern dynamic theories assume that the molecule of a fluid is active, and is never at rest, even in a state of equilibrium of the mass. Hence, the subject is more abstruse and unapproachable than Sir John thought. In this chapter Mr. Stanley describes an experiment in which water, varnish, and linseed-oil are respectively allowed to flow down a trough

* Experimental Researches into the Properties and Motions of Fluids. By WM. FORD STANLEY. London: E. and F. N. Spon.

and over a bridge, the height of the fluid being taken by means of a micrometer screw at its highest part. This experiment showed that the water was the most rigid or self-supporting, and the linseed-oil the least, which the author assumes to be due to a certain molecular polarity, which produces the property of gelatinity—a term he frequently has occasion to use, as the equivalent of "static mass elastic rigidity." At the commencement of the second chapter, which treats of the conditions of liquid surface, we have two more definitions—"tensile" meaning the disposition of parts of a system of matter to draw themselves together, as a drumskin, and "extensile" the disposition to separate or extend, and thereby produce external pressures. Proposition 16 reads:—"That every level surface of a liquid is held in equilibrium by attractions of the surface molecules to each other, and to those beneath equally per area of the molecular surface in contact; that such equilibrium acts as a condensation upon the surface of a liquid, thereby increasing the molecular surface density."

A common sewing-needle floats upon the surface of still water, although it has nearly eight times the specific gravity of the latter; it bends down the surface of the water surrounding itself a quantity equal to nearly eight times the bulk of the needle, so that the latter lies in a trough of the deflected surface. This experiment gives an idea of the general elastic cohesive rigidity, or gelatinity of the water, which in this case offers resistance below the absolute surface to make room for the indentation in which the needle is visibly buried. This experiment is certainly as old as the time of Descartes, but Mr. Stanley has repeated it in modified form, and uses it to point out that if the surface of the water were already under tensile strain, as is concluded popularly, the weight of the needle would increase the tension, and it would immediately break through and sink, unless, from some undefined cause, the special cohesion of the surface were very great. To observe the greatest amount of deflection, Mr. Stanley tells us that the needle should be very clean, and perfectly smooth, the slightest particle of oxidation or dirt causing it to penetrate the surface. He has found that a piece of steel $\frac{1}{16}$ in. long $\frac{1}{32}$ in. thick, with rounded ends, will float until oxidation sets in; but he cleans thoroughly by dipping the polished wire in a saturated solution of caustic potash, rinsing in water, and drying thoroughly in a clean cloth. The object is that the water may adhere to the wire, and so retain, as far as possible, the molecular surface positions. The truth of this proposition is proved by the converse, Prop. 20, "that the cohesive forces of liquids are directly proportional to the nearness of the parts," &c., in support of which the author gives a contrary experiment with the needle. In this case, illustrated by Fig. 1, the piece of steel wire, thoroughly cleaned as before, has a fibre of cocoon silk attached at each end by means of shellac varnish. This wire is suspended horizontally over a vessel of water, nearly touching the surface. By means of a siphon and another vessel of water, the surface beneath the needle can be very slowly raised or lowered, and the water, having once floated the needle, can be lowered until the appearance shown in the illustration is produced. The condensation and tendency to extensibility of a liquid surface may, perhaps, be better shown by the activity at the surface, when a solid, capable of solution, is immersed: see Fig. 2, which represents a stick of fused caustic potash or a clear sugar-stick—the conic pointing invariably commencing at a point $\frac{1}{8}$ in. below the surface of water, being produced by the solution of the solid falling over the lower parts, and having less solvent

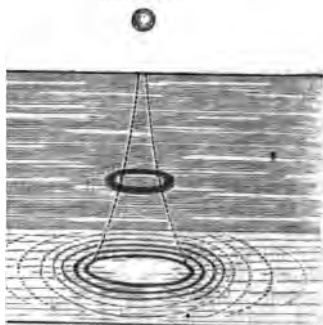
power over them, because already nearly saturated. Fig. 3 illustrates an experiment on capillary surface reflections, in which tubes varying from $\frac{1}{16}$ in. to $\frac{1}{1000}$ in. external diameter were employed. The tubes, after being allowed to stand some hours in the water until equally wetted, were raised so as to leave a quarter of an inch immersed, and when the upper parts were dry, the capillary action was read off by the aid of a bright reflection from a vertical straight-edge, which showed clearly the elevated water near the tubes, which appeared as rings of light. The greatest diameter was approximately $\frac{1}{8}$ in. for the $\frac{1}{16}$ in. tube and $\frac{1}{15}$ in. for the $\frac{1}{1000}$ in. In considering the entire attraction from all causes, Mr. Stanley found that a tube $\frac{1}{16}$ in. in diameter gave a ring only slightly in excess of the $\frac{1}{16}$ in. tube plus the difference of diameter of the tube, so that beyond $\frac{1}{16}$ in. diameter of a mass there would appear to be but little measurable distance of capillary force from curvature. Chapter III. treats of movements of fluids to and from gravitation equilibrium, from which we extract the following experiment on the traction of water:—"Take a glass tube, Fig. 4, about an inch in internal diameter and about a foot in length. Place it vertically in connection with a reservoir, so that water can flow through with a small force. If the supply to the glass tube be by an aperture of a quarter of an inch circular diameter, a larger stream cannot flow from the glass-tube. Then if the latter is allowed to fill by stopping the outlet, the water on being released, is drawn out as shown, coming to the $\frac{1}{16}$ in. diameter in a length of about 8 or 9 inches. Mr. Stanley says that by this arrangement he has obtained a denser liquid stream than by other means. If an open cell, as in Fig. 5, is placed over the end of the pipe, the stream at issue will be in this case triangular, but will form a perfect cylinder in about 6 or 8 in., if the supply force is small."

In chapter IV. the author explains his theory of rolling contact of fluids, which we may briefly indicate by taking Prop. 45. If a free mass of fluid flow upon or against a plane of resistance, the motive contact will engender a system of rotation in the whole or in near parts of the fluid mass, which rotation will approximately resemble the motion of a free roller on a smooth plane. An example is found by the author in a chimney pouring forth dense smoke, which may be seen to roll as it feels the resistance of the relatively static air outside the column of lighter gas issuing from the chimney. The exhaust from a locomotive furnishes another good example, especially on a cold day. To show the rolling contact of fluids, as in a river, a disc of pine painted white, with an arrow across (Fig. 6), was tried in the Thames near Weybridge. The disc was one foot wide by one inch thick, and placed in the stream, which at the point indicated runs fairly straight for some distance, the arrow revolved with the current, appearing to constantly roll upon the quiescent water towards the bank. Mr. Stanley gives other experiments, which lead to the conclusion that fluids may be considered as "infinitely jointed systems of matter." The next chapter—the fifth—deals also with an important principle—viz., that of conic resistance. The proposition we have selected for illustration is that which is thus stated:—"If a small unit mass of fluid matter be projected upon a large mass of static fluid with great velocity, the impact of the small mass will fracture the static fluid in a conoidal plane." A trough 8 ft. long and 9 in. in depth and width was nearly filled with water. A hole was cut at one end a little below the centre, and covered by securing a piece of parchment over it. Through this parchment diaphragm an Enfield bullet was fired, a regulation cart-

ridge being used. The trough gave way at the sides, but the lead of the bullet was clearly injected into the plane of infraction, showing that the lead flows down the surface of the cone of impression in the resistant water as a simple plastic liquid would. The effect of the contact of the bullet with the water is shown in Fig. 7, where its apex is seen opening out a plane of infraction in the forward water, as shown diagrammatically at CC. The percussion being of infinite power compared to the water at rest, the metal is compelled to follow in the plane of infraction as that of least resistance. Fig. 8 shows the section of the bullet as it is assumed to be at the time it is resisted by the perfect cone of impression, the plane of infraction being shown open in front for its further projection. "The momentum of the backward parts of the shot would in a mobile system suffer less resistance than the point of contact; therefore, the continuity of this momentum would further compress the conoid, so that in the next instant the projection would be as in Fig. 9; and by further continuity of the same mode of force, the outward deflection of the conoid of impression by the great momentum of the projectile after the first instant would react and attain a descending force, the projectile finally taking the form shown in Fig. 10." The portions of the bullet remain at a distance of from six to nine inches from the parchment diaphragm, and are shown laid together in Fig. 11, which is full size (Fig. 10 shows this in section). The outer edge of the shot in the diagram is the part that previously formed the pointed end, which has the lead rolled up as shown. The muzzle of the rifle was three yards from the parchment diaphragm, and Mr. Stanley concludes that a Spider rifle would possibly not be able to send its bullet through more than an inch of water at a distance of 10 yards. The chapter from which we have taken these illustrations is perhaps the most interesting in the book, and it is full of experiments. Amongst these are a series demonstrating the quiescence of the axis in what are termed vortex motions, as illustrated by rings of ammonia-chloride vapour. These rings may with a little care be threaded on a billiard cue. The best experiment, however, is made with a soluble aniline dye dropped into a shallow vessel of clear water. Mr. Stanley used "Tropæolum," which is of deep orange colour. The drops (see Fig. 12) may be made at the rate of 15 or 20 per minute, but they will all spread out, as shown, and pass uniformly down the same plane—the dropping tube being fixed. If this experiment be continued for a quarter of an hour, it will be observed that throughout the whole time the cone of impression will remain as clear water, even until the entire contents of the vessel except that portion is tinted by the dye. The spot directly under the cone will remain perfectly clear, proving that there is no circulation in the axial part of the system even by solution. Each consecutive drop will spread out and form the rings shown in the illustration. It is not inferred that one cone of impression remains throughout; it is re-formed by the projection of every drop; but the freedom from motion that exists in the axis, and immediately surrounding conic parts, re-forms the cones at every impression. Fig. 13 illustrates the cause of a greater efflux through a cone than a straight pipe. In this A represents a tube square in section with slips of wood (attached to the glass plate) to give an outward convergence to its mouth, which was ultimately made only $\frac{1}{16}$ in. deep, while the tube A was $\frac{1}{16}$ in. in section. By stirring coffee-grounds in the supply water, the motion of the particles could be clearly seen as they emerged, and these, as shown in the engraving, were whirled with great velocity in the direction calculated to pull forward the central

Figs. 14 to 17 represent an experiment which is analogous to that of the well impossible to blow me off" puzzle, a card laid over the orifice of a which wind is issuing is held in position. A pipe, such as is used for soap-bubbles, is held in a supposition, Fig. 14, and a disc of talc, larger than the bowl, is attached to

FIG. 12.



of a beam which just allows it to pass from the mouth of the bowl when passing. If water containing some

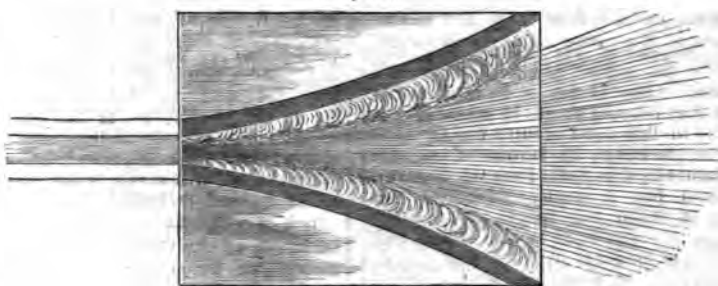
upwards by the whirls. The disc will continue to adhere until the bowl becomes full, as in Fig. 17, when the disc will be forced off and part of the water will escape, the series recommencing by the projection of the whirls as before. The result is that when no water passes through the bowl shown in Fig. 14, the disc falls away, but while water passes the disc is kept up to the bowl when

FIG. 18.



once started by bringing it near, although the beam is so balanced that it tends to draw it away. Fig. 18 represents an experiment made to demonstrate a theory of ocean currents or circulation by rotation. A trough 30 in. long, 20 in. wide, and 6 in. deep was made to rotate around a pivot c when moved by the handle A. The centre c may be assumed to represent the position of the terrestrial axis at the South Pole when the

FIG. 13.



id matter is sent through the bowl the disc is held up for an instant, a depression is formed upon it, with whirls impinging upon and rotat-

FIG. 14.

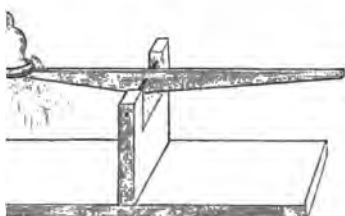


FIG. 15.



FIG. 16.



FIG. 17.



ds the bowl, Fig. 15; in another the whole projected fluid system a rotation within the bowl, as in and the disc will be actually drawn

trough is moved around in the direction of the arrows *bb'*. The water flowed in the direction shown by the arrows inside the trough, sawdust being used to indicate the motions. After a time the water ceased to rotate, the friction of the vessel finally retarding it, and all parts acquiring an initial radial velocity. When a current was projected from either end, the rotation commenced afresh. The current projected into the ends of the trough is intended to represent the effect produced by the heat of the sun; but we have not space to enter into the whole argument, and a portion only is useless. We have attempted to give an idea of the ingenious way in which Mr. Stanley devises interesting experiments, and to call attention to the novel views he has promulgated. The book is a work that must be studied, as distinguished from mere reading; there is food for thought on nearly every page, and abundance of experiments, many of them of a most interesting and important character, serve at once to enliven the matter and support the author's views.

BARFF'S PRESERVATIVE FOR ORGANIC SUBSTANCES.

A NEW preservative applicable to all animal and vegetable substances has been recently patented by Prof. F. S. Barff, of Kilburn. It is a compound prepared by mixing boracic acid with glycerine. The former is dissolved in the latter by the aid of heat, the solution taking about four or five hours, care being taken, however, that the temperature employed shall not be so excessive as to decompose the glycerine. To such solution or compound a further quantity of boracic acid is added from time to time until the boracic acid ceases to be dissolved. The compound resulting when allowed to cool is solid, and is called by the patentee, boroglyceride, which is a new chemical compound.

As an example of the manner in which the invention may be effectively carried out, the following directions are given:—

Heat glycerine to near its boiling-point, and add boracic acid until it ceases to be dissolved, the proportions being about 92 parts by weight of glycerine to 62 parts by weight of boracic acid (crystallised), which is equivalent to 3 molecules of glycerine $C_3H_5O_3$ to one of boric oxide B_2O_3 . Maintain the mixture at a temperature of about 200° centigrade, as long as water is given off. When the mass cools it becomes a yellowish transparent glacial substance tough and deliquescent; this dissolves in water, but when boiled in large quantities of the same it is decomposed into glycerine and boracic acid. The before-mentioned compound is also soluble in alcohol, and the solution has the property of preventing the putrefaction of organic substances. The composition of the glacial body, as determined by analysis, is nearly $C_3H_5BO_3$, or H_3BO_3 , in which H_3 is replaced by the trivalent radicle BO_3 . By using the constituents in different proportions, different (substitution) products are formed, but the one mentioned is that which Prof. Barff prefers to use. In order to employ the compound, he prepares a solution of the same either in water, alcohol, or other suitable solvent, and either immerses in or impregnates with such solutions the organic substances to be operated upon. Solutions may be prepared of various degrees of strength; but Prof. Barff finds that a solution consisting of about one part by weight of the compound and forty parts by weight of water will give good results; other proportions may, however, be adopted for special purposes. Solutions of the compound may be applied to the preservation of all organic substances either animal or vegetable.

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.*

By JOHN WATSON WARMAN,

Associate of the College of Organists, London.

p. IN determining (see further on, at 91, i) the weight of the Thumper, I have taken the total weight of *Eight Manual Keys* as the basis for a standard or minimum,—such eight Keys weighing, when of a total length of 2ft. 3in., about 1½lb. It should also be noted (at 91, j to l) that in the case of Metallic Thumpers there are two sizes given,—in order to provide for an extreme occasion, such as when the Keys are very short. For the Wood Thumper only one definite (though reducible) size is furnished; and it is not recommended ever to make this kind of Thumper larger than is thus (at 91, j) stated, but, if a heavier one be required, to resort to metal of some kind.

q. The Pins are simple small Plated rods of suitable metal, driven into, so as to remain projecting vertically from, the Bed-Rail and Mid-Rail, and thus afford the requisite guidance to the Key;—the latter being suitably Bored and Mortised (see at h, next) for the Pin to pass into or through it. There are two kinds of Key Pins,—viz., the Round and the Oval: the first are formed of mere long cylinders cut from ordinary Wire; the second are, at the portion which does not enter the Rail, made rather wider one way than they are the other, so that on the Key-Mortise becoming enlarged by wear, such Pin can be turned slightly across, so as again to completely fill the Mortise. The shape of the complete Pin will thus almost exactly resemble an ordinary cricket bat. Up to the present time it is only the Bed Pin that has been made of this Oval form; but some few years ago the present writer designed a very slightly Ovalled model for the Mid Pin also: this, however, has not yet come into use. For the *Posit* of both Bed and Mid-Pins see with their respective Rails (at w, ante and on).

qq. I am unable at present to point to an Example of an Organ Manual possessing Oval Pins—if only for the Bed-Rail,—Builders (even Willis himself) being seemingly very slow to perceive the advantages of such form. The Oval Key-Pin is, however, a little more expensive than the Round kind, and also is less easily

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adjustable to any Variation in the vertical thickness of the Keys.

r. The Material of the Manual Key-Pin, of whatever form, will usually be Brass, plated with German Silver or some other suitable metal.

s. The PADDING includes all soft or other substance or fillings placed upon either of the Key-Rails: its use is, as regards the Mid-Rail, to afford a properly elevated and defined fulcrum for the Key to ride or Hook on; and as respects the Bed-Rail, to furnish a soft Pad to deaden the noise of the descent of the Key Fore-part upon such Rail. The Padding for the Mid-Pins consists of little circular discs of suitable Cloth, or sometimes of Card, each Disc receiving a hole at its centre, through which the Pin passes and protrudes: each Mid-Pin thus receives one Disc. Card Pads possess the advantage of being loose compressible, and so not allowing the gradual working down of the Key, - such descent being especially inconvenient when the Tumbler form of Coupler Manual-to-Manual is employed (see, however, in Department of Coupling-Actions for the general inadmissibility of the Tumbler); at the same time some kinds of Card contain grit which will dull or try the cutting Punch. For the front or Bed Rail, Green-Hair is generally used; and nothing can be better, because it is not only essentially soft, but to a certain extent wiry in its nature, thus retaining its elasticity. The best form here will be one or more strips of the same size and shape as the Bed-Rail; the whole of latter being thus covered, and the largest amount of deadening surface therefore obtained.

t. It now remains to speak of the best way of Fixing the Rail-ends to the Cheeks. There are two methods, - viz., by Mortise-and-Tenon, and by Dovetail. If the first of these be adopted the Tenon must not be allowed to go completely through the Rail—at all events not through the Bed Rail,—for the showing of the Tenon-end is not to be here tolerated, because the additional strength that would, with so short a Tenon (see on this point hereafter in Department of Working Directions), be gained by the Mortising through, is of less consequence than the ill appearance resultant. Of course this does not apply if the outer faces of the Cheeks be entirely hidden; and in such event the Tenon may go through,—if the preferable Dovetail (see u, next) be not adopted. When the said Dovetail is employed the treatment will be to cut, into the under edge of each Cheek, two Sinkings or Matrices to receive the Rail-ends. The latter will, as regards being kept out of sight, be under the same rules as if the Rail were Tenoned.

u. The Mortise Treatment enjoys, as already seen, the advantage of possessing greater strength,—provided circumstances admit of the Tenon's going through and being wedged; this strength, however, is actually of very small value here. In every other respect the 'Screwed' Tenon is superior: it allows of the Cheeks' being adjusted to exactly square with the Rails (obviously a very important matter); it permits of the removal of such Rails for any truing which they may require; it equally allows of such removal for the substitution of new Rails; and it presents a convenience in manufacture, inasmuch as the Frame (see a, ante) can be put together without the aid of the Long Cramp. This last consideration is, it is true, not of much value, for such a Cramp will certainly be required for other parts of the Organ Work; but the facility for the retention of the old Cheeks is a palpable convenience, because on a renewal of the Keys themselves it is always desirable to avoid the additional cost and the ill-matching effect involved when such Cheeks also are made new.

v. Keys.—By the Stock is meant the piece at end of wood forming the Key proper,—considered as naked or without Fillings. Such Stock receives merely of such end or strip, as shown in the Frame, and is treated as to fit in the two Pins already described. Each Key thus being so hooked on the fulcrum provided by the Mid-Rail, and having its descent depending as previously upon the Pad attached by the Fore-Rail. See also the accompanying Plate at page 369. Each Key is at its front end, where without variation a Nail, or else furnished with a small piece of Card, which forms its end, a Spring, see h, next. The further details as to shape of the front end of

Naturals under certain circumstances see at n, next.

w. The present writer's form of Key (Patent No. 1064, A.D. 1869), designed for Contracted Levels, consists of two pieces, one being lapped over, and firmly affixed to, the other: the shorter of these pieces, which forms the playing part of the Key, is set as the higher, and thus the longer piece becomes so placed that its distance beneath the Bed-Rail over it is sufficient to leave room for a suitable Thumper (see n, ante) between the Key and the Rail,—such Thumper lying just behind, and not rising above, the said fore or Playing part of the Key. It will be understood that the Bed-Rail here meant is that of the Manual next above the Keys described; and to this it may be added that such Key, viewed sidewise, presents a Bayonet-like shape. As regards the Adoption of this Type see further on (at 92, q).

It may be here mentioned that this particular Contracted form of Keys has also been Invented and Patented in the United States of America, quite independently of any knowledge derived from the present writer,—the date being somewhere about 1868. The device has, however, been in that country very little employed, probably partly owing to the fact of Organs of more than Three Manuals being there comparatively rare. Messrs. Gray and Davison, of London, have also hit upon the Manual Bayonet Key, but have not Patented it.

ww. An Instance of the employment of the Form is or was presented in the small Organ Rebuilt by the present author for Mr. Martin Bradley, then of Leominster, Herefordshire. (See further at 60, c.)

x. The Material of the Manual Key Body will usually be either Lime, Mahogany, or Yellow Pine. Lime is not to be recommended unless the Key be very short, in consequence of the liability of this wood to cast: the springiness of Lime is, however, in favour of its being chosen whenever the Split form of Regulating Tail is used (see r, next). Mahogany may be employed when the length of the Key-Action (see Department of latter) is not sufficiently great to render it desirable that the Key itself be as light as possible. Pine should be used in all cases where, either from the last-named or any other cause, such lightness in the Manual Key becomes requisite; the actual Mortise, however, will be in a Cap of Hard Wood (see h, next).

y. Buffing.—By this is primarily meant the small pad or excrecence, of some soft material, which is attached on the Tail of the Key in some Actions. The use of this Buffing is to furnish a quiet and proper contact for the Nose of a Square or a Backfall in cases where the latter rests directly on the Key-tail, instead of being connected with it through the medium of a Sticker or a Tracker. The Buffing of a single Key generally consists of a small strip of soft Leather, having, at the exact point of Nose contact, a very small pad of soft Cloth placed beneath it; thus the latter throws the covering-Leather up so as to form the said small boss or excrecence, desirable for definiteness in the Action contact.

g. The Tail of Leather employed will be the ordinary Sheep-skin. The Cloth will be the usual Tailor's kind, but of extra thickness.

It should, however, be here observed that, strictly speaking, such Buffing forms no part whatever of the Manual Key. It must be remembered that the latter is always considerably thicker than the ordinary Backfall or Square, and yet that it would not do to cover less than the entire surface of the Key-tail, for both it and the Nose on it will possess too much lateral freedom to insure the parts being always at exactly the same lateral contact; but by simply Buffing the said Nose instead of the Key, a strip of leather of half the former width will suffice, and the Nose, in its lateral motion will, of course, carry its Buffing with it. See more fully on this matter in Department of Key Action.

h. Among Buffings which precede in this Buffing the Key-tail may be mentioned that of W. W. W. in the form of a wedge in the Small Manual in the Organ of the Parish Church of St. Andrew, Bath.

i. In cases where an Organ has more than three Manuals it is in some cases the Key it will be found that the latter is not

the Buffing. For such also the description as given will suffice. See here under Head of Wedge (at z, next); and again under that of Regulating-Tail (r, next).

zzz. Caps.—See with Mortise and Bury (next).

[88, a.] Combs.—These are the pieces placed on the playing ends of a certain number of the Stocks for the purpose of turning each such Key into a Sharp. They should never—though such is a very common treatment at present—be sloped at end or at its sides, but should rise from the Stock perfectly perpendicular or square at point. As regards the [fore] ends of such a sloping involves a real, although small, waste of the area at comb's playing portion; and although the [fore] ends of such area is of little more than Two Manuals, yet it becomes more weight with Three, and of course with as many as Four (see here at 94, b). As respects the sides of the Combs there exists the strictest necessity for keeping later on thin on plan as is possible, in order that the finger may be able to pass freely between them for pressing down a Natural at such point: if therefore such sides are sloped, and such passing of the finger is ensured, the top or crown of the Comb will become unpleasantly narrow; while if the crown be kept sufficiently wide, the other consideration will be sacrificed, and at the same time the Comb be rendered liable, through over-hanging its Stock, to catch on the top of the Natural,—when the Key Mortises shall have become a little worn. It is quite true that the appearance of the Sloped Comb is preferable to the Square; but this is a secondary consideration, and, besides, can be partly remedied in another way (as will be directly mentioned). As far as the present writer has observed, it appears to be the only Builder who has properly realised the foregoing points with respect to the Manual Combs; a model being again furnished in the Hodgesdon Organ (see 60, c).

It will be a very excellent plan to give the fore-ends of the Combs, on Plan, a *recessed Rounding*. By such form not only will the unpleasant appearance of the Squaring at Elevation be largely or entirely removed, but the finger will be less liable to be caught if it should pass round such fore-end of the Comb. Here again Willis seems to show his mastery of the subject, his fine *Parish-Dome Organ* already cited (see also 8, u) having, if I rightly reflect, its Manuals so treated. An Example of smaller work may be seen in the Instrument built by Mr. W. Hobday, of Canterbury, for Musical Professor in that City.

(To be continued.)

MAGNETISM AND THERMO-ELECTRICITY.

THERE are facts on record which prove that the molecular structure of iron and steel when submitted to magnetic action, generally undergoes a change which is different according to the direction of magnetisation, and that, consequently, other properties depending on molecular structure, such as the conducting power for heat and electricity and the thermo-electric behaviour of iron and steel, are likewise altered. With regard to the galvanic conductivity, it has been proved by Herr Beetz that in longitudinally magnetised wires there occurs an increase of the resistance; whereas in wires transversely magnetised, a change of resistance is not demonstrable. As to thermo-electric behaviour, Sir W. Thomson found that a longitudinally magnetised wire is thermoelectrically positive, a transversely magnetised wire thermoelectrically negative.

This behaviour of iron and steel has a great importance for the method proposed by Messrs. Strouhal and Barua, of measuring the degree of hardness of iron and steel wires. They have sought to do so, that is, by determining the galvanic resistance and the thermo-electric potential. But if these properties are altered by magnetisation, then this method of measuring hardness will only apply to unmagnetised, not to magnetised wires. Now, the change of the electric conductivity in the case of transverse

being found *nil*, and that in the usual so small that a hardly difference of hardness was implied, and Barus have limited their examining the change of the behaviour through magnetisation as Sir W. Thomson's results qualitative, and quantitative results for the end in view.

Experiments (described in a recent number of *Annalen*), were made with wires, which, now magnetic, now and united thermo-electrically equal differences of temperature, and as to their thermo-electric observed electro-motive forces: magnetic iron, and copper with iron afforded confirmation of Thomson's result, that a longitudinally there is more positive than one non-magnetic difference, however, were slight differences of temperature of a thermo-element of magnetic iron could not be deduced. Difference of the temperature was of ordinary temperature, and the lead, the variation of the thermo-current by magnetisation was found

over against the result, that the thermo-electric constants and annealing of steel reaches it is clear that no objection can be made of thermo-electric constants of the hardness, even in the cases. The following circumstance, noted as remarkable:—In change of hardness of a steel wire, its thermo-electric position are unusually, and, with increasing wire becomes thermo-electrically the case of magnetisation, on the resistance increases, but the electro-positive. Thus the thermo-electric case of magnetic differences, opposite direction to that in the cases of hardness; which is of different nature of the causes

OF FUEL FOR DOMESTIC PURPOSES.*

During a few preliminary observations on the combustion of one ton of fuel, Fletcher said:—If we examine an open fire, we find that for the greater part it is either giving off smoke, or it is doing very little work. I don't think that the open fire will be superseded, in our time; it does not need to be only to be made as it ought to be. Suppose we may class heat into two kinds: which is low or obscure, such as in hot-water pipes and warm surfaces. The work, except by heating air or contact with it. If we surround a fire with a close glass case with air and glass, we get no heat through the enclosed air is heated by contact and has mechanically carried the heat, which then slowly becomes warm. This is convected heat—i.e., obtained by the transfer of heated air, and which is to many persons pleasant, partly from the fact that it has accumulated in the higher parts of a room, the feet cold, and partly by carrying the organic dust which is in the air in large quantities, and supposed, by the drying of the air, the moisture does not do away any noxious feeling and taint of the air. The class is what is known as radiant heat, which is evolved in large quantities only at a high temperature. The temperature of the source, the larger the radiant heat we obtain, and it is this pleasant from a bright, open fire. It is quite independent of conduction, air or otherwise; it flies with enormous straight lines, like light, and can be absorbed in the same manner. It goes, very little check, through many substances, rock salt or glass, without heating itself making itself appreciable until it reaches a body capable of absorbing it. A lecture delivered by Mr. T. FLETCHER, at the Smoke and Fog Prevention Exhi-

nary greenhouse. The radiant heat from bright sunshine goes through the glass with little check. It is absorbed by the plants and other objects inside, raising their temperature, but not to such an extent as to give off radiant heat again. The consequence is that, converted into low or obscure heat, it has no power to again penetrate the glass and return as it came; it is in prison, and goes on accumulating to an extent which would surprise those who went for the first time into a closely-shut greenhouse on a cold but bright sunshiny day.

Another familiar instance is to go into a draughty railway waiting-room on a bitterly cold windy day. If there is a bright fire, any part of the body exposed to the heat radiated in direct lines from the fire may be burning hot, whilst any part of the body screened from the direct rays from the fire may be very cold, although possibly only a few inches from the part which is unbearably hot.

The radiant heat is practically nearly all which is utilised from an open fire of the ordinary construction; its quantity and carrying power depend not so much on the size of the fire as on its temperature. A small and very hot fire will do far more towards heating the contents of a room quickly than a large dull one burning the same quantity of fuel. It is a curious fact that this radiant heat does not of necessity always make itself appreciable by affecting an ordinary thermometer. A room may be, by thermometer reading, at a very low temperature, and yet by the presence of radiant heat be pleasantly warm to the body. In the same way, above the snow-line on mountains in the tropics, the air may be bitterly cold, whilst the radiant heat from the sunshine may be absorbed by the body to such an extent as to be unbearable. It is better to judge the heat of a room by our feelings rather than by an ordinary thermometer.

So far as I am aware, it is a peculiarity of radiant heat that it must, at least if in any large proportion, be evolved from a solid at a high temperature. The heat from a flame of mixed oxygen and hydrogen gases is evolved from gases which contain no solid matter, and makes its appearance as radiant heat only when a solid such as lime is placed in the flame and heated. It is, therefore, evident that what we need is to obtain the highest possible temperature in our fires, without increasing the quantity of fuel burnt.

It is well known that all metals are good conductors and bad radiators of heat. Any metal in contact with burning fuel lowers the temperature by conducting the heat away, and our first care must be as far as possible to encase our fires with a non-conductor, such as fireclay. If economy of fuel is any consideration, no metal must come into contact with it unless absolutely necessary. It is or was the fashion to put iron backs, sides, grates, and bars to open fires, the result being dirt, smoke, cinders, and great waste of fuel. Thousands of people who have these extravagant grates, knowing they are extravagant, go on from year to year because they object to the cost and mess of replacing them in houses which may be left at any time, the certain outlay being greater than the probable economy. I will try to explain to you how you can, with very little trouble or expense, convert these extravagant grates into the most modern and approved forms. The result will be, if my own experience is any guide, a saving of at least one-third the fuel, and more than half the dirt and trouble.

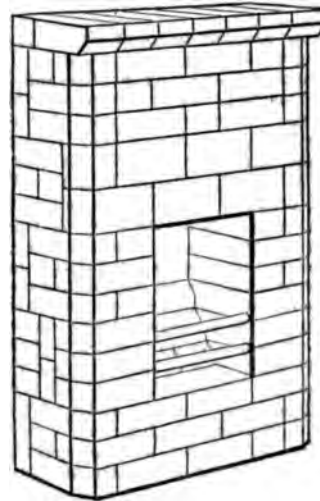
There is only one fairly good non-conductor of heat known at present which can be applied to grates—that is, ordinary fireclay. If we use this to line a grate, the result is, if not fitted and then burnt in a kiln, it simply cracks away and falls to powder when the fire is lighted, and here is the point to which I wish to call your special attention. If you take ordinary builder's fireclay, and mix it, not with water, but with a solution of silicate of soda, you can build, shape, or patch your firelinings to any extent, without risk of breakage or falling to pieces. If you get cracks you can repair them perfectly with the same material, and you can also repair broken or damaged fireclay linings already in use, provided the surfaces you wish to join or build to are clean and damp, to insure perfect adhesion. You will of course understand that loose fire-bricks or balls are an unnecessary nuisance, as you can reduce or alter your fire-grates neatly and well by this material, using, if necessary, lumps of broken brick to fill up any large spaces, and plastering over these, making a neat finish of the whole. Silicate of soda, or soluble glass, is not exactly what soap is made from, but it is used to an enormous extent for the adulteration of soap, and can be obtained easily at a very small cost. We pay for it at the soapworks about 1s. 3d. per gallon.

One most important point is, that the iron bars under the fire shall not only be closed by building up underneath the firegrate with bricks, but the mixture I refer to must be laid on the upper side of these bars until it is about $\frac{1}{2}$ in. to 1 in. thick, so as to totally prevent contact of the metal with the burning fuel. The front bars of the fire must be

left alone; it is not possible to interfere with these without spoiling the appearance of the fire. When we get a solid fire-clay bottom, back, and sides to a fire, we get a much higher temperature, because the heat is not conducted away by the metal; we get no cinders, and our fire, burning as it does principally on the surface, is both brighter; hotter, and much more free from smoke. It will be found, also, that the fuel consumption is very much reduced, and the fire burns much longer without attention. Some fireplaces are very shallow from back to front, and have very small bottom grates. I do not think these grates, as they stand, provided they have clay linings, can be much improved without altering their shape, as the metal bars are in contact with such a large surface of fuel, and are connected with such a bulk of metal-work, that they prevent an economical fire being made. In these cases, I believe the cheapest way will be to build a new fireplace in front of the present one, on the hearth, without interfering with the existing grate, if the house is not the tenant's property.

As this form of fire has no fierce draught through it, it will not burn slack, nor will it burn downwards to any practical extent; it will therefore be necessary to clear the grate before lighting the fire and it will also be necessary to use coal which contains very little slack or dust. Gas coke, if broken into small lumps, burns exceedingly well in this form of grate, without any assistance, and makes bright, hot fires; but my experience of gas coke is that it is very dirty in use, and makes a large quantity of ash and clinker. In other respects, it is a good and cheap fuel.

If I had to build my fire-grates again, I would make every one of the pattern of which I have a rough engraving, taken from a photograph of one



built by myself. This shows you the bond of the bricks and is sufficient in itself to instruct a bricklayer with a head of the thickest construction.

As to proportions, I would build it for a room not much exposed to weather and wind, with the fire-box seven inches deep from back to front at the top, six inches high inside to top of top bar, and one inch wide for every foot distance to the opposite wall of the room, a room 20ft. across having a fire 20in. wide in front; the bottom of the fire to be six or nine inches above the hearth. For very cold houses, I should make the fire-box nine inches high inside, with three bars instead of two. The fireplace has no metal about it except the front bars, which are fastened into the bricks.

I may say that such a fireplace as this may be built of white glazed bricks, at a cost of a very few shillings. It requires no skilled work, and from experience I believe it to be by far the most perfect open fire ever produced. So simple is it that an ordinary bricklayer could build it as a stove in front of almost any ordinary firegrate on the hearth in two or three hours, without altering or removing the existing fireplace and without interfering with the convenience of sweeping the chimney. Done this way, it would pay for itself in saving of fuel in a few weeks.

It may be as well to mention that the mixture of fire-clay with silicate of soda is what we use for repairing gas-furnaces. It will hold ornamental tiles firmly to a flat surface without iron frames or other support.

I will now take up the question of utilising the heat which escapes up the chimney. To utilise this lost heat without expense and without alteration of existing arrangements is a problem I have not yet solved. I do it to a large extent in my own house, because the house was especially built so that this heat could be utilised, and the plan is simply this: The flues are built in inside walls, and are only half a brick thick. The back of the

fire in one room does a considerable amount towards heating the room behind it, and the warmth of the flues can be distinctly felt in every room up to the top of the house. My house is completely detached, exposed to winds on all sides, and yet each room to the top of the house is more or less warmed by one fire in the lowest room only. I have repeatedly seen the thermometer at 40° in a bedroom with three large windows and two outside walls, with no fire in the room, when the thermometer was nearly at zero outside. The lowest reading last winter was 39° , pretty well for a fireless room in an exposed position.

On the ground-floor we had two fire-grates fixed with air-chambers at sides and back, supplied with fresh air from outside, the warmed air being delivered into one or two rooms as desired. No doubt this system, if carried out with the greatest care and first-rate workmanship, has its advantages for large rooms; but my own experience is that we failed to keep it smoke-tight for any length of time, and we got tired of the mess and dirt entailed by the constant leakages of smoke into the warm-air flues. Further than this I do not see much saving or advantage, as, with thin and well-built chimneys, the heat given off from the wall appears to me to be practically as great.

Descending to the kitchen, we usually find the very worst possible arrangement for every purpose. I know, from actual testing, that properly burnt, a quantity of gas equivalent to 1½ lb. of coal per day will do all the cooking, water and bath heating, for a family of ten persons, and this, without any special care or economy, provided the apparatus used is properly constructed. An average kitchen fire, to do the same work, will burn about 60 lb. of coal per day, a quantity which, in a properly-constructed range, would cook for from 100 to 150 people. With large numbers to cook for, and stock work in the way of food to be prepared and eaten cold, a coal fire can be utilised almost continuously through the day, and is far cheaper than gas, even in London, where coal is very dear and gas cheap. A kitchen fire is rarely used to one-quarter its capacity, and even that probably not for an average of two hours out of a daily average of sixteen hours' burning. For irregular domestic work, gas, as a fuel for cooking, is less than half the expense of coal, simply because it can easily be used to do exactly what is needed without waste.

An average kitchen fire is surrounded with metal on all sides, and is a dirty, wasteful, expensive nuisance, which needs for the comfort of householders to go out of existence, as a disgrace to all concerned, both in its manufacture and in its use. Some cooking-stoves are made which, if needed throughout the day, are both economical and good; but, as used for irregular domestic work they, at their best, do not bear the faintest comparison with gas. Our kitchen fires need to be blocked up with fire-brick, and used simply for warming during the severest weather, and as a stand by in case of failure of gas supply. They are fit for nothing except as a poor reserve in case of accident or extraordinary pressure of work, and for this they may be left as they stand.

Our own kitchen fire has been used for cooking about once in two years. It is small, and a first-rate one in every respect, but if I were to propose its regular use for cooking, even in winter, I should be looked on at home as getting old and foolish.

I will now repeat pretty nearly all I have said, and describe to you a fire which we have used constantly, and which has every fault I have already condemned, and these in an excessive degree. It is dirty, wasteful, surrounded with cold metal, and smoky, and yet for special work its advantages are great. In my own private workshop I had what was apparently an ordinary open fire. The fire-grate consists of an open coil of inch wrought-iron tubing containing water. This coil, the rings of which are about two inches apart, forms the bars, sides, and back of the fire. The ends of the coil go straight through a wall at the back, and are connected with about 100 ft. of 4 in. piping, which is used to heat a small tropical plant stove at some little distance away. To prevent loss of heat between the fire and the place where the heat is required, the pipes where the heat is not needed are covered first with a layer of hemp, and afterwards plastered with Roman cement, so as to make the coating weatherproof, the loss of heat through this being practically nothing.

On this pipe system, at the hottest part, I have a tank holding about 130 gallons of water, in which the excess of heat is gradually stored during the day and given off at night, as I do no night firing, however severe the weather. The amount of heat used in the pipes is perfectly controlled by a stop-valve, and all excess which is not being used goes towards boiling the water in the tank, forming a store which is utilised after the fire has gone out. This winter, having removed my private laboratory, I closed up the front of the coal fire with bricks, and placed a gill-stove on the top of the fire to warm the room, which is now used for stores. This alteration, as far as economy is concerned, is an improvement, but of course the advantage of the

open fire is lost. Last year I tried to heat one of my plant-houses with gas. It cost, for a place about 12 ft. square, £10 in gas for the winter. I lost nearly all my plants, owing to repeated failures in the gas supply during the most severe weather. After this experience, I have had quite enough of gas for the purpose, and should be sorry to attempt to use it again.

As I said before, gas is for all small and irregular work almost faultless, and very cheap. For heavy and continuous work, it is excessively costly as compared with coal, and where cost is any consideration its continuous use for heating purposes is to be condemned. Those of you who have, or have had gas fires, will no doubt be able to bear me out in this point. A really good bright gas-fire of the usual form in continuous use will cost as much as at least ten coal-fires of equal power in a properly-constructed grate.

I have here a new form of gas-fire, in which the radiant heat from the open illuminating flame is used, and the remainder of the heat, which is not utilised in this way, is absorbed by a number of upright tubes open at both ends. This I think is, so far as actual work is concerned, a decided step in advance. The rapidity with which a large air space is equally and comfortably warmed by a small arrangement of this kind is something wonderful. In addition to the radiant heat, which warms the lower part of the room, there is also a strong breeze of warm air thrown from the apparatus, and which can, if required, be taken from outside the building, causing a rapid circulation and warming of the whole of the air.

It has been recently proposed to use gas as an assistance to coke fires. From my own experience I can safely say that, provided the firegrate is lined with clay at the bottom, sides, and back, the addition of gas to a coke fire doubles or trebles the cost without the slightest advantage in brightness or cleanliness. The gas certainly lights the fire without the use of paper or wood, but the long time required to get a bright fire is practically a nuisance, and the advantage of speed in lighting with wood more than compensates for the trouble. Owing to the difficulty of entirely removing the sulphur from ordinary gas, there is always more or less taint when this is burnt in large quantities in a close room without ventilation. We must also bear in mind that about 25 cubic feet of gas, costing one penny, are about equal in fuel value to 1 lb. of coal, costing in London about one-tenth of a penny—i.e., our fuel, duty for duty, costs ten times as much, provided both can be burnt with equal economy, as undoubtedly they can for continuous work. With a proper system the results obtained in domestic arrangements could be produced just as well with less than half the fuel, dirt, and labour at present expended, and this, except for cooking, not with the introduction of new arrangements so much as with the use of common sense, combined with a knowledge of the nature and properties of heat. If fogs are to be decreased, there is no possible way of doing this except by the reduction of the total quantity of coal consumed. Coal produces every element necessary to produce fog—i.e., moisture, finely divided carbon or smoke, carbonic acid, and sulphuric acid—and in the absence of wind to carry these away and diffuse them there is no hope for an improvement until every household reduces his coal consumption to the smallest possible amount. Taking the existing arrangements as they stand, I think I have pointed out, so far as the domestic use of coal is concerned, a way of reducing this fully one half, and this in such a manner that the first cost will be more than repaid in a single winter. Certainly, so far as open fires in living-rooms are concerned the first outlay will be repaid in a few weeks, and the profit in a single winter will be something considerable. The expenditure on a gas cooking apparatus will be repaid every six months in saving; and as this needs little fixing, it may be taken about as easily as ordinary furniture in case of removal. I need not refer to the saving in labour with gas cooking, which is quite as great as the saving in cost, possibly much greater.

Gas cooking apparatus—ovens, boilers, &c.—should be all on one level, the height of an ordinary table, and one part should not be on the top of another if good work and economy are to be considered. Another point is the use of hot plates for boiling. These may with care be used with fair economy, but in practice they are excessively costly. A burner should be used only for one vessel at once, and should be so arranged that this vessel can only be put directly over it. If it can be pushed sideways when it boils, nineteen servants out of twenty will do this, just as they do with a fire, instead of turning the gas down, and the consequence is that instead of using about two cubic feet of gas to boil potatoes they leave the gas full on all the time and use perhaps ten or twelve feet to do the same work. If there is no support for the saucepans except immediately over the flame, a servant must of necessity turn the gas down when one boils, or it will boil over and make a mess, which she has the

trouble of cleaning up; she is, in fact, compelled to be economical with the gas, whatever her desires or ideas may be.

Now for the cost. My house contains twelve rooms, with a private workshop at the side, with two fire-grates, one being the dirty, expensive luxury which heats the plant-house. I paid, for the twelve months ending June 30th last, £51 7s. for coal for the whole year, and the only chimney I ever see smoke issuing from is the one belonging to the workshop. I have not taken the whole year's gas consumption for cooking and heating; but so far as I have taken it, I am quite certain it is decidedly less than £3 for the year. Gas, with us, costs 3s. 6d. per 1,000 cubic feet, and coal averages 13s. to 14s. per ton. We limit neither gas nor fire; both are used freely, without stint of our own pleasure and comfort, and I think the figures given prove my case.

After my experience as to the strong objection to the use of metal about a fire, if I were building again I should, as I said before, build every fireplace entirely of bricks and tiles, using only metal bars in front, the ends of which would be built into the bricks at the sides. Very beautiful fireplaces can be built in this manner, and the results obtained in cleanliness and economy of fuel are such as to place them in the first rank.

I have been asked to give a short practical demonstration of the production of high temperatures with gas. Not to delay you unnecessarily I will fuse and pour about one pound of steel in this little furnace which I could almost put in my pocket. Starting all cold I expect to do this in about six minutes. I can remember the time when with the best available apparatus known this would have taken about an hour. It will be noted that to do this I use a blast of air under pressure from a small foot blower. This enables me, not only to get enormously high temperatures rapidly, but also admits of absolutely perfect combustion at any speed in a small, close, non-conducting chamber, with no openings except a very small one for the entrance of the burning mixture of gas and air, and a corresponding one for the exit of the products of combustion. I here obtain combustion under the most perfect conditions possible. I believe the knowledge of gas-fuel used without an artificial blast of air is yet in its infancy, and that we have yet very much to learn; it is, I think, certain that a very serious change in our system of burning gas as a fuel is not far distant, and that our present clumsy apparatus will soon give way to a better system. It is quite certain that no gas-flame for heating purposes, burning without a blast of air, is perfect in all points, and the perfect burner has yet to be discovered. It will be no new experience if the discoverer ruins himself—inventors are, as a rule, with a few exceptions, commercial failures, and frequently not only reduce themselves to poverty but also drag their friends down in their fall. I trust that before long the elaborate process of squeezing the poor inventor indulged in by the English patent laws will be done away with, and that the inventor and the writer of books will be put on an equal footing and receive equal justice and protection at the same cost. If our lawmakers had been inventors instead of writers, this shameful injustice would have been remedied long ago.

THE DIFFERENCE BETWEEN FUSIBILITY AND FUSION-POINT.

ATTENTION has been recently called by Prof. Ledebour, in the *Mittheilungen*, to the difference which exists between fusibility and the fusion-point as given in the textbooks, and as his article is of practical importance to all who have to deal with metals and alloys, the following abstract may be useful:—

The term "fusibility" is one much used in metallurgy, and generally means the temperature at which a body passes from the solid into the liquid state, and the lower this temperature the more fusible the substance is said to be. Thus ice, which melts at 0° C. (32° Fahr.) is more easily fusible than tin, which melts at 230° C. (446° Fahr.) and the latter is more fusible than lead, which melts at 325° C. (617° Fahr.). The term "fusibility" can also be employed in a different sense, and it seems to me that the other is more sensible and logical. Fusibility may refer to the quantity of heat instead of the degree of heat required to raise it from the ordinary temperature, or, say, from 0° C. to its melting-point, and then fuse it. The smaller the quantity of heat required the more fusible the substance, because less fuel is needed to melt it. This very relation between fusibility, in the latter sense, and the consumption of fuel, which is an important factor in calculating the cost of fusion, is of such importance that I take the liberty of entering somewhat more into details. The temperature of fusion bears no direct ratio to the consumption of fuel, for it is only necessary, when the melting-point is very high, to have fuel of high pyrometric heating-power (pro-

ner temperature). Thus, coked or generally gives a hotter fire than the Gases, which burn easily and re-excess of atmospheric air than the t they are made of, give a still nature. The less the quantity of pro-duction, in proportion to the quantity coed, the higher the temperature; ivantages of warming the air used e amount of heat without increasing of combustion), also of employing instead of atmospheric air (by which of combustion are greatly lessened by e nitrogen of the air), whereby such rates are attained. The higher the it which a body melts the more we take advantage of these facts with- y increasing the consumption of fuel; infusible it is, in the other sense of more fuel will be required to melt it. ferent ideas of fusibility do not pro- a step side by side, as many would it suppose. To convert one kilo. of to water at the same temperature, its of heat, while only 15 units are eat a kilo. of lead from 0° C. up to int and fuse it. Lead, then, als at 325° higher than ice is five times that is to say, it only takes one-fuel to melt a given quantity of lead elt an equal weight of ice. From that a knowledge of the quantity sary to melt the metals and their fusibility in the narrower sense—is tant, both practically and theoret-ledge of the temperature at which his quantity depends upon three specific heat, the temperature at h it melts, and the latent heat of = $(s \times t) \div l$, in which s = specific ng point, and l = latent heat. These accurately known for all the metals; very with the temperature, and have determined accurately only for tem- the boiling-point of water; and the but few metals is known at all. It comparatively easy to ascertain this, ain a measure of its fusibility, by g the metal and pouring it into a ty of water, the temperature of urately measured, both before and hermometer graduated to one-fifth f a degree, and afterwards drying the metal, which was poured into

rimment the vessel employed is made copper or brass, holding a few quarts l by a poor conductor of heat (flannel raturum of air obtained by putting this a larger one). Within this copper ler one, full of holes, to receive the so that it can be easily taken out and re is also a spatula of copper or g after the metal is poured in. The s and spatula are weighed, and the ied by the specific heat of copper or and the product added to the ater used

of heat requisite to raise the metal s melting-point, and fuse it, may be W , and we have the formula—

$$V = s \times t_1 + \frac{V(t_2 - t_1)}{G}$$

the weight of the water plus the weight of metal multiplied by its

of metal.
heat of the metal below 100° C.
ture of the water before the metal red in.
turt of the water after pouring it

heult point is to tell when the metal and not over-heated. Pure metals d to cool until a crust begins to poured in, but for alloys this is not or those which melt below 380° C., e at the time of pouring can be hermometer.

ur determined the quantity of heat elt zinc, tin, bismuth, and lead by He also calculated it from their heats and latent heats. The two he following table:—

	Found.	Calculated.
..... 62 units.	71 units.	
..... 26 "	27 "	
..... 18 "	22 "	
..... 14 "	16 "	

nined several alloys, and found that er cent. lead and 10 per cent. anti- at 246° C., and required but 13·6 o melt it, while an alloy of tin and e same proportions melted at 236° C., 1 units of heat to melt it. It will be e quantity of heat necessary for the

fusion of an alloy cannot be calculated when we know this for each constituent, any more than one can tell at what temperature an alloy will melt from a knowledge of the melting-points of its constituents. Of the simple metals lead is the easiest fusible, requiring but half as much heat to melt it as tin does, although its melting-point is nearly 100° higher in temperature.

CHEAP AND EFFECTIVE FINISHED ENLARGEMENTS.*

CERTAINLY the most effective of all cheap coloured enlargements are those tinted (for it cannot be called painted) with oil colours, if done with judgment and taste, and not overdone with positive colours like the majority of the cheap club work. There is no reason why these should not be tinted with quiet taste, instead of being, as is too often the case, mere gaudy daubs, without taste or harmony. These can either be vignettes or solid; I prefer the latter with a background of medium tint, neither too dark nor too light. With a background of this description you can bear to bring out every gradation of the face, and so save work in the tinting: at the same time the lights must be pure and clear.

Now for the colours and materials required. Set your palette in the following order. A satinwood palette is best, as you can see the tints better upon the light satinwood than upon the mahogany. Naples yellow No. 1, yellow-ochre, light-red, Indian-red, vermilion, madder-lake, cobalt-blue, emerald-green, Payne's grey, blue-black, Cologne-earth, burnt-umber, raw-umber, burnt-sienna, raw-sienna, flake-white, magilp. You can either use the magilp as sold in tubes, or make it yourself. If you make it yourself, you can regulate its drying. Half copal-varnish and half light drying oil will make a good general medium. If you wish it to dry quicker, use more varnish; if slower, more oil.

The first thing to do is to put in the background; if a vignette, cobalt-blue, light-red, and white will form a good general tint, which must be graduated into the white of the vignette, it looks better to put it in the form of clouds. This can be done roughly with a half-inch flat hog-hair brush, using different brushes for the tint, the blue, and the white.

The graduating should be done with a badger softener, the tops of the hair being lightly dabbed into the colours, which it will distribute and soften into each other, with an effect almost like stippling; one painting should be sufficient for this. If a solid picture, you can afford to have the colours deeper, using less white, deepening the shadow on the lower part of the background with burnt umber with a little madder brown, deepening the back-ground upon the lighted side of the face, and lightening it where the the outline of the shadow side is relieved against the background. This can also be roughly put in, first with the hog hair brushes, and finished with the badger, used as described above. You will have to dab the colour over face and dress, but it is better to wipe the colour off where it is not wanted, than to stop short where it is wanted. Now with a clean linen rag wipe off all colour which may have gone over hair, draperies, &c., and put in with a flat tint the local colour of dress, hair, &c., using plenty of magilp, and the colours transparent. If dress or coat is black, Payne grey, well diluted with magilp, will be best for the local tint. Soften and even all flat tints with a long-haired flat sable brush.

Now take one of the half-inch flat sables, and put the flesh tint upon the palette; for fair complexions use madder-lake and yellow-ochre, well you may diluted with magilp; if the photograph is dark, use a little Naples yellow No. 1 added, but very little, for it is best that these first tints should be made transparent.

For male complexions use light-red and yellow-ochre, and for ruddy complexions light-red alone; of course, the thinning with magilp being understood in all cases. The first flesh tint should be laid like the others, with a flat sable, and softened with a clean brush of the same description. Mix some carnation with madder-lake, Naples yellow, and a little yellow-ochre (more of the latter for male complexions), and lay it where wanted, viz., from the wing of the nostril downwards towards the corner of the mouth, then upwards towards the ear, a little over the lower part of the ear, and round the chin; and in fair complexions upon the shadows, upon the forehead, softened and graduated into the local tint. Now warm up the deeper shades with light-red, Indian-red, and in some parts vermilion; for instance, the upper lip, if very dark, may want vermilion to brighten it up to the proper colour; if so, the line below the lip may be touched in with Indian-red. The nostrils, the deepest shades under the eyebrows, and on the extreme edges of the shaded side of the face, and the shade under the chin, may all be treated with the

same colour used thin and transparent, and the edges softened into the half-tints. The under lip must now be put in with madder-lake, vermilion, and Naples yellow, shaded with Indian-red. The local colour of the eyes should now be put in with a transparent tint of the proper colour, and the reflected light upon the iris put in with body colour; for instance, if the eyes are blue, or blue-grey, pass a flat tint of cobalt all over the eye, deepen the pupil with cologne-earth, and put in the reflected light with cobalt-white and a very little light-red to temper the positive blue. The high light upon both balls and white may be touched in sharply with the same colour, but with considerably more white. If this is done as described, you will seldom want to touch upon the eyes again. The next thing to attend to is the high lights upon the face. For the forehead use Naples yellow, madder-lake, a little yellow-ochre, and a little white. Put the high lights on in their proper places, the upper part of the forehead and over the eyebrow, and soften the edges into the flesh tint, being careful to keep the shape of the lights, and not to spread or work the solid colour too much. The same colours, omitting the white, and adding a little light-red and emerald-green, may now be used to graduate the flesh tint into the shadow on the shaded side of the forehead. Now, working downwards, using only Naples yellow and madder-lake, put in the high light upon the cheek-bone, graduating downwards, on the rounding of the cheek, and graduating it into the general tint of that part of the face. Touch in the light on the upper eyelid, and the light under the eye next the nose which strikes downwards towards the wing of the nostril, mark the line down the nose, and strengthen the light upon the nostril, the upper lip, and upon the chin and neck; the shaded side of the face can be treated in the same manner with the same colours, only adding the light-red and emerald-green to subdue the brightness of the tints. At this stage the picture must be left to dry, and when dry a few touches will finish it.

When thoroughly dry, charge a large hog-hair brush with magilp, breathe upon the picture, and, before the moisture has disappeared, rub the magilp over face, hair, and dress. If the face should not have colour enough, a little of the flesh-tint with the magilp will make a wonderful improvement; if too pink, a little yellow-ochre; if too yellow, a little pink. A few touches only should be needed upon the face. Perhaps the high-lights want strengthening; the deepest shades deepening or lowering, a few sharp touches about eyes, nose, and mouth; the line between the lips may want strengthening with Indian-red and madder-brown; the nostrils can have a touch with the same colour; and the cast shadows of the nose, and the deepest shade under the eyebrows. Any shadows that may be too warm may now be corrected with light-red and emerald-green; the deepest shades of the hair may now be strengthened, and high-lights touched in with solid colour. The coat or dress should be treated in the same way, a black coat being strengthened in the shadows with blue-black, carefully keeping to the photographic shadows on both hair and dress. The high-lights in black-silk can be touched in with Payne's grey, and white, with just a little Cologne-earth to subdue the brightness of the Payne grey. White collars, lace, &c., should not be painted in with pure white. Flake white and Naples yellow should be used for high-lights, and cobalt-blue, yellow-ochre, and white for the shadows.

It will be seen from this brief description that no part of the photograph has been obscured with colour, the only solid colour being in those parts where in the photograph we have white paper, and all the other parts being overlaid with transparent colour, through which the photograph is allowed to show. If this principle is carefully adhered to, losing the likeness is an impossibility.

PROF. TAIT ON MIRAGE

ON Friday last, Prof. P. G. Tait gave a lecture on Mirage before the members of the Edinburgh Philosophical Institution. Commencing with a reference to the phenomenon as seen in looking along a road on a summer day, and pointing out that the effect observed, under those circumstances, was similar to that produced by mixing two liquids of different refractive indices, such as alcohol and water, Prof. Tait went on to speak of the form of mirage seen in the desert, where there were vast tracts of sand heated by the sun, and the layer of air in contact with the sand was consequently hotter than the air above it. This, he said, occasioned a peculiar distribution of density: there was a gradual increase of density for a considerable number of feet above the surface. Light, therefore, moved a good deal faster in the layer near the hot sand than a few feet above it; and the rays from objects falling into that layer were bent upwards, and reached the eye of the observer as if reflected from the surface of the sand. Rays coming through air in this way irresistibly conveyed the idea of a reflecting

* By G. CHOCORON, in the *Photographic News*.

surface, and that gave rise to the impression that there were pools or lakes of water on the dry sand of the desert. The phenomenon was very carefully observed by the scientific men attached to the French army in Egypt in the end of last century, and Monge had given a most complete explanation of that form of mirage. A second form was that observed in the Arctic regions, of which a great many beautiful illustrations were given by Scoresby. The principal phenomenon here was what was called "looming," where a distant object showed an extravagant increase of vertical height, without any alteration in breadth. Distant hummocks of ice were thus magnified into immense towers and pinnacles, and a ship was sometimes abnormally drawn out till it appeared twelve or fourteen times as high as it was long. The celebrated Fata Morgana of the Straits of Messina was of the same character. Rocks were seen drawn up to ten or twelve times their proper vertical height; and houses, as well as human beings and animals, appeared in the like exaggerated form. The most remarkable instance on record of this form of mirage was one observed in 1798. From Hastings, forty or fifty miles from the French coast, that coast was seen quite distinctly. In ordinary weather it could not be seen at all, owing to the rotundity of the earth; but on this occasion it appeared to be elevated above the horizon, so that fishermen on the Hastings shore could point out the various harbours and promontories, as if they had been only a few miles distant. A third and perhaps the most extraordinary form of mirage was that observed by Vince in 1799, in which a ship at sea showed three distinct images—a lower and an upper one in the upright position, and an intermediate one in which the object stood upside down. Prof. Tait devoted the remainder of his lecture to an exposition of the cause of this phenomenon, which, he said, Wollaston reproduced by looking along the under side of a heated poker at an object held just below its point. Premising that light moved in straight lines only so long as it moved in a uniform medium, and that when it passed through a medium whose refractive index gradually changed, there was a correspondingly gradual change of direction, he explained, by the help of diagrams displayed by the limelight, the behaviour, under different circumstances, of the curved rays proceeding from an object to the eye. It was pointed out that when the curve passing through the vertices of those light curves lay towards the eye, the object was seen inverted, but when it lay from the eye there was a direct image; and an arrangement of light curves, such as would produce the three images in question, was shown to occur where a stratum of cold air below was separated from a warm stratum above by an intermediate stratum, in which the density gradually decreased from the cold to the warm. The phenomenon was produced in view of the audience by placing a flannel behind a glass vessel containing brine at the bottom, pure water at the top, and between the two a stratum in which they were intermixed.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE third meeting of the above Society was held on the 14th inst., at King's College, the President, Professor P. Martin Duncan, F.R.S., in the chair.

There being no donations to announce, Mr. Crisp suggested that the President should be presented with a pair of black gloves.

Mr. Crisp exhibited Parkes' Drawing-room Microscope, also two bottles from Prof. H. Van Heurck, of Antwerp, containing new fluids for use with homogeneous immersion-lenses; one with a refractive index of 1.610, and a dispersive power of .0072, and the other of the same index, but a dispersive power of .0077.

Mr. John Mayall, jun., exhibited Mr. Déby's method of turning the correction collar of objectives—the chief peculiarity of which was, that the collar was worked by a tangent screw (with a long arm) acting upon a worm-wheel, instead of by the ordinary collar adjustment, which Mr. Déby had found to be inconvenient. As at present made, it would not go into an ordinary box, but (as had been pointed out by Mr. Beck), the screw-pinion might be considerably shortened, so as to admit of its being put in a box in the usual way.

Mr. Beck said that it must be borne in mind that in adjusting an object-glass it was often desirable to get a sudden adjustment, which could not be very well done with this form.

Mr. T. Charters White described, by means of blackboard drawings, a new form of growing-slide which he had recently devised, and exhibited the slide in action under a microscope.

Mr. James Smith said he had been trying himself to work out some better form of growing-

slide than those in common use, but his attempts had hitherto proved abortive. He was, however, very much pleased with the one now shown by Mr. White, the great advantage of which was, its extreme simplicity, and its capability of keeping objects alive for any length of time.

The President thought that its only disadvantage would be that when carefully examining one particular individual, others might be introduced into the cell by the flowing water. With some kinds of organisms there would, of course, be no such danger, but it would hardly be safe with an *amaba*, for instance. He had himself found, when studying the life-history of minute species, that it answered very well to make a small cell of ordinary thin glass, and by surrounding the whole with blotting-paper, kept constantly wet, he had been able to retain three or four monads of large size under constant observation for several weeks. A similar arrangement to that adopted by Mr. White had been used on the human body as a means of applying evaporating lotions.

Mr. J. W. Stephenson said he had brought for exhibition some scales of insects (*Machilis maritimus*, and *Tomocertus [Podura] plumbea*), mounted in phosphorus, and shown under a 1.25th inch objective with very oblique light and the binocular. They demonstrated that it was possible even with such a high power to get with the binocular a distinctly stereoscopic effect, and that when so seen a much more perfect idea of the structure of the scale could be obtained than was possible under the monocular. Although the structure of the scales of *Machilis maritimus* and *Tomocertus plumbea* is probably the same, they cannot be said to be corrugated in either case. In *Machilis* the appearance of the upper side is that of longitudinal semi-cylindrical grooves, which has been likened by a medical gentleman to a pill-machine, whilst the latter, probably from being so much smaller, appears to have rectangular grooves, similar to those in a currycomb, the back being in each case supported by slender transverse bars, which are approximately half the distance apart of the longitudinal divisions.

Mr. Beck said that as to the *Podura* scale shown by Mr. Stephenson, what he described with respect to the structure of the scales was entirely opposed to what they had been shown to be. In such matters where high powers and oblique light were used, he thought it was very doubtful if they ought to believe what they saw, as they might so very easily be deceived by appearances. So far as he knew, no one had hitherto brought forward anything which would refute what he had shown some years ago, when he put moisture on one side of a scale, and found that it dried off quite flat, whilst if he put some on the other side, it ran up and down as if in corrugations. His brother also did the same kind of thing with a *Lepisma* scale and Canada balsam. Moisture, as they knew, would get into slides which were mounted dry, and the same appearances were presented there. Having kept the insects, and being able to tell which was the upper, and which the underside of the scale, and being also able to show these corrugations in a mechanical way, he could only say that even if the effect could be seen as described by Mr. Stephenson, he should not, he was afraid, be convinced, for he knew very well that in most cases, by reversing the shadows, they could reverse the appearances. If they wanted to determine the real structure with high powers, they must argue from analogy rather than from what they saw. They had compound substances to deal with, and effects were produced which had to be studied and analysed and examined very carefully. Unless, therefore, anyone could show upon the upper side what he had shown mechanically on the under side, he considered that the appearances obtained by simple vision were deceptive.

Mr. Stewart said he recollected some time since that a microtome was made, so delicate in its adjustment as to be able to cut sections of a valve of a diatom. Could not this be made available for making sections of the scale which would show the configuration of it as conclusively as if done in the mechanical way?

Mr. Crisp said that the existence of such a microtome had been reported, and he had endeavoured to obtain it, but hitherto in vain. So far as he knew also, no results obtained from any actual sections had been published.

Mr. Stephenson said that notwithstanding Mr. Beck's remarks, he could not but feel clear as to its being the upper side of the scale on which these grooves were, for the "quill" of the "feather," which is necessarily on the opposite side to the grooves, was bent down from the plane of the scale, and the markings were clearly on the opposite side to that.

Dr. John Anthony's note was read by Mr. Stewart, suggesting the statoblasts of *Lophophorus crystallinus* as a test for high powers. The difficult part was stated to be the structure of the membrane. The portions of the statoblasts referred to were drawn on the board and further explained by Mr. Stewart.

Mr. de Souza Guimaraens called attention to what appeared to be a male specimen of the *Echinorhynchus* of *Lota vulgaris* with ova in the interior, described as *dedans par hasard*.

Mr. A. D. Michael read a paper "Further Notes on British *Oribatida*," which Prof. Huxley and others state to be wholly viviparous. He finds, however, that they are chiefly oviparous, as stated by Nicolet and others, and that the young are brought to maturity in, at least, four different modes:—1st. The egg is deposited in a slightly advanced stage, as in insects. 2nd. Deposited with the larva almost fully formed. 3rd. The female is occasionally viviparous (in these modes only one egg is usually ripe at a time). 4th. Several eggs are matured at once, but not deposited. The mother dies, the contents of her body, except the eggs, dry up, and her chitinous exterior skeleton forms a protection throughout the winter to the eggs. The occurrence of a deutonymph stage in the egg is recorded, i.e., the egg has a hard shell which splits into two halves as the contents increase in volume, the lining membrane showing between, and gradually becoming the true exterior envelope of the egg. Several new and interesting species were described and figured, and exhibited under microscopes.

The President said he was very glad that Mr. Michael did not form a new species from a single specimen. The history of the death of the parent-insect before the escape of the ova was, he thought, very anomalous in nature; indeed, he did not remember anything at all like it. Many of the *Lepidoptera* died very soon after the eggs were laid, but he knew of no case in which this remarkable circumstance had been observed.

Mr. Stewart did not remember any in which the eggs were retained in the body of the dead mother, but in the case of the *Coccus* there was something, perhaps, a little like it, the mother dying immediately after the deposition of the eggs, and forming a sort of roof over them with her dead body, which served to protect them during the winter.

Mr. J. W. Stephenson said there was one mounting fluid which, with the exception of phosphorus, had a higher refractive index than anything known. This was biniodide of mercury. It had been used by Mr. Browning for prisms, and had an index of 1.33 to 1.68. The index of biniodide of carbon was 1.624, of mono-bromide of naphthalene, 1.658, and of sulphur, 1.662, so that the biniodide of mercury was .06 higher than biniodide of carbon. The biniodide of mercury was dissolved in a saturated solution of iodide of potassium. Mr. Browning found that the means of sealing it was by using white wax. He had brought some of it to the meeting as a sample.

The President said he had had his eyes opened to the value of this solution as a highly refractive medium, but had been disappointed, in consequence of being told that it was only useful for purposes of spectrum analysis, in consequence of the green effect which it had on the red rays.

Mr. Stephenson did not know how far its enormous dispersive power would be prejudicial, but he had tried it for mounting, and found that it was very well for diatoms.

Mr. Symons read a paper on "A New Stage for the Microscope," the details of which were drawn upon the board and the apparatus itself exhibited.

The President inquired if Mr. Symons had used this stage for observing the motion of the white blood corpuscles. He also suggested that the stage would be better if it came rather more flush with the plate.

Mr. Symons had not examined corpuscles with the stage, having hitherto only applied it to maintaining the melting-points of various substances. He thought there would be no difficulty in using high powers with it, as the objective would be brought into actual contact with the glass if desired, the only thing between the plate and the objective being the thin glass.

The Hon. W. N. Jocelyn, Dr. W. R. B. M.A., Mr. T. Wright, and others, were present.

The meeting was then adjourned to January 2.

Calvert's *Mechanics* ninth year's issue of this has made its appearance, and even better than the last, it shall have said sufficient. The might be replaced with advantage from the technical serials.

A good cement to close the stove can be made of wood mixed with an equal quantity of a little salt. Moisten the paste, and fill the cracks with it. The cement will not peel off very hard after heating. It joints in stove-pipes when tight.

SCIENTIFIC NEWS.

It is regretted that we have to announce the death of Wm. Radcliff Birt, F.R.A.S., well-known selenographer, who died at 11 o'clock on the 14th inst. Mr. Birt had been ill for some time, but his death took rather suddenly. Mr. Birt joined the Astronomical Society at the commencement of 1859, and since then he had made himself a master of lunar details. Many professional astronomers and numerous amateurs regret his loss.

The fate of the *Jeannette* is known at last. It was crushed by ice in lat. 77° N., long. 100° E., while endeavouring, apparently, to reach the N.E. passage, or to work further north the coast of Asia. The crew left in three boats, one of which, under the command of Lieut. Melville, has reached a place of safety on the Lena, while the third boat, under Lieut. Schlegel, is known to have reached the mouth of the same river, but the crew reported to be in a starving condition. Parties have been promptly sent out, and it is to be made for the second boat. The boats were separated by dense fogs about 100 miles from the mouth of the Lena.

Experiments of storage batteries for electricity coming rather common—there are several now, Mr. Brush has one, Edison has one, now we hear that Mr. Henry Sutton, of Sydney, in Australia, has also devised an accumulator, which is reported to be superior to all others.

The exhibition of electrical appliances at the Crystal Palace will not be complete until January. In addition to the Siemens railway, an electric tramway is being constructed on one of the roads, and it will be worked by Faure's system.

There is some probability that the Canonbury railway accident will lead to the introduction of telephones, at all events on crowded metropolitan lines. The invention is, no doubt, one of abuse; but in such circumstances as occurred on the 10th inst., it might have been of use in preventing the disaster.

J. H. A. Macdonald, formerly Solicitor-General for Scotland, has invented a "holo-course indicator," an electric apparatus designed to diminish the risk of collision at sea. The indicator consists of an arm with a light which is carried round with the motion of the rudder, so that the light indicates by the direction of its beam the course steered by the vessel. The device is not patented, so that there is little chance of its coming into use. The inventor considers he has done a service to the world by leaving his invention free to everybody, and we may remember the true saying of the poet, that if a potentially valuable thing lay in the gutter, no one would pick it up.

Awards of the jurors at the Glasgow International Society's Exhibition of Apparatus for the Utilization of Gas, Electricity, &c., have been decided. No awards are made at all for lighting appliances; but in minor prizes, Bruce, Peebles, and Co. get an award for electric flash-signalling. For gas lighting appliances awards were made to the Sun Auto-Pneumatic Heating Company, the "Alpha" machine, and Pintsch's Lighting Machine. Mr. T. Fletcher, of Warrington, got an award for laboratory apparatus, and a medal for a collection of gas furnaces, and apparatus designed for chemical and electrical operations. Stott and Co. receive a medal for gas regulators.

Received a paper on "Cooking and Gas," read by Mr. W. Denny, Philosophical and Literary Society, which is valuable on account of the experiments made by his assistants. It is published in the *Proceedings* of the Society.

Gresham Angling Society we have one on "The Causes of the Apparent Fish in the Thames," by Thos. which will interest anglers; and

another by C. S. Bentley, F.R.M.S., on "The Sense of Pain in Fishes," which is an interesting and scientific essay. These papers are published by Darling and Son, Eastcheap.

From Mr. M. N. Forney, of New York, we have a pamphlet on "Attachments to Locomotive Boilers," pointing out the risks run by drivers and firemen in consequence of the numerous attachments which are liable to be knocked off by a trivial accident. The suggestion is that many of these attachments might easily be placed in positions in which they would not be liable to be broken.

M. Deherain concludes that the electric light is capable of giving a certain impetus to vegetation when it supplements the ordinary action of solar light and heat, but is incapable of supplying this of itself, and the plants, being forced to draw on their own vitality, speedily become exhausted. M. Deherain thinks that the electric light produced by the voltaic arc has only a feeble and uncertain action on vegetation.

M. Goppelsroeder, of Mulhouse, shows the feasibility of making certain colouring matters by electrolysis, which he first announced in 1875 in a paper to the Industrial Society of Mulhouse. Many of the most beautiful of the aniline colours are obtained by him by the electrolysis of the chlorhydrates of methylaniline and other aniline products. Artificial alizarine is prepared at the positive pole from a mixture of anthraquinone and caustic potash.

The deposit of metallic layers of different colours by means of electricity is now effected by M. Weil (*Comptes Rendus*). He can coat any metal or alloy instantaneously, at ordinary temperatures and by means of a single copper bath, with an adherent bright layer of various suboxides of copper, whose chemical nature is not yet studied. The same bath gives the whole series of colours at will, according to the mode of exposure of the pieces. There is no battery, properly so called. That the colours are not due to suboxides of copper and not an effect of thin plates, M. Weil proves thus: Any metallic piece, polychromised by his process, is covered at once with a layer of pure copper, of fine red colour, when treated with nascent hydrogen.

Two new kinds of preservative paper (according to the *D. A. P. Zeit.*) have lately come into commerce. One is produced by dipping soft paper in a bath of salicylic acid and then drying. The bath is prepared by mixing a strong solution of the acid in alcohol with much water. The paper is useful for covering apples, &c. The other paper, meant to preserve from moths and mildew, consists of so-called Manila packing paper, dipped in a bath and dried over heated rollers. The bath is formed of 70 parts spirit of tar, five parts raw carbolic acid (containing about a half of phenol) 20 parts coal-tar at 160° F, and five parts refined petroleum.

One of the most delicate problems of photometry is the measurement of the illuminating power of lights of different colours. This has been lately treated by MM. Crova and Lagarde, on the principle that the illuminating power of a simple light may be considered as its power of showing small details (lines, &c.) on the illuminated surface. They compared sunlight and Carcel lamp. The light is received on the slit of a spectro-photometer, covered with a glass plate on which are photographed a number of very fine close lines, at right angles to the slit. These lines appear in the spectrum. The eye-slit of the telescope is limited to a set of simple radiations, and by suitable rotation of a Nicol prism, their intensity is reduced till the lines cease to be perceptible. Thus a means of comparison is had. The authors find the maximum of illuminating power, in the Carcel lamp, to correspond to the radiation 592, and in sunlight, to 564. An interesting memoir on the same subject, by MM. Macé and Nicati, appears in the *Annales de Chimie et de Physique* for November. The authors introduce two new expressions, *coefficients of equal intensity*, and *coefficients of equal visual acuteness*. They have determined, for a normal observer, and for different values of visual acuteness in 14 definite parts of the solar spectrum, the values of coefficients of equal acuteness. They show that Purkinje's phenomenon is not, or hardly, produced with radiations less refrangible than $\lambda = 0.507$, give a curve of the distribution of

light in the spectrum, and indicate the relation between visual acuteness and intensity for each radiation.

A photograph, probably the largest ever printed on a single sheet of paper, is now being exhibited in the art gallery of the American Institute in New York. It was printed from seven negatives, and covers an area of over ten feet in length by about eighteen inches in height. So perfectly have the negatives been joined that it is impossible to locate the joints. The photograph is a panoramic view of the Centennial Exhibition in Philadelphia. Duplicates of this picture have been sold at very high prices, and one was presented to our Queen. The artist is F. Gutekunst, of Philadelphia.

Continental papers often manifest an odd perversity in the spelling of English words or names. The following list, in a recent issue of *Cosmos Les Mondes*, of members of the committee appointed to co-operate with the Crystal Palace Directors, with regard to the exhibition, is amusing in this respect:—M. William Siemens, M. le Professeur Andrens, Sir W. Coles, M. le Professeur Fleming—Jankeng, M. W. Clowky, Sir G. J. Keed, Sir Edward Wietken, Sir Herbert Sundford! Professor Hughes' name recently appeared in a French paper as Gouge!

A short time ago a Dresden chemist, Dr. Fleck, attributed the production of pimples and inflammation on the forehead of some persons, in hot weather, to the presence of fat or fatty acids in the leather lining of hats. A denial of this by the German hatmakers' paper has led him to get a number of samples of the leather used by Dresden hat-makers, and analyse them. He finds that all the leathers contain fat, though in various quantities; that the quantity is greatest in the so-called Belgian leather (as also the proportion of rancid fat to the entire fat); that there is least fat in the German red leather, sold in skins; that even chamois-dressed leather contains fat, but the amount of fatty acid is less on account of the treatment with alkalis. These results are not surprising when the mode of preparing leather for hats is considered. The amounts of fat and fatty acid given in Dr. Fleck's table are indeed small, but quite sufficient (he thinks) for the effect in question. The effect of putting a little rancid ointment on an inflamed part of the skin makes it easy to comprehend how an irritable brow may behave when rubbed with leather in which is rancid oil. Dr. Fleck experimented on himself, by rubbing his forehead with emery paper, and then applying a leather-sample for 24 hours; this distinctly increased the inflammation and caused pimples. Using leather from which all fat had been removed, the pain and inflammation quickly ceased. Rubbing the greasy leather with burnt magnesia is the remedy Dr. Fleck recommends.

The great depth of 5,100 metres (say 17,000 ft.) was lately reached in dredging from the French Government Vessel *Le Travailleur* in the Bay of Biscay. Numerous animals were there found, of small size, indeed, but belonging to elevated groups, such as annelids and crustaceans; there were also various foraminifera, &c. The temperature of the water at that depth was + 3.5°. This cruise of the *Travailleur*, in August, was off the coasts of Spain and Portugal, and followed one in the Mediterranean in June and July. Both seem to have been very fruitful for zoology. (Some account of the results has been given to the French Academy by M. Alph. Milne-Edwards.) The close affinities of the Mediterranean and Atlantic fauna, and evidence that the former probably arose through migration of the latter, are among the main facts established. Many new genera and species have been discovered.

The Japanese Government have resolved that an International Fishery Exhibition shall be held at Tokio in 1883, and comprehensive arrangements are already in progress. The organisation has been intrusted to M. Matsubara, who acted as Imperial Japanese Commissioner to the Berlin Fishery Exhibition last year, and with great credit. Japan possesses a great abundance and variety of fishes, crustaceans, molluscs, corals, and other aquatic animals; some striking specimens of which appeared at the Berlin Exhibition.

An oscillating water-power engine has been devised by Herr Kröber, of Stuttgart, which can be used at once as a motor and a pump. It

has a thick piston-rod, and the end of the cylinder is curved, so as to oscillate on a distributing head, of corresponding shape, which has three passages, whose communication with the cylinder varies during the oscillation. The engine is figured in the *D. A. Pol. Zeitung*.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made Payable to J. PARNELL EDWARDS.

* * * In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physics: a view from whence great inconveniences derive their original."

—Montaigne's Essays.

JUPITER.

[19529].—THE delicate copper-coloured streak of the red spot represented in my drawing in your last issue, and also described by Mr. Denning (letter 19510) and by Mr. Calver (letter 19511) was again observed by me at 9h. 35m. on December 8th, when I traced it through more than 90° of longitude. Though I did not notice its apparent connection with the red spot before the 28th ult., I observed it as a fine thread-like coppery line S. of the S. equatorial belt on November 12th, and on three subsequent occasions. It is remarkable how frequently the Jovian markings repeat themselves both in form and position. In *The Observatory* (No. 33, page 281) is a drawing of Jupiter by Mr. Gledhill, dated 1870, January 23, about 5h. 20m., G.M.T., which shows, among other features, the curious "elliptic ring" then visible, and a fine narrow belt branching from the dark S. equatorial band almost in precisely a similar position with respect to the "elliptic ring" and the equatorial belt as is the apparently new belt described by Mr. Denning, Mr. Calver, and myself. There are one or two inaccuracies in my last letter which, with your permission, I will correct. The white cloud-like patches between the S. equatorial belt and the planet's equator were bordered by festoons of a decided bluish-grey colour, and the copper-coloured streak referred to above extends eastward, not westward, of the red spot. Your engraver has shown the N. equatorial belt and that S. of the red spot far too dark. I quite agree with "F.R.A.S." and "M.A." that the red spot is becoming paler and more ethereal.

Bedford, December 17.

Thos. G. Elger.

GREAT COMET OF 1861.

[19530].—In reply to Mr. Baird Gemmill, the hypothesis put forth in "E.M." was that the apparent tail was really the geocentric projection of the heliocentric path in the immediate neighbourhood of the comet, which path was made visible by the existence of a condensed meteor stream, and that, consequently, the tail was not, as usually supposed, in the direction of the comet's radius vector. Whence it follows that the earth in 1861 did not pass through the comet's tail, and the atmospheric phenomena must be attributed to some meteorological cause.

A good test of the hypothesis, although somewhat laborious, would be to calculate the angle projected on the heavens between the geocentric path of a comet and the tail, calculated in accordance with the above-mentioned hypothesis, and compare with observation at certain intervals, especially when, during the visibility of the tail, the projection of the earth upon the comet's orbit comes into opposition or conjunction with the comet. By such a test must the hypothesis stand or fall. The simplicity of it is, of course, very great.

W. O. E.

SATELLITES OF SATURN.

[19531].—THE apparent major and minor semi-axes of the disc of Saturn, of the outer rim of the ring, and of the ellipses described by the five inner satellites, will be:—

	1882.	Jan. 4.	Jan. 14.	Jan. 24.	Feb. 3.
Disc ..	9.2	8.4	9.1	8.3	8.9
Ring ..	21.3	6.6	20.9	6.5	20.6
Mimas.	29.1	9.0	28.6	8.9	28.1
Enceladus ..	37.3	11.6	36.6	11.4	36.0
Tethys ..	46.2	14.3	45.4	14.1	44.5
Dione ..	59.2	18.3	58.1	18.1	57.1
Rhea ..	82.6	25.6	81.1	25.2	79.7

The satellites move in the direction of decreasing position-angles, and will be at their inferior N. (north), and superior S. (south), conjunctions with the centre of the planet about the following Greenwich mean times:—

1882.	Gr. M.T.	1882.	Gr. M.T.
Jan. 1	5.0 En. N.	Jan. 21	16.2 Te. S.
	12.2 Di. S.	22	0.9 Di. N.
	12.8 Mi. S.		6.5 Mi. S.
	20.5 Te. N.		10.8 En. S.
2	11.5 Mi. S.		14.9 Te. N.
	11.5 Rh. N.		19.5 Rh. S.
	13.9 En. N.	23	3.3 En. N.
	19.1 Te. S.		5.1 Mi. S.
	21.1 Di. N.		9.8 Di. S.
3	6.4 En. S.		13.6 Te. S.
	10.1 Mi. S.	24	3.7 Mi. S.
	17.8 Te. N.		12.2 En. N.
4	5.9 Di. S.		12.2 Te. N.
	8.7 Mi. S.		18.6 Di. N.
	15.3 En. S.	25	1.8 Rh. N.
	16.4 Te. S.		4.6 En. S.
	17.8 Rh. S.		10.9 Te. S.
5	7.3 Mi. S.	26	3.5 Di. S.
	7.7 En. N.		9.5 Te. N.
	14.7 Di. N.	27	5.9 En. N.
	15.1 Te. N.		8.0 Rh. S.
6	5.9 Mi. S.		8.2 Te. S.
	13.7 Te. S.		10.9 Mi. N.
	16.6 En. N.		12.3 Di. N.
	23.6 Di. S.	28	6.9 Te. N.
7	0.0 Rh. N.		9.5 Mi. N.
	4.6 Mi. S.		14.8 En. N.
	9.0 En. S.		21.2 Di. S.
	12.4 Te. N.	29	5.5 Te. S.
	15.9 Mi. N.		7.3 En. S.
8	8.4 Di. N.		8.2 Mi. N.
	11.0 Te. S.		14.3 Rh. N.
	14.5 Mi. N.	30	4.2 Te. N.
9	6.2 Rh. S.		6.1 Di. N.
	9.7 Te. N.		6.8 Mi. N.
	10.4 En. N.	31	2.8 Te. S.
	13.1 Mi. N.		5.4 Mi. N.
	17.3 Di. S.		8.6 En. N.
10	2.8 En. S.		14.9 Di. S.
	8.4 Te. S.	Feb. 1	1.5 Te. N.
	11.7 Mi. N.		4.0 Mi. N.
11	2.1 Di. N.		23.8 Di. N.
	7.0 Te. N.	2	0.2 Te. N.
	10.4 Mi. N.		10.0 En. S.
	11.7 En. S.		22.8 Te. N.
	12.4 Rh. N.	3	2.7 Rh. N.
12	4.1 En. N.		8.6 Di. S.
	5.7 Te. S.		21.5 Te. S.
	9.0 Mi. N.	4	17.5 Di. N.
	11.0 Di. S.		20.1 Te. N.
13	4.3 Te. N.	5	9.0 Rh. S.
	7.6 Mi. N.		18.8 Te. S.
	13.0 En. N.	6	2.3 Di. S.
	18.6 Rh. S.		17.5 Te. N.
	19.8 Di. N.	7	11.2 Di. N.
14	3.0 Te. S.		15.2 Rh. N.
	5.5 En. S.		16.1 Te. S.
	6.2 Mi. N.	8	14.8 Te. N.
	1.6 Te. N.		20.1 Di. S.
	4.7 Di. S.	9	13.5 Te. S.
	4.8 Mi. N.		21.5 Rh. S.
16	0.3 Te. S.	10	4.9 Di. N.
	0.8 Rh. N.		12.1 Te. N.
	3.5 Mi. N.	11	10.8 Te. S.
	6.8 En. N.		13.8 Di. S.
	13.5 Di. N.	12	3.8 Rh. N.
17	23.0 Te. N.		9.4 Te. N.
	2.1 Mi. N.		22.7 Di. N.
	21.6 Te. S.	13	8.1 Te. S.
	22.4 Di. S.	14	6.8 Te. N.
18	7.1 Rh. S.		7.5 Di. S.
	8.2 En. S.		10.0 Rh. S.
	12.0 Mi. S.	15	5.4 Te. S.
	20.3 Te. N.		16.4 Di. N.
19	7.2 Di. N.	16	4.1 Te. N.
	10.6 Mi. S.		16.3 Rh. N.
	18.9 Te. S.	17	1.2 Di. S.
20	9.3 Mi. S.		2.8 Te. S.
	9.5 En. N.	18	1.4 Te. N.
	13.3 Rh. N.		10.1 Di. N.
	16.1 Di. S.		22.5 Rh. S.
21	17.6 Te. N.		
	7.9 Mi. S.		

The observations of some conjunctions of Mimas with the following end of the ring, which Mr. Common has made in November, leave it doubtful what correction the ephemeris of the satellite really requires. The statement must, therefore, suffice that the conjunctions of Mimas with the ends of the ring will occur about three hours before

or after the predicted times of the conjunctions with the centre. As regards the other four satellites, their approximate places may be easily found with the help of the little table on page 279.

Differences of right ascension between Iapetus and the centre of Saturn at Greenwich noon:—

1882	$\alpha - A$.	1882.	$\alpha - A$.
Jan. 1	+ 37.8	Jan. 21	+ 2.5
2	37.7	22	- 0.2
3	37.4	23	3.0
4	36.8	24	5.7
5	36.0	25	8.3
6	35.1	26	11.0
7	33.9	27	13.5
8	32.5	28	15.9
9	31.0	29	18.3
10	29.2	30	20.5
11	27.4	31	22.6
12	25.3	Feb. 1	24.5
13	23.2	2	26.0
14	20.9	3	28.0
15	18.5	4	29.4
16	16.0	5	30.6
17	13.4	6	31.7
18	10.7	7	32.5
19	8.0	8	33.2
20	+ 5.3	9	- 33.6

Iapetus is North of the parallel of Saturn till Feb. 2nd, when it passes the parallel and remains afterwards on the south side.

A. Marth.

66, Lambeth-road, S.E., Dec. 17th.

SELENOGRAPHICAL—AN OBSCURING MEDIUM.

[19532].—SOME attention has been drawn lately to the question of an obscuring medium on the moon, and in the letters on the subject two classes of phenomena seem to be indicated. An obscuring medium may be regular, occurring in some particular part of each lunation, or its appearance may be as variable as volcanic eruptions are on the earth. "M. A.'s" letter (19332, p. 159) apparently refers to the first class. If there is water on the moon, the sun's rays will undoubtedly raise some of it, perhaps all of it, in the form of vapour. I remember reading in some work on the moon—I think Nasmyth and Carpenter—a denial of the possibility of the existence of water-vapour on the moon because the terminator is always clearly defined, which could not be, it was said, were there vapour present, as the vapour would be continually crossing the terminator from the illuminated to the dark portion. If this reasoning be correct, there should be a manifest difference in clearness of outline between the terminators before and after full moon. The temperatures on each side of the terminator after full moon are nearly the same, which is not the case with those on each side of the other terminator. The temperature of the ground which the sun's rays had just left is (as far as we know) above the boiling-point of water, and that of the ground which was about to receive the sun's rays is, we suppose, below its freezing-point; therefore, far more vapour would cross the terminator before full moon than that after full, and as the greatest rush of vapour would very likely be on about the third and tenth days after new moon, the definition might be expected to be worst then. But there yet remains the antecedent question as to the nature of the transfer of vapour. "M. A." says the haziness he has observed only appears when the sun has risen for some time, and if the temperature of the ground was much below the freezing-point before sunrise, and water was present this is—apart from travelling vapour—about what should be expected. The ice would not be melted until after, say, two days of sunshine, and there would be fog. Later, when the temperature had risen somewhat, the fog would be dissipated. As the value of g is much less on the moon than on the earth, water-vapour would not tend to disperse itself as rapidly as it would here; but absence of atmosphere would cause it to expand much more rapidly. If, however, an atmosphere is admitted, even though of considerable tenuity, the dispersion of vapour would be retarded, so that, at all events in the fog-stage, it might be assumed to be at rest. The sun's rays do not reach the insides of deep craters as soon as the surrounding district, so the fog, if any, will rise later, and, if the crater is deeper than the general level, it will be cooler, it may be more concealed by vapour. Ice, if any exists there, is probably melted first by conduction of heat through the ground; this, of course, depends on the size and position of any particular crater.

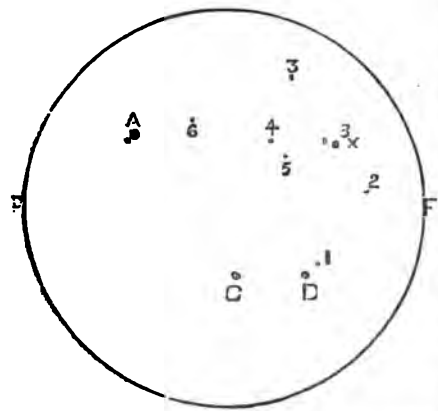
When the sun had set, water-vapour would condense over the whole surface of the moon and not much more in one place than another, so that, when the sun again rose, the vapour would not appear in one or two, or several isolated spots or patches, but would be, to all intents and purposes, uniformly distributed, although certain portions would naturally be covered by water-vapour sooner and in greater quantity than others.

Of the other class of phenomena—viz., those caused by exhalations from craters or fissures, and to which some of those observed by Schröter and quoted by Mr. Birt (letter 19386) may belong, I have nothing to say. Mr. Birt has disposed of them for the present (p. 182). My object in writing is to show that "M. A."s haziness seen over the whole moon is not identical with the bright obscuring spots of which Mr. Birt speaks, and could very likely not have been caused in the same way, and to inquire whether the presence of water-vapour would satisfactorily account for it.

Paugul.

ASTRONOMICAL

[19533.]—I wish to call the attention of your astronomical readers to a group formed by the star 2 Camelopardi, and several small stars near it, which have not as yet, I think, been noticed. They all lie within a circle of about 250' of arc diameter, and will form beautiful tests for good telescopes. I subjoin diagram, which gives pretty fairly, I think, their exact position. The six minute stars, which I should estimate at from 12 to 15 mags., I have numbered according to their difficulty, 1 being the easiest. A is 2 Camel. with



its comes, B Webb's small pair following 2 Cam. C and D the comparatively large and wide pair to the north. C and D are much larger and more distinct at night than the pair B. Yet in twilight I have noticed that even the small star of the pair B is distinctly visible some twenty minutes before C and D. The group, as drawn, I see with my 8½ Calver and 190 eyepiece. G is very difficult, and required 350, and is then not always visible. This, however, is in my comparatively bad atmosphere. I dare say Mr. Sadler and others will see more stars, which I occasionally fancied I glimpsed; one I suspected where I have placed a cross following B. I shall be very glad to hear what others can do with this group, stating aperture and power.

Dec. 14th.

B. M.

SHAPE AND POSITION OF FLAT, &c.

[19534.]—I AM glad that Mr. Calver (19492, p. 327) has written so decisively on the fallacies that have appeared lately on this subject. Wherever the flat is the mirror must be square with the line which joins the optical centres of the flat and mirror, both vertically and horizontally. Such being the case, how is it possible that there can be any correct position for the flat but in the centre of the large tube.

Even if the eccentricity of the flat, alluded to some time since, necessitated a corresponding change in the position of the axis of the cone of rays in the flat, this would be done by adjusting the mirror to it without altering the position of the flat itself.

But the eccentricity does not need any such adjustment, because there is no optical eccentricity, as seen from the eyepiece, which is the point from which all adjustments are made.

Then, again, as to the shape of the flat: the office of the flat is simply to receive the cone of rays and reflect it through the eye-tube, and it is manifest that if it does this with a margin to spare all round, it is optically a matter of supreme indifference what the shape of it is. It may for this purpose be oval, circular, square, oblong, triangular, or anything else. But there are other considerations which render the ellipse the best shape.

1. The section of the cone at the flat is an ellipse; therefore this shape must be the best to receive and reflect it.

2. It is highly important that while reflecting the cone it should obscure as little as possible the light falling on the mirror. An ellipse obscures less than any other figure, the mount being just circular round it.

3. The shape, as an ellipse, is used as a means of adjustment. When seen from the eyepiece at

45°, it is a true circle, forming consequently a concentric circle round the mirror; this nothing but an ellipse would do. The ellipse, therefore, is the only proper shape for the flat.

I think "Mimas" will see (19491, p. 327), that as there is no means of knowing whether the eye-tube axis makes exactly 90° with the axis of large tube, and the flat 45° with both, it cannot be necessary that they should be precisely at those angles. They will be nearly so—perhaps the nearer the better. All that is really necessary is that the axis of the cone of rays should be absolutely central in the flat, and from the flat absolutely coincident with the axis of the eye-tube.

It is very interesting his seeing Encke's division. I should like to know what time in the evening it was visible, and whether it was invisible earlier. I have several times, as I think, glimpsed it; but the air has not been quite good enough to hold it. I see Ball's division and six moons clearly with 80, mirror 12½ in. Calver.

Fordingbridge.

T. Westlake.

DOUBLE OBJECT-GLASSES AND FUNICULAR POLYGON.

[19535.]—WITH regard to the difference between the form of lenses proposed by "Orderic Vital" and myself, I can only say at present that it has most likely arisen from a difference in the purpose to which the pair of lenses is supposed to be applied. Thus, if I understand "Query" rightly, he wants a pair to be used as a telescope, whereas I rather suspect that Coddington based his calculations on the supposition that his lenses were to be used for microscopical purposes, and this will make all the difference. I have not got his book.

Moreover, when one says that this or that form of lenses is the best, it is, in reality, a matter of taste rather than of mathematical calculation, for it constantly happens that the conditions which will best remedy one defect are not those which will remedy another, so that we must choose between the two.

I would certainly recommend "Query" to wait awhile before he goes to any expense in the matter. If he grinds his own glasses, it will be another thing; he may be gaining skill by practice. But I have not much confidence that the plan which I proposed will be any great success, for the reason which I have given before—namely, that the magnifying power of such an instrument will be small. I am engaged in an experiment myself, and if it is successful I will make the result known.

Most strange statements occasionally creep into "our" columns; among them is one which appeared the other day to the effect that, so somebody stated, an equation whose roots are the different values which an expression of the form $a^2 + b^2 - 2ab \cos. c$ can have, may have a negative root!

W. G. P.

CLEOMEDES.

[19536.]—IN letter 19386, p. 229, Mr. Birt gives a very interesting account of the fine walled plain, Cleomedes, with reference to an obscuring medium. In May, 1881, a series of observations of this object was begun here, in order to ascertain its present condition, a period of nearly ten years having elapsed since the last observations, recorded in "Selections from the Portfolios of the Editor of the Lunar Map and Catalogue," second issue, were made. The results derived from these observations are so peculiar and interesting, that I am induced to give them very fully, in respect of certain selected objects. These are (1) the craters 1 G^α and 1 G^β, (2) the crater 1 G^β 25, (3) the distribution of the light and shade. It will be most convenient to first give the observations, and then proceed to state what these appear to show; but, first, a short description of Fig. 1 may make it easier to follow the subsequent observations and remarks.

Fig. 1 gives the distribution of light and shade on the floor of Cleomedes. It is not intended to be rigidly accurate, but merely to give a general idea of the principal features under a high illumination. These are (1), a bright, prominent surface, having much resemblance to a fork, composed of the streak 1 G^β 33, the bright region south of 1 G^α, and a bright arm, *g*; (2) a bright, broad streak, which extends from 1 G^α 3 to 1 G^β 25, as part of the line of eruption, and from 1 G^β 25 to the south wall, divided, for greater convenience, into three parts, *b*, *c*, and *d*; (3) a bright, prominent streak, *e*.

The following observations are arranged in order according to the moon's age, the numbers inclosed in [] show their order according to date.

(1) [1] Age 5½ days, 1881, May 3rd, 5½ in. Calver, p. 110—1 G^α plainly visible as a crater, divided into two by a low ridge, the wall on the north being loftier, streaks *c* and *d* visible, but not very bright. (See Fig. 2).

(2) [7] Age 6½ days, Sept. 29th, 2.75 in. achrom., p. 75—Streaks *b*, *c*, *d*, and *e*, were bright and well defined, whilst 1 G^β 33 was very faint and hardly visible. 1 G^α 3 and 1 G^α 4 difficult to make out. Perhaps a little of the ridge *h* (Fig. 3), is shown in the drawing of that date. 1 G^β 25 appeared as a crater, the N. and S. ends being brighter, so as to appear as two bright spots.

(3) [2] Age 6½ days, May 4th, 5½ Calver, p. 110—1 G^α 3 and 1 G^α 4 appeared as in Fig. 2. In place of Grunthuisen's nine lozenges, there was a bright patch, which may be considered as part of streak *c*. 1 G^β 25 as a crater, the two ends being visible as bright spots. Streaks *b*, *c*, *d*, visible, in general faint, though in some parts bright.

(4) [8] Age 6½ days, October 29th, 2.75 in. achrom. p. 75—Streaks *b*, *c*, *d*, *e*, were all bright, much brighter than 1 G^β 33, *b*, *c*, and *d*, were brighter than *e*. 1 G^β 25 appeared as two bright spots, the northern being the brightest.

(5) [9] Age 7½ days, October 30th, 5½ Calver, p. 110—Of streak *b*, there was only a small triangular patch S. of 1 G^β 25 visible. *c* was narrow and only just visible; *d* very faint. Streak *e* was also faint, not well defined, and not of uniform brightness. 1 G^α 4 was very curious; it looked like a long ridge south of 1 G^α 3, casting a considerable shadow, while the ground a little east was brighter. 1 G^β 25 appeared as two bright spots, 1 G^α 3 as one bright spot. The dark portions of the floor, 1 G^α 26, 1 G^β 32, and 1 G^β 36, were seen on this night.

(6) [6] Age 8½ days, July 4, 2.75 in. achrom., p. 102. Streak 1 G^β 33 was not very plain, but *b*, *c* and *d* were bright, and *e* was very bright. The east arm of the fork (*g*) appeared as in (7) post.

(7) [3] Age 11½ days, May 9, 5½ Calver, p. 150—1 G^α 3 was very bright, and merged gradually into the S.W. wall of 1 G^α 4, the ring of which latter was occasionally visible all round, the higher portion of the wall on the north being visible as a bright spot. The fork was visible in its entirety, bright, plain and well defined. Streak *b* was bright, broad and well defined, but *c* and *d* were not noticed. Streaks *a* and *f* were faint. 1 G^β 25 appeared as two bright nearly round masses, apparently just in contact.

(8) [4] Age 12½ days, May 10, 5½ Calver, 110—Appearance same as (7), ante, but the bright region south of 1 G^α 3 and 1 G^α 4 was a little more diffused.

(9) [5] Age 14½ days, May 12, 5½ Calver, 110—Same as (7), ante, except that 1 G^β 6 and 1 G^β 35 were smaller and not so bright, and 1 G^α 3 and 1 G^α 4 were more smudged, so as to be very difficult to make out. 1 G^β 25 was seen as a bright oval spot, only a very slight trace of its double form being visible.

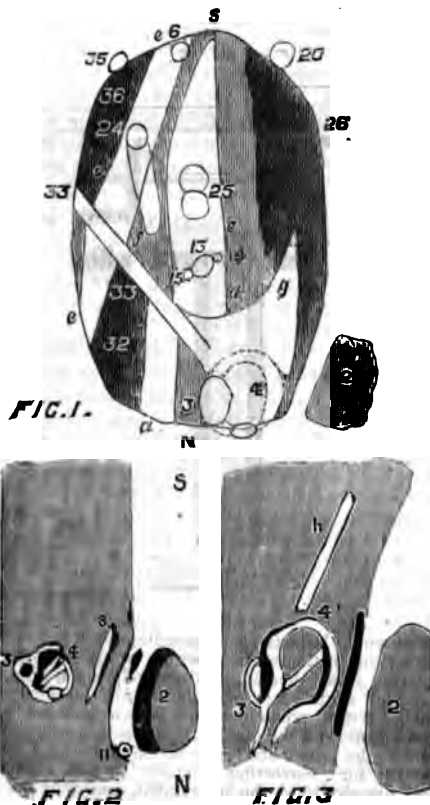
(10) [10] Age 16½ days, Nov. 7, 5½ Calver, 150—A very interesting observation of 1 G^α 3 and 1 G^α 4 was obtained, revealing some features which do not seem to have been noticed before. (See Fig. 3.) Both craters were beautifully sharp and distinct. 1 G^α 4 appeared to be divided into two by a low ridge; on the north the two sides of the wall gradually converged and were lost in the high ground on the north of Cleomedes, thus forming a sort of pass. A low ridge (*h*) was visible running southwards from 1 G^α 4 till it was nearly opposite 1 G^α 13, and exactly in the place of the east arm of the fork. The S.W. wall of 1 G^α 4 was loftier than that of 1 G^α 3, casting a shadow on the wall of the latter. 1 G^α 4 was estimated as being very nearly twice the length of 1 G^α 3.

Schröter's observations of 1 G^α 3 and 1 G^α 4 furnish strong evidence of the existence of an "obscuring medium," which the above observations seem to support. In (5) the S.W. wall of 1 G^α 4 cast a considerable shadow, whilst the ground on the east was brighter and appeared level. This seems to favour the idea that the rest of the crater 1 G^α 4 was hidden by some concealing medium, which caused the light, even appearance on the east. This is important, as Schröter, on Jan. 29, 1789, describes "a mountain with shadow and level ground around," and on March 31, 1789, "a long hill with shadow, with possibly a little unevenness to the east of it." (See letter 19386, p. 229.) The sharp and distinct appearance of the craters on Nov. 7, would seem to indicate a condition unusually free from any concealing medium. The observation (5) is almost precisely the same as Schröter's of Jan. 29, 1789. On both occasions there was a hill with shadow, and level

ground on the east, except that the bright level surface of Oct. 30, 1881, did not quite reach up to the hill; on this latter occasion 1 G²³ was visible as a white spot, rather smaller than usual, as if that, too, was partially obscured.

The change undergone by the crater 1 G²⁵ is very curious and interesting. At first visible as a plain and easy crater, it becomes less and less easily discerned as such, as the lunar day increases; but the north and south extremities become brighter, and the east and west wall much fainter. As the lunar day increases, it appears as two bright round spots, just in contact, thus forming two of the curious row of bright spots delineated by Mr. Birt on April 9, 1869 (see "Selections," &c., second issue, Fig. 27). Towards sunset, it loses its double form and appears as an oval spot, which soon takes the appearance again of a fine large easy crater.

The streaks *b*, *c*, *d*, and *e*, varied very greatly in brightness, not merely altogether, but also *inter se*;



and this variation was entirely unconnected with the moon's age, as will be seen from the above observations, nor are they at all connected with the order of date of these observations. They can, therefore, only be due to two causes—either by the difference of instruments, definition, &c., or by an actual change in the brightness of the different portions of the floor. The variations in brightness are, however, much too great to be ascribed to the first, so that there seems here to be very strong evidence of an actual change, probably caused by obscuring vapours. The excellent series of drawings by Mr. Birt, reproduced in "Selections," &c., second issue, also seem to show great change in the distribution of the light and dark markings.

Of all the full-moon features on the floor of Cleomedes, the streak 1 G²³³ seems to be the most permanent and unchanged in position, brightness, and form, and it seems especially adapted for the purpose of a standard of comparison by which the other objects may be rated.

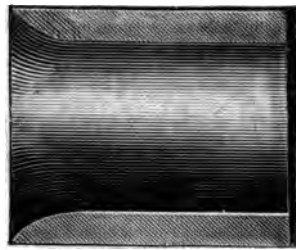
A. Stanley Williams.

Brighton, Dec. 6th.

TESTING FOR POTASSIUM BY THE BLOWPIPE.

[19537].—THE following is an improvement on the usual method of holding the cobalt glass in a clamp, when testing for potassium in the presence of sodium by means of blowpipe flame. Take a large cork, about 1½ in. diameter, and 1½ in. long, cut the central part out, leaving a hollow cylinder, the sides being about ¼ or 3-16 in. thick. Cut a piece of cobalt glass same size, and cementing it carefully round the edges, fasten it on one end of the cylinder. When dry, with a sharp knife pare down the other end, from the inside, until it fits the eye similar to a watchmaker's glass. The sketch shows a section of it complete. When test-

ing, all that is needed is to fix the open end in the eye, same manner as watchmakers hold their

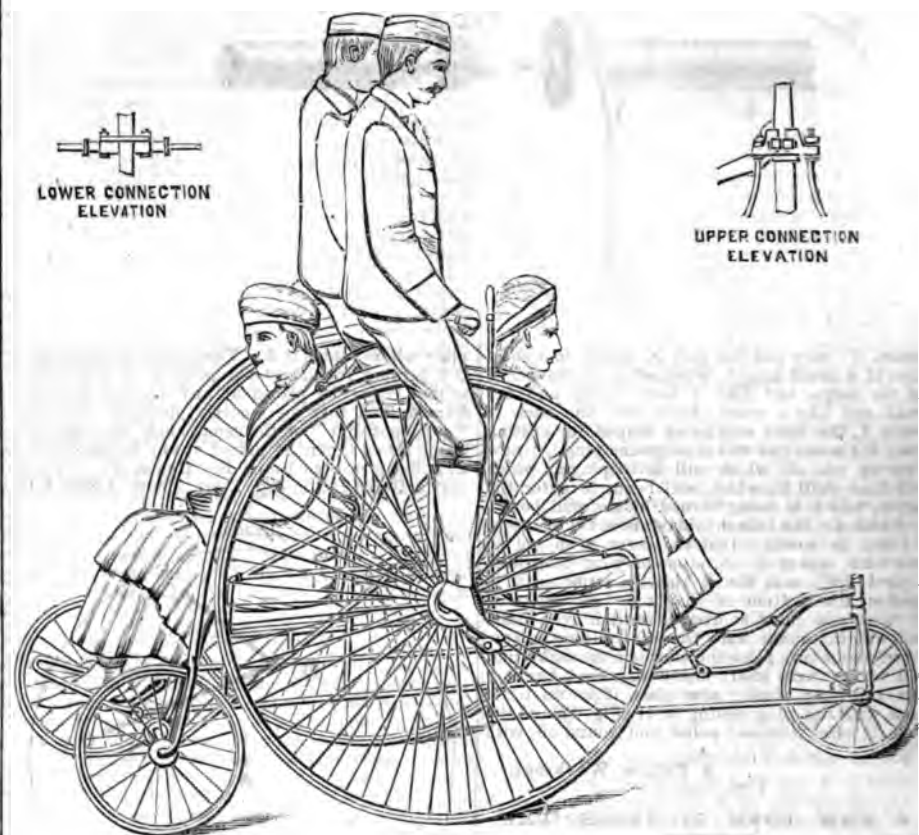


glasses, and view the flame. This piece of apparatus takes up very little room in the blowpipe case, whereas the clamp is cumbersome.

Momus.

THE COMBINATION CARRIAGE.

[19538].—THE sketch sent is a drawing of a machine that will take its place in the market soon.



I send it thinking that it will interest a large portion of your readers. As will be seen, it is a carriage supported by two bicycles, which can be attached or detached in five minutes.

J. Hope.

TRICYCLES.

[19539].—I PERCEIVE that "Sunlight" (letter 19506, page 330) and myself are still at issue on the double driver question.

"No. 170" certainly does gainsay him thereon. A "double-driver" machine is simply one in which the power is applied to both wheels, in contradistinction to the "single-driver," in which it is applied to one only. Surely this definition is good and sufficient. Now, I maintain that the "Salvo" fulfils this condition under all circumstances, and consider that the experiments I mentioned last week abundantly prove this. I will add that this, and other machines on the same principle, divide the power equally between the two wheels, the driving-pinion using the teeth of each of the bevel-wheels with which it is in gear, as a fulcrum from which to drive the other wheel. When, therefore, the resistance to each wheel is equal, as well as the power applied to it, the motion of the machine is straightforward, irrespective of the action of the steering-wheel. When, however, the resistance is unequal (the power always remaining equal), the tendency of the machine is to travel in a curve of a radius proportioned to the inequality of the resistances; this

tendency is restrained by the action of the steering-wheel, which compels the machine to travel in a given path. A portion of the power applied to the free wheel is then expended by it in trying to move the steering-wheel laterally; the steering-wheel resists this effort; this resistance reacts through the bevel wheel to the driving-pinion, and thereby enables it to apply additional force to the other wheel, where the extra resistance has to be overcome, and until it is overcome. Hence it will be seen that the wheels act and react upon each other so as to share the driving power between them equally. It will also be clear that both wheels drive when turning a corner, as at all other times, and not the outside only, which "Sunlight" seems to think the best arrangement. I consider that the action of good balance-gear, enabling both wheels to drive on a curve, is superior to that of any plan which only allows one wheel (no matter which), to be made available.

It may be urged that the effort expended in trying to move the steering-wheel laterally, causes a loss of power. No doubt it does; but the loss is but small, being in proportion to the difference between the resistance on the two sides of the machine, and not, as in the single driver, to the sum of those resistances. The trifling weight re-

quired for steering purposes appears to me to confirm this view.

I think that "Sunlight" should now show the errors, if any, in my experiments, or in the conclusions I have drawn from them, and not content himself with a simple contradiction of my statements.

With regard to the brake question, it should not be overlooked that the tendency to lift the steering-wheel always exists, although it may not always be sufficient to lift it. In the front-steering machine the tendency is just the reverse of this: that is, to press it down instead of to lift it.

I have been much interested in the discussion as to size of drivers, and am disposed to think that "Sunlight's" views are nearly correct, and that a 40 in. wheel, speeded as required, will be the best size that can be used, or thereabouts. My own 40 in. are speeded down to 40 in. for level roads, and to 32 in. for hills. I should prefer more power and less speed for hills, and intend to try some plan to effect this if possible.

No. 170.

PIVOTING WITHOUT THE USE OF THE GRAVER.

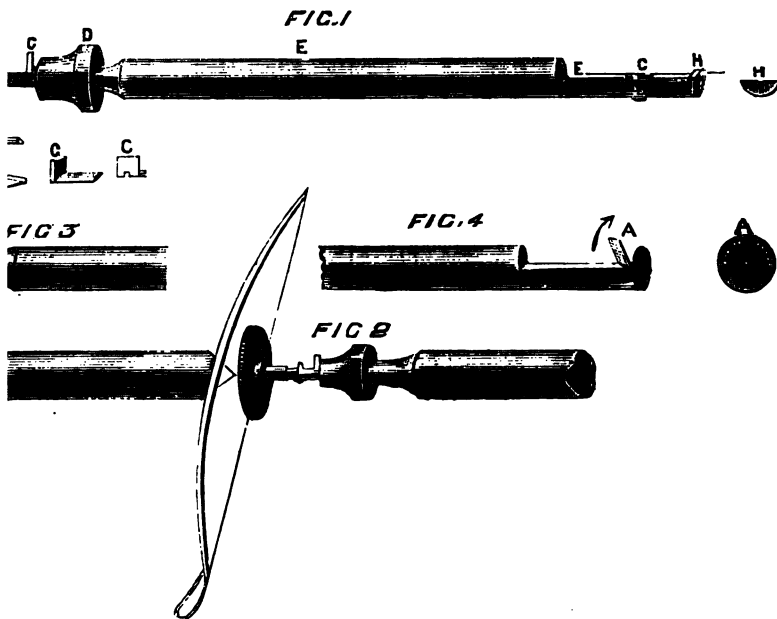
[19540].—I HAVE noticed that some of your correspondents are not very well up in the use of the graver. It is very difficult to turn with a graver hard metal, especially when it is small. I therefore send you a few instructions, with drawings, which will, I think, enable any amateur to pivot any wheel in any

er hard or soft, after he has had ce. Fig. 1 represents a female (J) centres combined, which is the principle for pushing up drill K, led by rose D, which works on a we will take the third wheel of a 2, which is next the centre or hour up pivot is broken, and you wish to another pivot. Fit your rose or e pinion, and fix in turns, as shown ot of the pinion will come into the

Leaving out of consideration the various "chucks" in which this purpose is accomplished by applying motion to the work, I know of only one machine which effects the purpose by applying the motion to the tool, and that is Holtzapffel's epicycloidal cutting frame. I have endeavoured in Fig. 2 to give a sketch of the principle on which this frame is made, leaving out most of the details. A square shank of the ordinary size and shape fits into the tool-box of the slide-rest, and at its extremity at right angles to it revolves a circular

consequently the distances of B from A will form a scale of chords, which are, as we know, not proportional to the angles they subtend. Hence, if we have graduations to show the distances of B from A, these graduations will be in a gradually-diminishing series, and consequently we cannot employ any form of micrometer-screw or vernier to sub-divide these graduations.

This is in itself a drawback which it would be well to remedy; but there is a more serious objection still. It will constantly be the case that we shall wish to perform our pattern by cutting a certain curve, then cutting the same curve a little smaller, then a little smaller again, and so on. To do this it will be necessary, after describing the first curve, to move B somewhat nearer to A; but in doing so we have to revolve the arm BO, which will by the train of wheels cause the tool-box BC to revolve slightly. The effect of this will be that when we are ready to cut our curve with smaller dimensions our tool-point has been moved, and will not start in the same relative position as before. For instance, if our original curve is star-shaped with one point vertical, the reduced edition

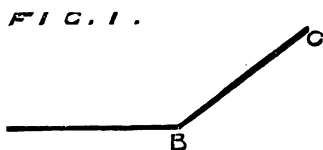


ow put the drill K (which is a short all broach, which must be sharpened end like a cold chisel, and the e a wood chisel) into the back of large end being shaped for cutting ll end will come under plug C; now D, which will drive plug C, which ll K, which will begin to enter the is being turned by the drill-bow—the hole should be about 1-16in. deep. mention that the point A should be tre J. Now make your plug take and file it slightly taper until it bottom of the hole. To make it must shorten it until it goes about make sure there is no burr. Now in., place the wheel on the shake, and ree smart taps with a small hammer; home; now place it in the turns plug resting on H (Fig. 1), and file wanted; polish and round off with

A Fellow Workman.

FORM OF TROCHOIDAL CUTTER.

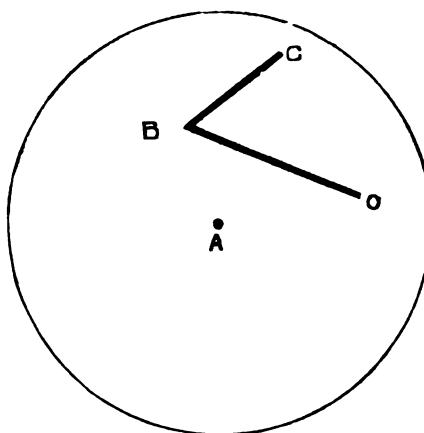
ROBABLY every amateur turner is the ordinary eccentric-cutter, by of various sizes can be traced upon id very many will also know some-lliptic-cutter, by which in the same f various dimensions and in various be traced upon fixed work; my pre-to describe an instrument by which all the various curves known as curves. To explain what is meant we may point out that if (Fig. 1) a nted to a bar BC, so that while AB



nd A as centre, BC can also revolve ntre, then a curve will be described), and the nature and appearance of be wonderfully varied according as elative speeds and lengths of AB and rding as we make BC revolve in the eite direction to AB. Every such rised under the name "trochoid." is to devise an instrument capable such curves.

plate whose centre is A. There is a movable arm O B turning round a fixed point O on this plate, so that B can be placed at any required distance from A, and then be securely clamped. BC is a "cutting-frame" of the usual kind, by means of which a tool C can be placed at any distance from B, and can revolve round B. Hence, it is evident that AB and BC in Fig. 2 are identical with AB

FIG. 2.

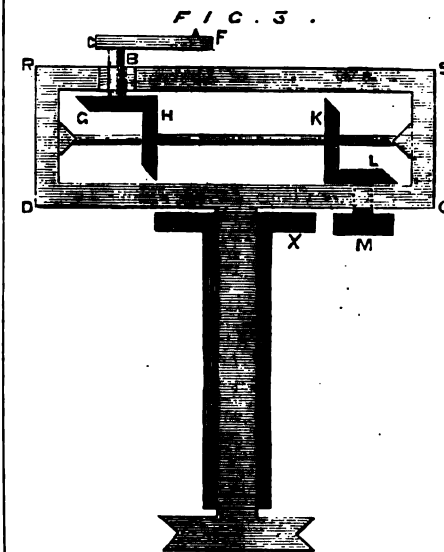


and BC in Fig. 1. The plate A has a pulley behind it, so that by overhead-action we may give rotation to the arm AB: all we have now to contrive is to give an independent speed of rotation to BC in either direction. This is done by fixing a toothed wheel on the boss of the cutting-frame BC, and then, by means of a train of intermediate and idle wheels, we connect this toothed-wheel with a fixed toothed-wheel outside the machine, this fixed wheel being, as a matter of fact, attached centrally to the square shank. It is then clear that as the plate revolves, the wheel which gears into the fixed wheel will be compelled to revolve, and this motion of revolution will be carried by the train of wheels to the tool. The usual device of "change-wheels" and of removable idle wheel will, as in screw-cutting, enable us to impart any speed of revolution in either direction.

If my explanation has been clear, it will be seen that Holtzapffel's instrument entirely fulfils the purpose of cutting any variety of trochoid, and is capable of the most perfect and beautiful work; it has, however, one serious drawback, which I wish to point out, and which I propose to remedy. It will be seen that as B is moved from one position to another, it traces the arc of a circle, and that

of this would have the corresponding point thrown slightly out of the vertical, which would ruin the pattern. Consequently, in Holtzapffel's machine, a special contrivance has to be introduced, by which, at the expenditure of some considerable trouble and care, we can bring the tool-point back again to the proper starting position, and it is this necessity for "correcting obliquity" which is the great drawback to the instrument, and which I propose to remedy.

I may perhaps be allowed to say that my ideas on this subject were fully developed before I knew of the existence of any instrument of this kind—in fact, it was not till Mr. Basley's book on the subject fell into my hands a year ago that I found out that I had been anticipated in the plan which I had projected of making a trochoidal cutter. In carrying out this plan, with the help of De Morgan's articles in the *Penny Cyclopaedia*, I was naturally led to follow very much in the same steps as Messrs. Holtzapffel, but finding the drawbacks alluded to above, I hammered away at it till I found a remedy. It appeared evident that the only chance was to make B always move along one of the diameters passing through A, and Fig. 3 will show how I eventually accomplished this. A rectangular steel frame, RSCD, is rigidly attached to a steel spindle passing through a square shank, as in the eccentric cutter. The top bar, RS, carries a boss, B, which can be clamped at any part of RS, through this boss, and through a slot in the bar RS, a spindle passes, carrying at one end the cutting-frame, F, and at the other end the bevel-wheel, G; a square bar revolving freely on steel points which enter its two ends, carries two bevel-wheels, H and K; H can be slid along so as always to gear with G, and is then firmly clamped on the bar; K gears with another bevel-wheel, L, mounted on a spindle, which carries at its other extremity a toothed wheel, M; this toothed wheel is connected in the usual way with the fixed wheel, X, by a train of intermediate wheels, which are omitted for simplicity. It will be seen, therefore, that in order to change the distance of B from the centre of the instrument, it is only necessary to unclamp it and slide it along, also unclamping and re-clamping H; no disturbance is caused to the initial position of the tool-point. I think, also, that the extreme smoothness of action of bevel-wheels, and the fact that they can so easily be



adjusted to prevent back-lash, is in favour of the plan here suggested. I fancy, also, that the cost of construction would be far less than in Holtzapffel's machine, on account of the easiness of introducing adjustments; in fact, I have had my drawings on hand for some years, hoping eventually to find time to make the instrument—a thing I should not dream of attempting with a machine requiring such splendid workmanship as Messrs. H.'s does.

Inverness.

C. W. Bourne.

EXPERIMENTS IN MICROMETRY.

[19542].—WITH regard to the statement on page 341, No. 873, that Mr. Fasoldt claims to have resolved lines of 150,000 to the inch, I should like to point out that the mathematical limit of resolving power of a lens of even 180° in crown glass is only 146,500 lines to the inch! The widest-angled lens ever made is the oil-immersion $\frac{1}{4}$ in. of Messrs. Powell and Lealand, which has an angle of 152° in crown glass.

The lens which will show Mr. Fasoldt 150,000 lines to the inch has yet to be constructed.

Dec. 17.

Edward M. Nelson.

ELEMENTARY MATHEMATICAL OPTICS: XI.

The Equation of Aberration.

[19543].—THE terms of the equation of aberration given in Section X. have distinct coefficients for each refractive index. Coddington has a table of these for indices 1.4 to 2 inclusive, but the intermediate values for 1.5 to 1.66 are of more importance. I give a table of these, arranged somewhat differently from Coddington's. Taking the first value of the index 1.5, and substituting it in the literal eqn. (9), we obtain $\frac{1}{6} \{ 7x^3 + 10ax + 13a^2 + \frac{27}{4} \frac{a^3}{\phi^2} \}$. I think it is preferable to make the coefficient of x^3 unity in each case, as the equation is then in a more suitable form for solution. This gives $\frac{7}{6} \{ x^3 + \frac{10}{7}ax + \frac{13}{7}a^2 + \frac{27}{28} \frac{a^3}{\phi^2} \}$. For parallel rays a is always equal to -1 , and these equations I have placed in a separate table. Generally decimals are used in preference to ordinary fractions.

PARALLEL RAYS.

μ	Coefficient of Aberration.
1.50	1.166 ($x^3 - 1.428x + 1.428$) $\frac{a^3}{\phi^2}$
1.51	1.115 ($x^3 - 1.438x + 1.464$) "
1.52	1.070 ($x^3 - 1.488x + 1.503$) "
1.53	1.025 ($x^3 - 1.520x + 1.527$) "
1.54	.984 ($x^3 - 1.548x + 1.574$) "
1.55	.941 ($x^3 - 1.583x + 1.623$) "
1.56	.908 ($x^3 - 1.612x + 1.656$) "
1.57	.874 ($x^3 - 1.640x + 1.692$) "
1.58	.841 ($x^3 - 1.670x + 1.736$) "
1.59	.808 ($x^3 - 1.704x + 1.779$) "
1.60	.780 ($x^3 - 1.733x + 1.816$) "
1.61	.751 ($x^3 - 1.767x + 1.862$) "
1.62	.723 ($x^3 - 1.796x + 1.905$) "
1.63	.700 ($x^3 - 1.823x + 1.947$) "
1.64	.676 ($x^3 - 1.872x + 2.000$) "
1.65	.653 ($x^3 - 1.883x + 2.034$) "
1.66	.630 ($x^3 - 1.920x + 2.080$) "

In the second part of the table I have not repeated the numbers 1.166, 1.115, &c., but each must be used with its corresponding equation, in the same way as for parallel rays.

The above table is an important one, for it contains all that is essentially necessary for combining four or more curves. Coddington's method has the advantage over Barlow's, in that it requires the solution of an easy quadratic equation only; and it is immaterial whether we assume the curves of the flint or the crown to be given, whereas with Barlow's formulae, we must combine a crown with a flint lens, whose radii are known.

In section VI., page 143, it is shown that when two lenses are placed in contact, the first approximate value of the final conjugate focus is given by the formulae:— $\frac{1}{C_1} = \frac{1}{f_1} + \frac{1}{f_2}$

$\frac{1}{f}$, or if we have any number of lenses, the

th or last focal value is $\frac{1}{C_1} = \frac{1}{f_1} + \frac{1}{f_2} + \dots + \frac{1}{f_n}$

The variation of $\frac{1}{f}$ due to spherical error must now be introduced. If ω_1 represent the coefficient

of aberration divided by the cube of the focal length of the first lens, the variation of $\frac{1}{f_1}$ is $\omega_1 y^2$, and for $\frac{1}{f_2}$ it is $\omega_2 y^2$. Hence, the value of C_n becomes:— $\frac{1}{C_n} = \frac{1}{f_1} + \frac{1}{f_2} + \dots + \frac{1}{f_n} + \omega_1 y^2 + \omega_2 y^2 + \dots + \omega_n y^2 = \frac{1}{f} + \Sigma \omega y^2$.

If y or the semi-aperture of each lens is the same, and Σ denote the sum of similar quantities, this equation may be expressed:— $\frac{1}{C_n} = \Sigma \frac{1}{f} + \Sigma \omega y^2$; or if the rays be parallel and F be the compound focus, $\frac{1}{F} = \Sigma \frac{1}{f} + \Sigma \omega y^2$.

When a concave lens is placed in contact with a convex this formula becomes $\frac{1}{F} = \frac{1}{f_1} - \frac{1}{f_2} + (\omega_1 - \omega_2) y^2$.

Now it is obvious that if ω_1 be equal to ω_2 they will destroy each other, since they are of opposite signs, consequently the equation will lose its third term. The combination is then free from spherical aberration, for the positive error of the convex, is neutralised by the negative error of the concave.

If we had a third lens, convex, of equal aperture in contact with the first pair, then we should have to make $(\omega_1 - \omega_2 + \omega_3 = 0)$, and the combination would be free from aberration.

Hence the general rule, for forming an aplanatic combination of any number of lenses of equal aperture in contact, is that $\Sigma \omega$ must equal 0 in all cases.

This method of treating the subject, though somewhat different from Barlow's, is much more concise, and does not require so much preliminary computation. Barlow determines the aberration for each lens, but Coddington simply finds what ratios of curvature will cause the increments of the focal reciprocals to destroy each other. Both methods give the same, or nearly the same, results from similar data. There is also another point of considerable importance; the interior curves should be as nearly as possible alike, but such a ratio cannot be found from Barlow's formulae, except by

VERGENT RAYS.

μ	Coefficient of Aberration.
1.50	1.166 ($x^3 - 1.428x + 1.428$) $\frac{a^3}{\phi^2}$
1.51	1.115 ($x^3 - 1.438x + 1.464$) "
1.52	1.070 ($x^3 - 1.488x + 1.503$) "
1.53	1.025 ($x^3 - 1.520x + 1.527$) "
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1.59	.808 ($x^3 - 1.704x + 1.779$) "
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1.61	.751 ($x^3 - 1.767x + 1.862$) "
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1.64	.676 ($x^3 - 1.872x + 2.000$) "
1.65	.653 ($x^3 - 1.883x + 2.034$) "
1.66	.630 ($x^3 - 1.920x + 2.080$) "

a very tedious process. With the present rules we can apply such a condition directly to the equation, and thereby obtain the required result with one calculation only. Barlow's rules were specially adapted for finding the curves of an achromatic combination; whereas Coddington's equations are suited for uniting two or more lenses, so as to be free from spherical error, without reference to their achromatism. If the component focal lengths are required to be in a given proportion, the calculations may be slightly shortened.

Orderic Vital.

ERRATA IN SECTION X.—On page 187, in first column, fourth paragraph, instead of the ratios there given read "427 : 227 : 29 : 15 : 5 : 3." Sixth paragraph, read "29 : 19 : 3 : 2 : 54 : 41." These ratios were accidentally inverted.—O. V.

THE CANONBURY ACCIDENT.

[19544].—THE extraordinary and in many respects unparalleled series of collisions which took place upon the 10th inst. in the tunnel between Finsbury No. 1 signal-box and Canonbury Junction, cannot fail to call the serious attention of the public to the whole question of railway accidents and their prevention.

The fact that four passenger-trains were per-

mitted to follow each other into a tunnel and cause three collisions upon a railway supposed to be worked upon the block system is most remarkable.

Colonel Yolland yesterday (16th inst.) concluded the Board of Trade inquiry, and the evidence given shows clearly the circumstances of the case. The cause of the catastrophe is without doubt due to a mistake in signalling, and the practical point which is brought before us is how to prevent such mistakes in the future. Both signalmen are experienced servants, and from the evidence given it is quite clear that they both did that which at the moment and under the circumstances they conscientiously believed to be right.

Pending the verdict of the coroner's jury, I shall not, of course, prejudice the case by expressing any opinion upon the question of which signalman was the cause of the accident, but shall at once pass on to consider some of the circumstances under which an error was committed.

The Canonbury signal-box belongs to the North London Railway Company, and the line to Finsbury, No. 1 box (although the property of the Great Northern), is worked under the North London Block System regulations. It therefore follows that the signalman in the No. 1 box should be well conversant with the regulations of both companies.

The accident would not have happened if the railway Companies had adopted one standard and universal code of block-signals, instead of each line having a different one of its own; and in the present instance one man gave a signal which he considered as a "positive block," but which the other man understood to mean "permissive block." The very fact that the North London code contained any mention of this latter signal shows that it was liable to mislead.

"Permissive Block" is a delusion and a snare, and forms one of the most dangerous traps into which an engine-driver can be led; it is, in fact, no block at all, and should therefore be at once abolished upon all railways.

All signal-boxes ought to be furnished with speaking telegraph instruments; but, from the evidence, it will be seen that this most useful means of communication was not provided between the two signal-boxes in question. Why did the companies permit such an omission to exist, and why was the Canonbury distant signal electric repeater allowed to be out of order for a considerable time?

I do not know if the subject of brake-power will engage the attention of the coroner's jury; but I may mention that there is a very strong impression in railway circles that if the trains had been fitted with efficient continuous brakes, instead of chain brakes, the drivers might have greatly mitigated the force of the collisions, and probably prevented any fatal consequences. The accident is the result of a mistake between two signalmen, and it therefore becomes most important to render such mistakes impossible.

Human fallibility does cause the most experienced signalmen to commit errors in signalling, and the only way to avoid mistakes is to establish an absolute block by electrically interlocking the signal-levers—in fact, by combining the present block and interlocking systems. The general report of the Board of Trade, and also the reports of the inspectors, have many times called the attention of the companies to the importance of thus securing safety, and also to the fact that such a system is in use upon the Metropolitan, District, Chatham and Dover, Great Western, and other lines.

Major Marindin has lately most clearly pointed out that the very serious accidents at Penilee, Nine Elms, Desford, and very many others, would have been avoided by this additional safeguard.

When General Hutchinson drew up his report upon the Dalston Junction accident upon the North London Railway, he remarked—

"Considering the collisions which have from time to time occurred on this railway from the mistakes of signalmen, I would urge the directors and officers to carefully consider whether the means adopted on some of the metropolitan railways to guard against such mistakes might not with advantage be introduced on the North London Railway."

The line from Canonbury to the Finsbury box is worked under the North London regulations, and had the directors adopted the course urged upon them by General Hutchinson, we should not now have to deplore the loss of life which is the result of the "permissive block" so-called accident at Canonbury.

Clement E. Stretton.

Saxe Coburg-street, Leicester, Dec. 17.

CALEDONIAN RAILWAY-ENGINES.

[19545].—IN my letter (19429) two misprints occur, though I am glad to say they are obvious and scarcely require correction. For diam. of cylinder, 18ft. should be 15in. For 324 to 338, read 324—331. The last time I saw 334 to 338 they were goods engines. In last paragraph after "I have other details," should be a full stop.

I have now by me details of 167—170, bogie

ank-engines. Until lately these were numbered 88-491; built by Neilson 1873-4. They are all at Edinburgh, where 167 is shunting passenger trains, 168 and 169 run on Leith branch, and 170 runs to Balerno, &c. The cylinders are 17in. by 22in.; leading and driving-wheels, 4ft. 8in.; bogie-wheels, 2ft. 8in.; wheel-base (engine), 5ft. 9in.; bogie, 5ft.; 156 tubes, 1½in. outside diam., and 10ft. long; heating-surface-tubes, 715 sq. ft.; fire-box, 81.6 sq. ft.; weight, 41 tons; tank capacity, 300 galls. In 19336 I mentioned Mr. Drummond's large tank engines, which run on Burntisland and Helensburgh section of N. B. Ry. I find that there are two classes of them. On the former section they have, as I said before, leading and driving coupled 5ft. wheels and one pair of trailing-wheels; examples of this class are Nos. 167 and 89. On the Helensburgh section, however, they have a leading bogie. Built at Cowairs works 1877; they have cylinders 17in. diam. and 26in. stroke; driving and trailing-wheels, 6ft.; bogie-wheels, 3ft. 6in. diam.; boiler, 10ft. 1in. by 4ft. 4in.; contains 220 tubes, 10ft. 8in. long and 1½in. diam.; heating surface, 1075.5 sq. ft. Their tractive force (104.2) enables them to cope with the heavy and fast coast traffic with ease. Carstairs.

COAL-GAS, AND HOW TO USE IT.—II.

[19546].—If we have mains at different levels supplied from the same original main, we find that the higher one has more pressure of gas in it than the lower one. This is just the reverse of what happens in the case of water, the reason being that gas is lighter than air. We must, therefore, make provision for the lowest parts of a town having enough, and the highest not too much, pressure. The amount of the gain in rising is 1in. for 100ft. The adjustment of pressure is effected by governors. As the gas leaves the holders it passes through these instruments, and then goes into the town at a pressure adapted to the height of the district it is to supply, and regulated at various times during the day according to the amount of gas being consumed. Each town has usually its own requirements, according to its trade.

Sections of governors can be seen in the gas-trade journals before mentioned; but the principle is the same in all: an increase of pressure causes the gas to be partly shut off, until the same pressure exists in the town-mains; and a decrease, caused by increased consumption, causes more gas to be turned on by the opening of a coned valve. This effect is produced by the pressure of the gas on the inside of a bell, which is weighted more or less according to the pressure desired to be given. As the bell sinks it opens the valve; as it rises it closes the valve.

We are now ready to consider the distribution of the gas. This is effected, as everyone knows, by mains of various sizes, laid under the streets, each main being made of such a size that it will supply the street or district along which it runs. If the mains are too small, more pressure has to be put on at the gasworks governors, in order to force the gas to distant or lower parts of the town; this causes waste through leakage, and consumers near the works have more pressure than they require.

The leakage from gas-mains is often very considerable, especially in old and badly-laid mains. To diminish this, and also for the sake of the consumers, it is the interest of the gas company to keep down the pressure on leaving the works as low as possible consistent with all consumers getting a sufficient supply. A pressure of one inch to twelve-tenths is often kept on during the day, when only a few people are using gas, and two inches, or two and two-tenths, during the heavier hours of the evening and early morning. The figures given are those in use in a moderate-sized manufacturing town.

Now let us consider the apparatus connected with the supply of consumers from the mains. The pipe which is taken out of the main is called the service-pipe, or service, and may be of lead, wrought iron, or cast iron. Where the ground is chiefly "made ground," and contains ashes, wrought iron is soon corroded away, and lead should be used for the smaller, and cast iron for the larger services. The service ends at the meter, where it is furnished with a stop-cock for turning off the gas. The meter is a very important article, and I shall perhaps have to deal with it somewhat carefully.

There are many different makes of meters, but they all fall under two heads—wet and dry. Both have been described in recent volumes of the *ENGLISH MECHANIC*, the wet at p. 466 of Vol. XXIX., the dry at p. 338, Vol. XXX.

The question has often been debated as to whether wet or dry meters are the best. I believe that, as a general rule, wet meters are the best for both producer and consumer. Perhaps it may be well to run over a few of the leading points in each.

1. Cost.—The wet meter is much more expensive, but it lasts much longer. Probably not much advantage either way.

2. ACCURACY OF REGISTRATION.—The wet meter is certainly the more certain, and it is always used where accuracy is required, except where portability is essential, as for taking round to test other meters in their places. The chief points in which the dry meter may, and nearly always does, in time become inaccurate are—(a) the valves wear, so that gas passes them; (b) the leathers of the bellows get stiff, or get a hole in them. The stiffening of the bellows is often caused by frost.

3. ATTENTION REQUIRED.—The watering of a wet meter is often spoken of as a disadvantage; but this is mostly done by men employed for the purpose, and does not seriously incommode the consumer.

4. LIABILITY TO ACCIDENT OR DERANGEMENT.—Here, again, the wet meter is frequently cried down, because it is liable to get frozen up. This can easily be prevented by the addition of about one-fifth part of glycerine to the water in the meter. Of course common glycerine is meant, not the fancy article. Some meters never freeze; a great deal depends on the situation. In frosty weather, dry meters are liable to have the leathers frozen stiff, which tells against the consumer in the quarter's gas-bill. In dry meters also the valves often stick fast, through accumulation of thick tarry matter on their surfaces. A wet meter is now working in the house in which I write, which has been in for over 25 years, and had nothing done at it except watering. At a meeting of the Gas Managers' Association, the recommendation was given that all dry meters should be brought into the works and examined every four years.

Wet meters cost more to repair than dry meters, but a dry meter will need repairs several times by the time that a wet meter needs repairing for the first time. The chief advantages of a dry meter are that it goes into less room, and can be put into any out-of-the-way place; as stated before, it is less affected by frost; but whatever advantages it has are obtained at a sacrifice of accuracy of registration. Pioni Almon.

THE LANTERN.

[19547].—MANY of ours will be glad to read "Sunlight's" letter (19493) on the lantern; let us hope it will bring to the "E. M." some reliable information from some of our experienced brother lanternists. The information most required is the oil-lamp, the jets, the limes, and the means of storing the oxygen.

For the oil-light I have found nothing better than the triplex-lamp. However, I seldom use it now, the lime-light, of late, has been so simplified. I have for two seasons used a portable gas-holder (Chadwick's) and find it most convenient, reliable, and exceedingly simple to work. I never run short of gas, no matter how long the entertainment may last. I am not at all satisfied with the blow-through jets as now made. I have tried lately some half-dozen or more: in no single instance did they give the light stated by the maker. I found the best to be a small bore for the oxygen about the size of a pin-hole; however, the objection to this jet is the clogging of the small hole after about an hour's burning. I am pleased to learn that "Sunlight" is bringing out a new burner. I would much like to have two of them. I advertise my address.

I have tried the cylinder and disc form of limes. The former is convenient, taking up little space, but liable to break through the middle and drop off the lime-pins. I am now using the disc form, fitted into a brass ring, which holds the lime together even if it should break; but this form takes up a lot of room, and is much more expensive. I think of trying a cylinder lime (somewhat thicker than those usually sold) worked horizontally. George Baker.

THE LANTERN—MORGAN'S PAPER.

[19548].—KNOWING that all amateur photographers who are also lanternists are tempted to have a try at making their own transparencies, it will not, perhaps, be amiss to say a word or two on this subject. My own time being exceedingly limited, gelatine plates would naturally suggest themselves as most suitable. I have been very fairly successful with the formula propounded by Mr. Kennett, and by it I have been able to secure some most brilliant transparencies; although Mr. Lancaster does not seem to be of my opinion, except the plates are specially prepared for the purpose. In my own case, I use quarter plates, which are the right size to cut to transparencies, and these are easily printed by direct contact. And here another point arises. It is, I find, a good plan to keep a black paper mask, such as is afterwards used in mounting the views, and having selected the portion you want of the negative for the slide apply it so as to print the picture in a circle at once, thus stopping out the parts not wanted. When you go to afterwards cut the plates to size, this is a great assistance. I prefer to make all slides by an artificial light at my leisure in the evening. And for this purpose I

have rigged up a sort of copying-camera. It is a very simple plan, being a shot-box open at the end. Into the back go the negative and the plate to be printed; and facing that in the front is a 5in. lantern condenser, with a gas-burner behind it,—the position of the condenser to the flame being such that parallel rays are transmitted direct to the plate. I find that the most rapid plates do not make the best transparencies by any means; but that plates requiring some two or three seconds' exposure yield the most brilliant results. The developer I like best is the alkaline-pyro one. After being developed, well wash and flood the plate with acid-pyro, and silver to give a bite for the toning solution. Again wash, and then apply the chloro-ride of gold solution. Finally, fix with cyanide. If cyanide is not used, a pink or red tint appears on the clear glass parts, which I do not like.

So much for gelatine. But let me add a word for the wet collodion process. The Rev. B. Holland, who spent much time in trying the best formula to be used, at last laid down a formula that with both myself and others has proved a most decided success, and it has so many advantages that with the Editor's permission I will detail it here, and it is so easy that none will fear failure who can work the ordinary collodion process pretty well. The bath should be nitrate of silver 40z., nitric acid 3 drops, acetic acid 12 drops, and water 10oz., and should be well, sluiced and filtered. Coat the plates with ripe collodion immersed in the bath five minutes. It is an advantage to well rub the plates with French chalk before coating them. When exposed develop with pyro 30 grains, citric acid 1 drachm, acetic acid 2 drachms, alcohol same quantity, nitric acid 7 drops, and water 10oz. The developer acts somewhat slow, but has the great advantage of requiring no toning solution, the colour of the deposit being good. Finally fix with hypo as usual.

The wet process entails the use of a camera to do it properly, and here a difficulty arose, the ordinary ½-plate camera not having draw enough to enable the same camera required to take the negative to open sufficiently far to enable the transparency of the same size to be taken in it. This was a serious nuisance, and I mentioned these facts to Messrs. Riley, of Fenton-street, Commercial-road, London, and, recently, they have, in response to various applications of a similar nature to mine, made a special camera for the purpose, which is termed the "Universal Combination" Camera. It is arranged to close up, base and all, to the length required for the production of the ½ plate negative, whilst, by an ingenious arrangement, it opens to a great length for copying the negative for a transparency. As an ordinary ½ plate camera, it has a range of from 4in. to 10in., whilst for copying it extends no less than 21in. They sent me one of these cameras, and I certainly find it one of the most handy instruments possible, from the great range of draw. To any amateur photographer or lanternist in the West of England, I shall be very happy to show it, at any time I am at home, as I am so pleased with it, that I think it should be better known, from its certainly universal adaptability.

Several inquiries being on foot as to Morgan's paper for enlarging, &c., it may interest readers to hear that it certainly is a great advance on anything obtainable before. In competent hands, enlargements from my ½ plate negatives are something wonderful, as there is no blurring or loss of delicacy. In the case of portrait studies, the hair, which is generally the weak part in an enlargement, is not coarse and ropy, but is simply a sharply-defined enlarged copy of the small negative details. As a means of obtaining proofs of my small negatives before taking transparencies from them, it is simply invaluable, as a print can be got. So much so, that we can get a copy from the light of a gas-light in less than 1½ minute, on the average. I need hardly say that there is no other sensitised paper I am aware of that will do this; neither will the ordinary sensitised paper keep as Morgan's paper does. I do not find it in any way injured by keeping in the dry. The only drawback is the price, which, I fancy, could be reduced. To amateurs who do not mind the cost, to save time and trouble it is the very thing, from its enabling one to print at home of an evening. The only thing I wonder at is that it is not widely advertised. In fact, the first practical notice of it was in the reprint of Mr. Palmer's paper, No. 868 of this journal, and but for which it would have very possibly escaped my notice. So that here is a direct instance of the practical information afforded by the "E. M." to readers in all parts of the civilised globe. Sunlight.

PHOTOGRAPHIC.

[19549].—In answer to 19498, "Pyro," I have used the universal joint described in No. 769, 33892, with a light "Lancaster" pocket camera, and also with an eight by five camera, also with 12lb. weight on the camera, and found it quite firm and steady. I have no set screw to this joint, but

have soldered a small piece of brass to each cup, which enables me to screw it down on the ball very firmly. As regards the stand (described 38892, No. 769), I use the feet (of steel) much longer, and higher up the stick than is shown in the sketch, for the sake of steadiness.

I made an umbrella-stand for pocket camera thus: A piece of iron wire 2ft. 9in. long is wormed at each end; on to the one end is screwed an umbrella handle, on to the other end the ferrule end of an umbrella-stick. A light tripod in six pieces, of some suitably hard wood, slightly tapering towards one end, is then made, each piece rather shorter than the space between the wood of the handle and the end piece; these are placed round the iron wire, and held there by means of an indiarubber ring. An ordinary umbrella case is then drawn over.

Barium.

GEOLOGY.—I.

[19550].—INTRODUCTION.—The part played by Geology in the agricultural world has, till quite recently, been almost completely ignored by the agriculturist in his agrarian pursuits. Recently, however, agricultural chemistry has initiated a new era in the farming world: it opens up resources to the modern farmer unknown to agriculturists a few years since. Even the 19th-century farmer is heavily shackled with firm-set prejudices—the accumulation of generations—which restrain him from committing himself unconditionally to the "nova monstra" of Progressive Science. Nevertheless, the intelligent farmer resuscitates his exhausted soil, he nourishes artificially the soil naturally deficient, he regenerates his once fructiferous soil, weakened by successive crops, with the elements necessary to plant life. No one will deny that soil is the element of success in agriculture, nor will they deny the variety of soil when we compare the luxuriance of the Sunderbunds with the paucity of the Sahara: we must look further ahead than climatic influences. The distribution of the flora is not less ubiquitous than that of the fauna, nor is it less dependent upon ulterior circumstances. It is the relation between between the soil and the plant I will endeavour to show. Except where otherwise stated, this paper refers solely and entirely to England.

ENGLAND.—POSITION AND CLIMATE.—Reference to a map will at once show that England lies between the parallels of 50° and 56° N. lat., and the meridians of 2° E. and 6° W. long; but the climatology of England is not read in its position; Kamchatka and Labrador are equally proximate to the Equator; yet how vastly different the climate! So many meteorological and physical modifications combine to form the English climate that it stands without the pale of ordinary calculations. The isotherm of 50° F. which passes through Norfolk also passes through Oregon and Maine, in the New World, and through the Black and Caspian Seas, and Japan in the Eastern Hemisphere; its equivalent in Southern latitudes passes through Patagonia and New Zealand. "The territory has a singular perfection; the climate is warmer by many degrees than it is entitled to by latitude, neither too hot nor cold. . . . In variety of surface it is a miniature of Europe. . . . From first to last it is a museum of anomalies."

THE GEOLOGICAL FORMATIONS.

A. Tertiary or Cainozoic:—

a. Tertiary system. Containing limestones, clays, and sands.

B. Secondary or Mesozoic:—

b. Cretaceous system. Containing chalks, flints, tem. chalk-marl, and grave, (Wealden).

c. Oolitic system. Limestones, sandstones, clays, &c.

d. Triassic system. Salt and gypsum.

C. Primary or Palæozoic:—

e. Permian system. Magnesium limestone, sandstones, &c.

f. Carboniferous system. Coal, limestone, millstone grit, &c.

g. Devonian system. Sandstones, limestones, marbles, &c.

h. Silurian system. Slates, metalliferous veins, &c.

i. Cambrian system. Slates, metalliferous veins, &c.

D. Igneous:—

j. Granite and similar rocks. Containing tin and other metals.

This arrangement may be further classified into agricultural formations (A B), and metallurgic or rather metalliferous formations (CD). The whole of the really agricultural formations lies on the east of a line drawn from the mouth of the Tees to the mouth of the Exe. The Triassic or new red sandstone separates the two great economic systems. It runs parallel with the Oolite with a spur in a N.W. direction, thus totally separating the Silurian and Devonian of Wales from the Car-

boniferous and Oolite of England. It also separates the Carboniferous from the Oolite in the N. and S.W. of England. The agricultural system crosses England in the S. from Bridgewater Bay to the Strait of Dover. The Oolite also appears in S. Glamorgan and in N. Shropshire. Diluvial deposits also occur on the W. coast. A geological map will prove invaluable in assisting this paper.

FORMATION OF SOIL.—The formation of soil is due to the disintegration of rocks by the action of the atmosphere, which being in reality a chemical action, at once clearly shows different rocks give different soils. Silicious rocks give soils more or less sterile. Argillaceous rocks, from their adaptability to the retention of water, afford excellent pasturage, while the calcareous rocks are progenitive of our richest soils.

INORGANIC STRUCTURE OF PLANTS.—Plants derive their nourishment from two sources: the atmosphere and the soil; from the former by means of stomata or other respiratory organs, from the latter by means of radical filaments. Plants, like animals, possess also a twofold structure, organic and inorganic, the material for the latter being absorbed from the soil. Although we find similarity of constituents in the inorganic structure of plants, the percentage of individual components differ widely in different plants. Thus, for every 1,000lb. the amount of inorganic matter in oak is 2lb.; elm, 19lb.; wheat, 20lb.; oats, 40lb.; peas, 50lb. Table II. shows the inorganic structure of several vegetables in detail.

II.

Inorganic Matter.	Wheat.	Linseed.	Potato.	Indian Corn.
Potash	237	215	557	325
Soda	91	34	19	
Lime	24	147	20	14
Magnesia	120	99	53	162
Oxide of iron . .	7	19	5	3
Phosphoric acid .	509	381	126	449
Sulphuric acid . .	3	9	136	28
Silica	12	57	42	14
Chlorine	—	3	42	2
	998	994	1000	997

It may not appear incongruous to add the organic structure of one or two of the vegetables in Table II.

III.

Organic Matter.	Wheat Flour.	Indian Corn.
Water	16	14
Gluten	10	12
Oily Matter	2	8
Starch, &c.	72	66
	100	100

The organic structure of plants varies according to the climate and condition of the atmosphere.

For the healthy and successful cultivation of vegetables the matter enumerated in Table II. must be present in the soil either naturally or artificially, and it is to the farmer's interest to find out the components in which the soil is deficient. The rotation of crops—which is not yet thoroughly understood—is based upon the varying consumption of inorganic matter by various plants.

AGRICULTURAL FORMATIONS.—I. THE OOLITE.—The finest and richest soil for the cultivation of cereals is formed by the decomposition of the Oolitic rocks. The system is immediately superincumbent on the Lias, and is striated with argillaceous bands which divide the system in several courses. The Inferior Oolite resting on the Lias is separated from the Middle Oolite by the Oxford clay, while the Kimmeridge clay separates the superior and Middle Oolitic divisions. It must be borne in mind that these argillaceous bands are due to local action and are, therefore, neither absolutely uniform nor contemporary. Table IV. gives an analysis of the Oolitic system based upon that of William Smith, the "Father of Geology."

IV.

Superior Oolite.	Middle Oolite.
1. Purbeck beds	4. Coral rag
2. Portland stone	5. Oxford clay
3. Kimmeridge clay	
Inferior Oolite.	
6. Kelloway rock	10. Fuller's earth.
7. Cornbrash	11. Inferior oolite
8. Great oolite	
9. Stonesfield slate	

The three great corn-bearing strata are numbers

7, 8, 11. The chemical composition of the will prove their productiveness; the reader compare tables II. and V.

V.

Components.	Inferior Oolite (11).	Great Oolite (8).
1. Carbonate of lime . .	89.20	95.346
2. Magnesia	.34	.739
3. Sulphate of lime . .	.09	.204
4. Aluminium	4.14	1.422
5. Phosphoric acid . . .	.06	.124
6. Soluble silica	2.75	1.016
7. Insoluble	3.27	.533
	99.85	99.384

The Inferior Oolite consists of sand stone; the Great Oolite is chiefly calcareous; the cornbrash is composed of a loose stone, frequently not more than 6in. Oolitic hills are distinguished by their broken aspect. The chief heights are (1862ft.), Burton Head (1485), both in Shire Wolds—a locality noted for its Clevehill (1134), in the Cotswolds.

THE CRETACEOUS SYSTEM.—We now come to the Chalk which borders the Oolite on the side. In this system we meet with argillaceous and calcareous soils; we have a right to infer a variety of agricultural products hardly borne out in practical observation. Table VI. gives a general statement of the Cretaceous Formation.

VI.

UPPER CRETACEOUS.

1. Maestricht beds and Faxe limestone
2. White chalk with flints.
3. Grey chalk.
4. Upper greensand.
5. Gault.

LOWER CRETACEOUS OR NEOCOMIAN.

1. Lower greensand.
2. Wealden beds. { Weald clays.
Hastings sands.

Commencing at the base: The Wealden formation or wolds lying on the Wealden clay quite recent cultivation, which has been about only by deep drainage. The rocks of the Hastings sands are more argillaceous than the Wealden. The Upper and Lower Cretaceous formations are seen to be separated by the Gault which in England or marly clay in Germany, a mass of sandstone, marl, and limestone—the place of a vast age must have elapsed between the formation of the two formations, as only about 1 the Neocomian fossils occur in the Upper Cretaceous. The Gault forms pasture land: the clay is also for brickmaking. The South Downs are for chalk strata, and afford excellent sheep pasture. The Cretaceous system generally presents a tame aspect, owing to the absence of tree soil, in many places, is very superficial; by western extremity of the formation it is brought under tillage, the chief crops being and clover, and more recently still, cereal divisional formation of the Gault is, perhaps most fertile of the whole system.

The Greensand is an agricultural formation between the Chalk and the Gault. On the coast it is celebrated for its building stone.

THE TERTIARY SYSTEM.—We now arrive at the nearest geological approach to modern time classification adopted by Sir C. Lyell is given.

VII.

THE TERTIARY FORMATION.

Periods.	Localities, &c.	Per cent. of Recent Species.
Post Pliocene.	Fresh water of the valley of the Thames.	99 to 100
Newer Pliocene.	Marine strata near Glasgow	85 to 90
Older Pliocene.	Norwich crag	60 to 70
Miocene	Suffolk red and coralline crag	20 to 30
Eocene	London and Hampshire . .	1 or 2

The Tertiary system is for the most part unstratified. The Bagshot sands when on prevent the successful tillage of the Eocene. The Bagshot sands are superseded in the l. of Wight and Hampshire by the Fluvio-marine beds. These Bagshot heathy wastes so familiar in the suburbs of London. In Hampshire the sands have become tilted; in other parts visible the once-superincumbent strata

destroyed by atmospheric action. The Coralline crag of Suffolk has a ferruginous composition the marls composed from it are useful as manures. The Pliocene formation is of small importance in England, although it is largely developed on the Continent. In the British Tertiary no elevation exceeds 700ft. The highest are Langdon-hill, in Essex (620ft.); Highgate-hill (450ft.); and Hampstead-hill (450ft.), both in Middlesex. The system is deficient in lime. The presence of the botanical order Ericaceae is at once condemnatory to the thought of cereal cultivation; the heaths are almost identical with sterility. The *Erica vagans* assists the miner in frequently marking the course of metalliferous veins, especially in Cornwall; the *Arctaria Norvegica* and *Cerastium alpinum* are identical with the Ophiolite of the Shetlands.

DILUVIAL DEPOSITS.—Diluvial deposits are most abundant in the low-lying counties on the E. The chalk which dips eastward is overlaid by successive beds of gravel, sand, and clay interspersed with layers of "crag-pit shells." The crop most successfully raised in this district is barley, which frequently yields four-quarters per acre.* Marl and phosphate of lime (obtained from crag) and the stickleback are the chief manures.

DEVONIAN SYSTEM.—Monmouthshire, Brecknockshire, Herefordshire, and part of Worcester-shire are occupied by the rocks of the old red sandstone formation, and although the system exists to the west of the divisional line, this paper could not pretend to anything like completeness without reference to that important agricultural field. The Old Red Sandstone is easily decomposed, and forms a fertile soil bearing on its surface good corn lands and fructiferous orchards. It exists under these circumstances in Devonshire, Cornwall, and Somerset, as well as the counties enumerated above.

ORGANIC FORMATION.—TURF.—We come now to our concluding formation. Turf consists principally of an accumulation of aquatic plants, especially marshy plants, such as moss, &c., which have become a rusty-coloured, slimy, combustible mass, chiefly by the action of humic acid. A vast interest is taken in Ireland at the present moment, and as bog-land occupies a large area in Ireland, it has had its proportionate attention. Liebig and others have shown that even if the bogs were thoroughly drained, they would frequently be unprofitable, and in some cases unworkable. The bog of Allen embraces four counties, and occupies 3,000,000 acres. These mechanical deposits lie upon a vast deposit of clay, which overspreads the mountain limestone; these bogs are deficient in mineral essentials to plant-life. Kefenstein remarks that bogs are abundant on siliceous and rare on calcareous bottoms, but those of Ireland oppose this assertion as they overlie calcareous rocks. Turf sometimes supersedes lacustrine strata. The Irish peat is chiefly oak and fir. Iron pyrites are abundant. Bog-iron (limonite) is deposited by ferruginous springs.

Roscoe gives the following composition of fuels (ash deducted):—

Description of Fuel.	Per cent. of C.	Per cent. of H.	Per cent. of N. & O.
Peat (Shannon)	60.02	5.88	34.10
Wigan cannel ..	85.81	5.83	8.34
Woody fibre	52.65	5.25	42.10

W. G. Rolfe.

In filing a flat surface on a piece of iron, unless there is some skill or care used in the operation, the exterior edges are apt to be greatly pared away, so that that part of the surface about midway between them will be the least filed down. The work should be held in a bench vice, in such a position that the file will run in a horizontal direction nearly level with the workman's elbow; but should the work be of a very light nature, it may be held in a more elevated position; or, if it be very heavy, it may be held a little lower. In filing flat surfaces, a "surface-plate" is used, to enable the operator to finish the work with accuracy. This is a cast-iron plate, planed and carefully reduced to a true surface. Some red lead is rubbed on this plate before being used; then the plate and work are rubbed together, and wherever the work is reddened it shows that it is above the level and it must be filed down; and this process of filing and testing is carried on until the work is reduced to a perfectly true surface.

A GELATINOUS substance forms in sponges after prolonged use in water. A weak solution of permanganate of potash will remove it. The brown stain caused by the chemical can be got rid of by soaking in a very dilute solution of muriatic acid.

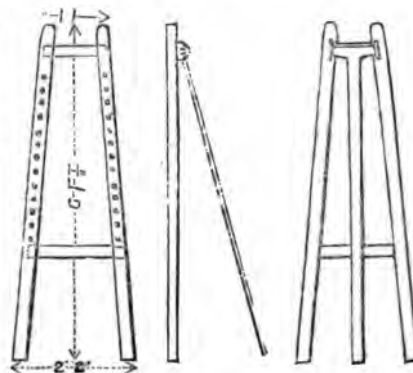
* The yield for S. Oolite, Inferior Oolite, and Corn-brash is 4, 3½, and 5 quarters respectively.

REPLIES TO QUERIES.

* In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[44629].—**Tasmania.**—In case this query has not been replied to, I send a few lines which may assist "C. T. K." All trades are well represented, and pretty well filled, too, in Tasmania, so that an emigrant intending to set up in trade must not expect to immediately find an opening; at the same time, if steady, he will, after a little looking about, probably be able to find some place where he may set up for himself and make a living. His best plan would be to take ship for Launceston, the northern capital, and then look out for the most eligible place to settle in. He could make a tour of the whole of the inhabited part of the island easily in a fortnight. I don't know of anything he could take with him as a speculation, as the colony is well supplied with English goods of all kinds, and duty is levied on almost everything. Sheep and stock-rearing is already in the hands of men who thoroughly understand the business; an outsider would have but little chance of making a "do" at it. The universal cry about agriculture is that it doesn't pay, but at the same time thousands of men live by it, or, at all events, off the produce of their farms, one way or another, taking a job now and then road-making, clearing land, or anything that may be going, and supposing nothing else offers, a man can always go to the mines, where he is certain of good wages. There are few things the Tasmanians cannot turn their hands to. The place is full of handy men. As an instance, I may mention that once during threshing-time we broke the traveller of the horse works. Out of the company of some twelve or fifteen men there were no fewer than three blacksmiths, and as I had a force on the premises, the smash was soon rectified. —**ANTIPODES.**

[45048].—**Easel.**—I inclose drawing of my easel,



which I can recommend. Sizes of the wood 2½ in. by lin. deal; holes to be about 2½ in. from centre to centre. If the easel is for a painter's shop, make wider than I have given; cost about 7s.—**WORKING TOM.**

[45092].—**Silvering by the Electro Process.**—Copper conducting wires and wires used for suspending goods in the bath should be occasionally annealed. The silver can first be scraped from the latter and preserved. Zincs should always be kept well amalgamated. After use they should be cleaned. A stiff brush and plenty of water may be used for this purpose. The hands should be well washed after handling or amalgamating the zinc plates, or you may find spots of mercury on the plated articles; therefore, keep the mercury well away from the silver or silver goods, as they are easily attacked by it. In the event of any of them being so spoiled, the best cure is to put them into a tolerably hot oven (with the door open), and leave them there till the mercury has disappeared, bearing in mind that anything which is soft-soldered will not stand a great amount of heat. Keep the plating-bath where it will not be shaken or stirred up, as there is always a certain degree of sediment at the bottom, and it is as well to leave it there. In the event of it not being in use for any time, keep it covered with a wooden cover made for the purpose. Well wash the goods after the scratch-brush, as the porter will not do the bath any good. In the event of the deposit not being a good colour (it should be white), it is generally advisable to add a little cyanide to the bath, as there is no standard quantity of cyanide: what will work well at one time will not do so at another. By the bye, recollect that the cyanide is very poisonous, and anyone that is in the habit of going near it should be warned. Don't let the fingers get into it more than you can

help, as, with some people, it will produce very nasty sores, especially if the skin is broken. The deposit should never commence too quickly, if it does it will be apt to strip in burnishing. Before the goods are placed in the first time raise the anodes considerably, and when they (the goods) are well covered you can pile it on as fast as you like. Don't have too much battery power at first, for the same reason. The anodes also may be annealed, and scratch-brushed now and then to keep them clean. Alter the position of the goods in the bath two or three times during the process, as the deposit varies at different depths, and the spot where the suspending wire touches will be found uncovered. After use, place the porous cells in cold water, and if you are not going to use them for some time, change the water every 12 hours for some days, till all the copper sulphate is removed; otherwise, the sulphate will crystallise in the substance of the cell, and cause pieces to come off. I have known a porous cell to fall to pieces from this cause. The method of making the bath which I have given, generally proves satisfactory; in fact, it is quite so for large goods which have to be burnished; but for jewellery, which must come out a pure white, I will give another method; but I don't recommend it for burnished work, as it is more apt to strip. Take, say, four ounces of silver—old silver will do as well as the pure—cut it in pieces, and place it in one of those thin glass flasks (with a round bottom) in which olive-oil is sometimes sold; pour on it two or three ounces of nitric acid, and heat it gently over a spirit-lamp, or in boiling water. The acid will commence to dissolve the silver, red fumes being given off. Take care that these fumes go up the chimney, as they are, to say the least of it, very unpleasant; take care also that your acid does not boil over, and don't let it touch your fingers. When no more red fumes are given off, if there is any silver at the bottom, add a little more acid till the metal is all dissolved, when you will have a solution of the nitrates of silver and copper. Pour it into an earthenware pan, and add at least a quart of water, rinsing out the flask with a little water. Now pour in some muriatic acid, and a white powder will fall to the bottom. This is chloride of silver. Leave off adding the acid when the precipitate or powder ceases to be formed, and let it settle to the bottom; when it has done so, pour off the liquid, and throw it away, and fill up the vessel with rain-water (if you have it); when the powder settles, pour this off, and repeat the process with three or four changes of water. Now have ready a strong solution of cyanide of potassium; pour some of this on the chloride of silver, and stir till dissolved. A little excess of cyanide will do no harm—in fact, it will be necessary. This will make a bath of four or five gallons, to be used the same as the last, with pure silver anodes. This bath gives a very white deposit. I think I have now finished for the present, but shall still be happy to reply to any particular question.—**OS.**

[45132].—**Change of Pitch in Railway Whistle or Bell.**—See reply, p. 331. May not the sudden or gradual change of tone depend on the position of the hearer?—**CAPT. CUTTLE.**

[45206].—**To "Sunlight."**—In designing a small compound engine, I should first take the proposed steam-pressure in the h.p. cylinder and find its volume. Next find the capacity of the h.p. cylinder and the volume of steam needed to leave a terminal pressure of, say, 3lb. to 5lb. at the end of the stroke. And having this volume of steam, it is comparatively easy to find out the useful point of cut-off in the h.p. cylinder. But you would find it with so small an engine advantageous to be able to carry the steam to nearly the end of the stroke of the h.p. cylinder, as there would be a loss from condensation, &c., in the transfer from one cylinder to the other. The high-pressure engine should be fitted with link-motion to work the valve, whilst the low-pressure cylinder needs a single eccentric only, and that a slip one, to admit the steam nearly the whole of the stroke. I should myself make the high-pressure engine with its slide to admit steam for say 8-10ths of the stroke as a maximum, and then in running you could easily notch up the gear and cut off at any point desired. Also, do not forget that a small engine is more wasteful of steam than a large one, and that the supposed or theoretical pressure at the beginning of the low-pressure cylinder stroke would really be much less, from loss by radiation, in the transfer. In fact, the theory is one thing and the practice another, and many things that look quite correct and feasible on paper are not realised in practice. I should not also like to speak definitely on several points of this question unless the drawings were before me. There might be important features causing loss of steam. All these require careful consideration. The best thing you can do is to get out the drawings of the proposed engine, and I will, if you like, submit them to me, then advise you on the many points. Real good could then be attained, as I would point out any defective points of detail.—**SUSANNAH.**

[45224].—**Railway Passenger Carriage.**—I think "Javenis" will be more likely to obtain what he wants by looking in *Engineering* or the *Engineer*, which often publish dimensioned sketches of rolling stock. Such a sketch would of necessity occupy considerable space, and the mere drawing of it would occupy considerable time; but I fancy if "Javenis" tries he might do it for himself, and save your space, especially as it would be of little use to the majority of readers. —INSPECTOR OF COACHES.

[45229].—**Engine Query.**—A gas-engine would be the most economical for the work described; but "J. G. B." can easily ascertain the cost by asking for estimates from, say, half a dozen houses. —T. P.

[45236].—**Dietetics.**—Possibly the improved health of the nobleman referred to is due to the fact that he has not "two bottles of brandy a day." You can get the prison dietaries in some of the Parliamentary papers published by Hansard, or possibly by applying to the Home Office; but if you refer to Dr. Pavy's book on "Food and Dietetics," on pp. 464-5 you will find the dietaries for hard, light, and industrial labour in convict prisons. People who are "inclined to be corpulent" are inclined to be diseased, and it is decidedly "beneficial" to keep them at about their minimum weight. At the place cited Dr. Pavy gives the food constituents in nitrogenous matter, carbo-hydrates, &c.; but I may mention that there is plenty of variety, *e.g.*, cocoa, oatmeal, barley, bread, milk, molasses, cheese, salt, meat, suet (and flour for "duff"), carrots, onions, turnips, and potatoes. There is not much chance of laying on adipose tissue at a convict establishment, though the food is, perhaps better in quantity and quality than 25 per cent. of Londoners get. —N.T.N. DOB.

[45245].—**Tin and Antimony.**—Mr. Cooke does not say in what proportions he used the components, nor in what order he melted them. The tin should be melted first and the antimony added just as the tin becomes fused, stirring carefully to mix. The antimony soon melts in the tin, and the temperature being allowed to drop steadily, it is imprisoned and cannot rise in lumps as he suggests, even supposing it had not melted. Only analysis can disclose the nature of the lumps. An alloy of tin 80, antimony 20, is about the best. —N.T.N. DOB.

[45248].—**Spots on Speculum.**—Where do you keep the speculum, and who resilvered it? It is not unlikely that if you put the lid over mirror and pack the instrument away in a warm place, that may be part cause. But look through the back volumes, and you will find a great deal said about this matter. It may be that there is something in the air of your district which is injurious. T. P.

[45257].—**Battery for Bells.**—Cap the carbons with lead. —T. J. M.

[45265].—**Process of Hardening.**—Does not the hardness depend a good deal on the composition? Gun-metal can be hardened by hammering, but that is scarcely what the querist can mean. There are works on brass-founding and a founder's manual in Lockwood's catalogue. —T. J. M.

[45282].—**Gelatine Dry-Plates.**—In answer to "B. Sc.'s" query about the process recommended by Captain Abney: I have been using it myself, as follows:—Nelson's No. 1 gelatine, 25 grains; bromide of ammonia, 11 grains; nitrate of silver, 15 grains. Dissolve the silver and bromide each in 2oz. water. Put the gelatine in 1oz. water to soak. Make the silver and bromide solutions warm, and gradually add the silver to the bromide solution, stirring vigorously all the time (in the dark room of course). Wash the precipitate thus formed, and drain. Then add the melted gelatine, and cook for nine hours, with three or four shakings between. This gives a very sensitive emulsion, but rather coarse. My great difficulty has been to get sufficient density with the pyro-ammonia developer; but much better with ferrous oxalate. The exposed plates, after development and before fixing, should be put for half a minute or so in a solution of alum, when they come out very nice and clear from the fixing solution. Will not someone come forward and give directions for making gelatine plates? I am sure, if anyone would do so, he would be thanked by many who, like myself, cannot afford to take the expensive journals devoted to photography. —WHITE FRANK.

[45294].—**Texas.**—The climate of Texas is various. You can live on high ground at the north-western part of the State and have it cold, or in the more southern part, and have it hot. It is a pretty well established fact, however, that the more healthy portions of Texas are situated where the soil is comparatively barren, while the man who would live where the land is fertile must submit to malaria and well-nigh unbearable heat. Texas is one of those States concerning which a

great many untruths are told by unscrupulous and venal men working in the interests of the railroads. I desire, for the benefit of the readers of the *ENGLISH MECHANIC*, to give here some of the real facts concerning this State. This can, perhaps, be best done by relating some of the experiences of a friend of mine—a Londoner. About two years ago my friend, a Mr. R—, an experienced maker of pianoforte-hammers, finding business very slow in London, chanced to come across a man having an office in Aldersgate-street, who strongly recommended him to emigrate to Texas. My friend was about forty-five years of age, and had a wife, a son, and a daughter living in London. Texas was painted to him in glowing colours. It was a perfect El Dorado—it was the very land Sir Thomas Moore saw in his dreams. Mr. R— gathered from the account he heard of this new land that farming in the United States was another name for coining money with rapidity. He believed what he heard, and, in company with a friend, they sailed from Liverpool to New Orleans. R—'s wife and children were left in London, for, as both the boy and girl were old enough to work, it was deemed best for the father first to secure a homestead before inviting his family out. It is well this course was followed. In due time R— reached Houston, the chief city of Texas. It is a difficult matter to describe the people and city. Everybody is lank, lazy, enervated by the excessive heat and malaria. There is not a decent house in the city; revolvers are more plentiful than walking-sticks in England. Vice, sickness, and misery are rampant. Does "An Inquirer" know what "chills and fever" mean? My friend, Mr. R—, was attacked by them, as everybody else is in Texas. He was incapacitated for work, and by selling watch, chain, and everything on which he could raise money, he got to New York. I was with him, more or less, for six months in New York, and during all that time these "chills and fever," caught in Texas, were upon him. Had he not met with friends in New York he must soon have died. Finding that the malaria of Texas had so firmly got hold of his system, he decided to return home. This he did, after being a year and a half absent; and he is now in London—a wiser man. He looks ten years older than he did two years ago, and his pocket is lighter by some £150. There is no doubt that in some respects he acted unwisely when in Texas; but the fact remains that the State is anything but a desirable one to emigrate to. It is the cemetery of countless hopes brought across the ocean, and many an emigrant finds there a premature grave. Cattle ranches exist in some parts of the State in abundance, where the cattle browse over the vast swampy land; but an English farmer has no experience in such farming as this, and cannot succeed in it. If "An Inquirer" wants to emigrate, let him keep further north. Let him go to Kansas, Missouri, Minnesota, or even Manitoba. A word in reply to the latter part of "Inquirer's" question. There is no duty to pay on tools of trade that may be brought out by the emigrant. But let me quote a few clauses from the statute, putting would-be emigrants on their guard. It says "the exemption [from duty of tools of trade] shall not be construed to include machinery or other articles imported for use in any manufacturing establishment." "The law authorising the admission free of tools of trade is limited, and does not cover 'machinery,' or any article to be worked by any other than manual power, and is restricted as to numbers, quantity, and value to what is considered reasonable for the actual use of the person to whom they belong." —R. M. TUTTLE, Providence, R.I., U.S.A.

[45305].—**Keyless Geneva Watch.**—I have a keyless Geneva watch to clean, with an escape-wheel with 30 teeth. I must say it's the first that I've ever seen. It consists, as "Guyot" says, of 80-teeth going barrel, centre-wheel 90, pinion 10; third-wheel 96, pinion 6; and escape-wheel 30, pinion 6. It has no fourth-wheel; the second-hand (or should be) is put on the escape-wheel pivot instead of the fourth-wheel, and goes round four times to the minute. The escape-wheel goes the same way as an ordinary Geneva's fourth-wheel, and the notch in the cylinder is at the contrary side to any other Geneva, to allow of the escape-wheel going the contrary to an ordinary watch. They are cheap auctioneer's watches, very rough, and only jewelled in two holes. They are badly finished, and common brass cases. I shall be glad to answer any more questions about it if this is not sufficient, but cannot say who the maker is. —J. N., A BROTHER PIVOTER.

[45331].—**Waste Timber in Saw-Mills.**—May be cut into brush-makers' stocks and boards to advantage. For turning it into bobbins, a wood-turning lathe would be required, which would not require much power. If "Saw Miller" will send his address to Lewis, brushmaker, Swansea, he can receive sizes and patterns. —JAS. I. LEWIS, 60, Oxford-street, Swansea.

[45345].—**Enlargements from Quarter-Plate Negatives.**—A good deal, of course, depends upon the quality of the negatives and the care and

skill with which the enlargement is made; but rule (though my experience has been principally in portraiture) negatives will not bear enlarging than from about four to six times without the result being too clearly evident. If, therefore, "D." wishes to enlarge up to 12 by 10, I think he will do well to keep his 5 by 4 apparatus. —FRODO.

[45348].—**Launch Machinery.**—I should alter the stroke of the cylinder now, as it involves a new crank being fitted, but do you can with the existing engine; not only unless you had a boiler giving a more ample of steam, there would be a direct you are about to have a new hull built it yourself, you can easily give lines. What I like is a fine bow, with a but nearly pure wave lines. A hull although it looks well, does not give the of speed. Then, again, the lines from must lead up to the mid-body line, yet an increasing degree, so that the the weights are carried are full, and to sustain them. The lines of the stern hollow, as tending, to produce a series of favourable to the screw. The rest of the hull may be pretty good, as it gives a form of hull well adapted to seaway, and yet easy to drive through the water. I now see by what you say that the boiler is totally unfit for its work. When I mentioned 15 tubes I meant at least 15 to 20 of them. It would be no use to reduce the area of the existing ones—in fact, it would be a detriment, as tending to reduce the draught. The reason you have had to reduce the length of grate is no doubt the want of proper combustion room, and nothing you can do will alter it. The best thing you can do is to apply the petticoat-pipe on the funnel, and you may also enlarge the blast nozzle to 12 in., which will ease the back-pressure somewhat. You will be sure to find, with a short stack, the draught improved at first with the petticoat-pipe, but the instant the blower on the engine starts, it will be found an improvement decidedly. —SUSANSON.

[45350].—**Pig-Iron Analyses.** It does not seem to have occurred to "Avon" that the insoluble residue which he weighed as carbon would also contain silica, derived from the silicon invariably present in pig-iron, hence the inaccuracy of his results. If he will try the following method, due to Ulgren, I have no doubt he will be more successful: Weigh out about 2 grams of the coarsely-powdered sample into a small flask, containing 10 grams of copper sulphate dissolved in about 50cc. of water, heat gently with constant agitation until the iron is completely dissolved; allow the solid particles to settle, and pour away as much of the clear liquid as possible. To the residue in the flask add 40cc. of concentrated sulphuric acid, allow to cool and then add eight or ten grams of chromic acid; now close the flask with a doubly perforated cork, carrying two glass tubes, one being closed with a caoutchouc cap, the other serving to connect the flask with a series of three U-tubes; the first containing pumice, which has been saturated with copper sulphate and strongly heated; the second calcic chloride; and the third coarsely-powdered soda lime. The object of this third tube is to absorb the carbon dioxide which will result from the oxidation of the carbon by the chromic acid. Its weight must be accurately known. All being arranged, apply a gentle heat to the flask, gradually increasing it as the evolution of gas slackens, until white vapours are seen within the flask; then remove the lamp, and the caoutchouc cap from the inlet tube of the flask, and aspirate a slow current of air through the apparatus, so as to sweep every trace of carbon dioxide into the soda lime tube, which is then detached and accurately weighed. Its increase in weight shows the amount of carbon absorbed, from which the quantity of carbon in the sample is readily calculated. The above estimates the total carbon. To estimate the carbon, dissolve three to five grams of the in moderately-concentrated hydrochloric acid, collect the insoluble residue on a weighed filter, wash well with hot water, with dilute hydrochloric acid, with potash, to remove silica, and finally with alcohol and ether. Dry at 120°C., and weigh the residue obtained as above may be dried, with copper oxide in a short combustion tube, burnt in a current of oxygen, the carbon is then collected and weighed in the form of carbon dioxide. —ANALYST.

[45351].—**Lantern Slides.**—I will endeavour to help you with the latter portion of it—namely pictures on paper, rendered semi-transparent by paraffin or similar substances. Such pictures make slides, but I do not recommend them, and will do you little credit, if they do not damage your entire entertainment. If you are a Londoner would show you some of them and glass pictures by way of contrast; but, if you draw fairly, might make pleasing slides by coating glass with negative varnish, and, when dry, dipping 2 finger in powdered resin, and rubbing the surface with a light circular motion; you will produce

leaves. Having arrived at this point, if covered jewels are put to any of the wheels, re-oil with a blunt-pointed needle, say, and then replace the wheels, &c., in precisely the same order they were in before, the pillar-plate following next. With the tweezers in the right hand, and the movement in the left, carefully set each pivot in its place in the pillar-plate, a gentle but constant pressure of the plates to each other must be kept up during this process, or one pivot will pop out of its hole whilst another is being attended to. With this operation satisfactorily accomplished, replace the pillar-pins, the short pins going into the two pillars which come close to each other. Now turn the fusee round until the hooking-in hole for the chain rests just over the centre-wheel teeth. Hook the proper end of the chain in the hole, and place the barrel in position, the squared end being put through the bottom plate. Replace the barrel-cock, and then, having hooked the loose end of the chain in the barrel, gently and carefully wind the chain round the barrel. Holding the chain in that position with the thumb; replace the ratchet-wheel and wind the spring up about a half-circle, insert the point of the click in a tooth, and screw down tight. At this juncture, oil all the pivot-holes, giving more or less according to the size of the pivot, or bearing. The smaller pivots will need only so much as would make a spot on paper as large as a period, or full stop, in any part of this letter. Attention may now be given to the staff and balance wheel. To clean this, procure an ordinary address card, and from its edge, inwards, cut a narrow strip, pass the card under the hair-spring, and between it and the jewelled roller, and brush the roller and bottom pivot perfectly clean, then, for the top pivot and wheel, pass the cut card between the spring and the wheel. This plan obviates the possibility of damage to the delicate hairspring. Place the balance-staff in position, and pin the hairspring up as before, inserting the outer coil of same between the little regulating-pins in the index-pointer. The spring must be left free to play between them, and free from the pointer itself. The jewel-pin in the roller must now be placed in the lever-fork, and the watch be got in beat. There is more in this expression than meets the eye. Many watches stop through being out of beat. An infallible test of correct setting is when a bar of the balance is at rest exactly over the pallet's hole, and the ruby-pin in the roller is in an exact line with that and the staff-pivots. I cannot enter into a more lucid explanation of that now, as I fear I have already exceeded the limits of a reasonable letter. Oil the cock-hole before screwing down. If the hair-spring has been set right, it will appear perfectly flat, and free from the top plate and balance-cock. Here apply a little oil to the 'scape-wheel teeth, or the faces of the pallets, and then wind the watch up, guiding the chain, in so doing, to the grooves of the fusee. Now replace the cannon-pinion, hour and minute-wheels, dial, and lastly, the hands, in their respective places; the securing of the movement in the case coming after that has been cleaned. In thus putting before the uninitiated the *modus operandi* of cleaning a lever watch, I must beg to be excused by my brother watch-maker readers if I have been a little prolix in my description. I have convinced myself in this matter that it is better to err on the side of a good intention than to land an unwary amateur in difficulties by leaving necessary instruction unsaid. —ALFRED.

[45456].—Pumps.—To "SUNLIGHT."—Really the case is one that can hardly be correctly dealt with from mere description. The most likely thing is that the air-vessel gradually loses its air by absorption. This would account for the noise. Beyond this there may be the reasons set out by Mr. A. Butler and another gentleman. What you say now the more inclines me to think that the noise is in the air-vessel. A reason why a noise occurs now which did not during the first two years' working, might very possibly result from the fact of corrosion in the air-vessel, even in the air-space, due to oxidation having formed a blow-hole in the casting perhaps. I am sorry I cannot say more with certainty. In a case like this, one could most likely locate the place and cause easily enough if a personal inspection were made, whilst it is next to impossible to speak positively in the face of voluminous written description only. —WILLIAM.

[45457].—Box Oak.—It will be best to cut it up into sections required. When cut bury it in a dry sand and place in a dry, well ventilated box. Time taken to dry I cannot say. That will depend upon the temperature and thickness. —JACK OF ALL TRADES.

[45458].—Lacke Centres.—About 3ft. Gin. to 4ft. Gin. —JACK OF ALL TRADES.

[45459].—Canadian Railways.—Drivers' pay is about 50 dollars per month. Firemen's is much less in proportion to theirs. You would have to agree with the railway on road. Your best chance

would be in the fitting shops; from what I have seen I should prefer the United States to Canada, and should not go until April. —ENGINEER.

[45475].—Turning Face Plate for 5in. Lathe.—Your lathe is a gut-lathe, I expect. If so, get a piece of beech or any hard wood 1 1/2 in. thick, and bore to size of crank-shaft. Put upon mandril and turn down as small as you can well do with it, that strap, when running from it and upon your large speed, will clear your lathe-bed or shears. Cut the same in a half, and make fast upon crank, and drive with a strap, which may be done by pulling your headstock forward. —JACK OF ALL TRADES.

[45475].—Turning Face-Plate.—If your casting be thick, and you have metal to spare, I should get somebody to rough-turn it for you on a back-gear lathe. It will probably not run quite true when screwed on the mandril, but having the scale removed, you will not find much difficulty in turning it up true with your plain mandril lathe run at a slow speed. I have seen objects, as large as this, turned without back-gear. —HAWLEY.

[45478].—Dipping Brass in Mixture of Hydrochloric Acid and Alum to Impart a Gold Colour.—I am very doubtful if that will do it. Dipped in aquafortis, i.e., dipping acid, or nitric acid, and plunged into water, in which a small portion of common washing soda is dissolved; it will come out a good gold colour. I have used it to take off the peculiar white glint that some brass has after dipping. —JACK OF ALL TRADES.

[45478].—Dipping Brass.—Having had some brass-work to finish lately, I tried the recipe for dipping-bath of hydrochloric acid and alum, given a fortnight ago. I could not make it answer at all, and the lustre given was much duller and of a greenish hue, in comparison with that given by strong nitric acid. When dipping articles, I have a bath of whitening and water close to my acid-bath. When the article has been dipped four seconds I remove it, and instantly plunge into the whitening and water, which removes at once all the acid and oxide, and it comes out a beautiful dead gold colour, requiring to be only dried, warmed, and lacquered. Should the first dip be not sufficient, you can repeat the process, and end by a dip just in and out again quickly, having previously cleaned the article in water and dried it. Don't put it into the acid wet, because some parts being wetter than others the acid will attack them unequally, and the result may be a cloudy mottled appearance on the surface. Never use a pair of iron tongs or forceps for holding the work when dipping; either suspend it from a brass wire or make a pair of tongs out of a piece of 3/4 by 3/16th brass, something like a long pair of sugar-tongs. If obliged to use this process indoors, you should get a draught to carry away the brown fumes; they are not pleasant to inhale, to say the least of it. If you have a fireplace not in use, make a board to fit it exactly, and at a convenient distance from the bottom cut a hole in it about 6in. square. Place your acid-bath close in front of this, and the air rushing through will carry the hurtful fumes up the chimney. —HAWLEY.

[45484].—Speculum-Grinding.—The diameter of the bevel-wheels in my machine is 4in. They appear strong enough for 9in. or 12in. speculum, if desired. —A. WOOLSEY BLACKLOCK, M.D.

[45489].—Turning Granite Rollers.—I know a wood-turner who has turned marble and other stone columns by an old three-cornered hand-saw file, put into a long handle (not patented). He had no slide-rest or back gear; he used the hand-tool alone, and to reduce the speed of his wood-lathe the engine ran slow on purpose. —WORKING TOM.

[45489].—Turning Granite Rollers.—This may be done with chilled cast-iron rollers or wheels with teeth in them used in a fork in the slide-rest, the same as a milling-tool, the surface being reduced by the crushing action until a fine surface is got finished by grinding and polishing. —JACK OF ALL TRADES.

[45491].—Silicate Solution.—There is a silicate paint that adheres very well to iron, and gives a good surface. See "London Directory." —JACK OF ALL TRADES.

[45493].—Fixing Burnished Bands on Picture Frames.—I do not know what special bands you mean, unless the German mitre plates and angle pieces made of latten brass. Some picture frames I have seen completely covered with it; the framework is rabbeted on the inside for the moulding or bead, and a saw kerf or channel about 1/4 in. down the outside; the metal is laid upon the frame, turned over the side, and seemed to me to be turned into the quirks and channel by a wheel jigger. Some few years ago I saw some rolls and stamped angle pieces for mitres. I have not seen any lately, but I have some photo carte frames of the same material by me now that have kept their colour well. —JACK OF ALL TRADES.

[45495].—Coil to give 1/2 in. Spark.—To Mr. LANCASTER.—You can, of course use cotton-covered wire in place of silk-covered wire, but there are three objections to its use. First, its insulation is not equal to silk; second, it is more bulky; and consequently, thirdly, it is impossible to wind as much in same space as of silk-covered wire; therefore, the spark will be shorter. I have not time this week to make drawings, but as soon as the bustle of Christmas business is over I will send drawings of every part of the coil. —W. J. LANCASTER.

[45496].—Cement.—Get some good Portland cement, and render your tank from 1/2 in. to 1 in. thick before cementing your glass in. Roughen your glass by grinding it with No. 2 emery, about 1/2 in. or 1 in. all round the edge; when the cement is set and dry, make it moderately warm, and paint with paraffin wax, and for colours, red and yellow, use ochres or Torbay red; sienna, raw or burnt; for blue, smalts; black, ivory black; for white, zinc or Spanish white. —JACK OF ALL TRADES.

[45496].—Cement.—If for anatomical specimens why don't you buy the ordinary glass jars with the tops ground smooth on to which a plate of glass may be cemented? You can putty a glass into the front of a zinc case; but if I were you, and wanted a large vessel, I should make it entirely of glass both bottom and sides. —W. J. LANCASTER.

[45497].—Cheap Perfume.—Why don't you get rid of the nasty smell? Why try to mix a good odour with a nasty one; better by all means build a fire of iron, or zinc will do, and carry away the smell into the outside air. You will find that unless you get rid of it, you will always detect its nastiness, even among eau-de-cologne, or any other good odour. —W. J. LANCASTER.

[45498].—Dew-Cap.—Dew-cap may be longer with advantage. You might make up a light dew-cap of two ends connected by wirework, then cover the whole of the wirework with fine gauze, such as gardeners use to protect trees from frost—thus preventing radiation, and consequently not allowing the deposition of dew. You can make a dew-cap 2ft. long in this manner, and although so long it will be lighter than an ordinary one half the length. —W. J. LANCASTER.

[45499].—Berthon Observatory.—Put a frame-work, say, 1ft. high, all over the top of observatory, and on to this nail some gauze, such as described in answer above; this will prevent the formation of dew on the top of observatory, and will keep the observatory much warmer than without it. You ought not to rub telescope when it is damp, leave it until dry, then wipe it with a chamois leather kept on purpose, or an old handkerchief. —W. J. LANCASTER.

[45500].—Reflecting Telescope.—To Mr. W. J. LANCASTER.—Don't think of making a metal speculum at all: they are things of the past, and I am glad "Orderic Vital" has also answered the query. You may depend upon it that however much fashions come round and round again, that metal specula will never be fashionable again. Begin at once to grind a glass speculum, and this is worth doing well, so don't hurry it; make it slowly, and you will succeed. You can purchase a piece of plate-glass the size you want to make speculum; this is better by far than having it cut as some have done. The ordinary plate will be more homogeneous, and will be worked easier. The glass will cost you a mere nothing; it is time, patience, and perseverance that will make the speculum a good one. —W. J. LANCASTER.

[45507].—Cleaning off Useless Negatives.—I prefer for this purpose a hot strong solution of caustic potash, in which the plates should be immersed and left until cold, when the potash may be poured off, and the plates washed under tap, any adherent portions of film being rubbed off with a rag. —PHOTOS.

[45507].—Cleaning off Negatives.—I easily clean the plates; put them into water with a small quantity of sulphuric acid; the plates soon lose the film, but the films will not be saved; better throw them away than waste time over the recovery of a small weight of silver. —W. J. LANCASTER.

[45509].—Making Wood Fireproof.—A liquid silicate and lime will render it to a certain extent fire-proof—the only process I know of. Perhaps Ransome's can supply the silicate. —JACK OF ALL TRADES.

[45510].—Magneto-Electrical Machines.—You can put a dial in the lid of the machine, on an index finger, having a small pinion underneath moved by a rack coming from the armature magnet, so that as the armature is drawn out the finger will move round. You can divide the dial in any way you like, but the divisions are of much value, if any, as it is impossible to late the strength of the current from such a machine. —W. J. LANCASTER.

[45511].—**Gelatine Films**.—Gelatine films are not yet a success; there are difficulties in framing them that will have to be removed, and then the gelatine itself will not fall into a perfect plane, as it should do, to obtain a crisp image all over the plate; still, I have no doubt the evils will be remedied before long.—W. J. LANCASTER.

[45514].—**Power of Field Glass**.—Deeper eyepiece lenses with an additional length of tubing will give you more power, but at the same time will reduce the field. You should get one of the three-change glasses, having three pairs of concaves of different foci.—W. J. LANCASTER.

[45519].—**Chest Pain**.—To DR. EDMUNDS.—From the symptoms described, I should be inclined to think that if "A Poor Sufferer" neglects his pain, he will discover ere long that he is another victim of chest disease (consumption) unfortunately so prevalent. I am led to "speak to" this query on account of some information I gained in my last visit to Paris. At the Exhibition of Electricity, I met a Christian Brother, in shovel hat and long robe, and in course of conversation I learned that the Educational Society, to which the *frère* belonged, employed for its own members afflicted with chest disease a solution of double phosphate of lime, compounded by one of the fraternity. Its potency in chest diseases, he assured me, was vouched for by innumerable testimonials. But to me the most convincing argument, as regards its efficacy, was the fact which was incidentally mentioned, that although never advertised nor "pushed" in any way, the sale was extending daily, and last year 15,000 gallons were disposed of. As this solution is sold at 5 francs (4s.) a quart, I procured some (two quarts), and have since then endeavoured by experiment and comparison to test its qualities. My ignorance of chemistry prevents me from stating in a precise or absolute manner the result of my homely experiments. But I am inclined to think that a chemist will find that this acidulated solution is richer in phosphate than Dr. Churchill's, which is so dear as to be out of the reach of all but the wealthy. If Dr. Edmunds, or any other competent person, will advertise his address, I will gladly forward, say, half a pint of this solution, on the understanding that their appreciation be made public. And if favourable, I am sure that our apothecaries will not be slow in taking up so valuable a remedy which has not, as yet, made its way into this country.—T. P. M. C.

[45520].—**Rag-Pulp Balls**.—I am sorry I cannot tell you how to do what you want, and I never care to recommend any amateur to waste his time in doing things that I know but little about; there are many of our readers who do know, and will be pleased to tell you how to do it.—W. J. LANCASTER.

[45521].—**Condenser to Steam-Launch**.—I would just like to say at the onset, does "Edinburgh" intend to fit the launch with a boiler with sufficient natural draught to be able to dispense with the exhaust in the funnel? If so, I should then most distinctly advise him to use a surface condenser at once. But if he proposes to use a boiler of the usual size for high-pressure launches, then he will find himself short of steam and dependent on a blower in the chimney to maintain the pressure. I am speaking from actual experience in this matter—and from the insight I had in practice with the "Crighton" form of condenser I have not forgotten this fact. There are several plans open; one is to apply a "Crighton" surface-condenser, which is simply a wrought-iron pipe running along the keel on either side, and which I have several times fully described; or to use a plan fitted by the Neath Abbey Engine Company many years since with great success. It is to use an ordinary box surface-condenser, with an arrangement so that the fan acts as the circulating pump most efficiently, and a third plan is that used for some towing launches in the river Platte. It is to take part of the exhaust steam into a condenser at atmospheric pressure, whilst the other part is sent into the funnel to maintain the draught. Now it really means this: if you have a boiler with the necessary heating surface and draught, then use a surface condenser; if you have an ordinary high-pressure boiler, then you might use the last plan I mention. This means, with the aid of the fresh water in the tanks at starting, running in a seaway for something like 36 hours, with care. You would, of course, have a sea connection in case of exhausting the tanks; and if the hull is to be of iron I can suggest a plan I have tried already that will save very much in first cost and yet be perfectly efficient. I am sorry to have to say that I do not consider the plan you suggest a good one, and, further still, I do not think it would prove at all satisfactory in actual use. I shall be happy to further assist you if you so desire.—SUNLIGHT.

[45522].—**Expansion**.—To find at what portion of stroke the steam is cut off, when the lap, lead, stroke of valve, and stroke of engine-piston are given, the rule is, to twice the lap add the lead; divide the sum by stroke of valve; square the quo-

tient, and multiply it by the length of stroke of piston; the product is the distance of piston from end of stroke when steam is cut off. If you are not in possession of the requisite data, then apply the indicator to the cylinder, and the diagram will show you where steam is cut off.—LABOR OMNIA VINCIT.

[45524].—**White Metal Bearings**.—Old type-metal is frequently used for bearings, and is very satisfactory. I have seen many cameo-cutters' lathes in Italy with their bearings made of this metal. They had the head, where the pulley runs, protected by a tin lid on a hinge, and some had also a cap fitting accurately over the mandril-nose, where it projects from the head, with an intervening space to intercept any grit. A mixture of tin and zinc, I have been told, makes a good mixture for bearings, but I have not tried it, so cannot say for certain. The metal is often melted and poured round the mandril, previously smoked and placed in position in the head. It is surprising how little wear there is upon a spindle if protected from grit from the very beginning. I once ran an oilstone-spindle in boxwood bearings for more than a year, having it protected, and it was not abraded at all. Type-metal is tolerably hard (not like iron, of course), and I once made a nut upon a bolt by placing the bolt in a mould the shape of the nut, when I had not a tap that would cut the same thread as that on the bolt.—HAWLEY.

[45527].—**Fontaine Engine**.—The Fontaine locomotive has the drivers mounted on an axle carried over the boiler, the cylinders being supported, as it were, at the side of the smoke-box, at an angle of 17½ degrees. The engine is made in two types, the single-driver and the four-coupled, and, but for the wheels on the top, looks exactly like the ordinary American passenger-engine. What are driving-wheels on ordinary engines are in this type termed rolling-wheels, and they carry the friction-wheels, or, in reality, have another tire set some inches in from the real treading and flanged tire of the rolling-wheels, and of course projecting a sufficient distance to allow of the driving-wheel working on the friction-tire without coming into contact with the tire of the rolling-wheel. Both driving and friction-wheels have plain cylindrical steel tires. These wheels can be pressed together by means of a small steam cylinder acting on a system of levers. The dimensions of the engines are of no special interest, as they are the same as several good types of American locomotives; but it may be mentioned that in No. 1 the elevated or driving-wheels are 72in. diameter, the friction-wheels on which they work 56in., and the rolling-wheels, those on the rails, 70in. in diameter. In a freight-engine, No. 2, the drivers are 60in., friction 70in., and rollers 78in. No. 1 is said to have run 111 miles in 98 minutes, and 235 in the same number of minutes, including stops for coal and water; 75 miles an hour can be done on good road—the engine running "like a bird," which is not very definite, but may be taken to mean steadily and easily.—ESSAR.

[45528].—**Screen for Magic-Lantern**.—You will find good, white paper, pasted on strained calico and allowed to dry, superior to any dressing, and it will fold up well, lasting for years.—A. PUMPHREY.

[45531].—**Pianos**.—To MR. DAVIES.—If the strings are not very rusty they are better left alone, or at most rubbed over with a rag touched with a mere suspicion of sweet oil and paraffin. Rust in itself has rather a tendency to improve the tone, and so long as it has not gone too far will produce no ill effects; but as soon as the strings begin to snap cleaning the rust off would do no good whatever, and would besides be much more troublesome than re-stringing, which would only cost about 5s. for the wire, and would give the piano a new lease of life. It is a very sensible suggestion to prepare the piano for the professional tuner by previously tightening the wires. A simple way to do this is to begin at the bass and to raise each note to unison with the one next above, say, C to C sharp—C sharp to D, and so on throughout the gamut. This should be done with a steady hand; it would indeed be better to employ the two hands, as the pins will most likely be very stiff from long disuse. The piano should then be left to settle for a few hours, and the same process repeated. The piano has now been raised a full tone, and might be expected to be up to pitch; but on trial it will probably be found to be still nearly ½ note below, and to require still another repetition, when it may safely be left for the tuner to fine over, and as he will be very likely in a good humour at so much hard work being spared him, he ought to make a very satisfactory job of it.—W. H. DAVIES.

[45532].—**Colours of Express-Engines**.—The N. E. engines are of light green, with broad lines of darker green picked out with black and white; the frames are of a light red colour. The number-plates are, as a rule, red, but I have noticed lately that some of them are painted black. L. and N. W. and Caledonian goods and mineral engines are black, picked out with red and white.

The L. and N. W. passenger-engines are same, only the black used is (I think) of a finer description, and rather more inclining to brownish tint; the number-plates are red, and name-plates polished black. The plainness of Mr. Webb's engines is somewhat relieved by the coat of arms of the company being painted on the splashers. The Midland and Great Northern are of light green colour; the frames of the latter are coloured not unlike those of the N. E. engines, but darker; both the M. and G. N. engines are picked out with white and red; G. E., black, with broad red lines; L. B. and S. C., yellow, with black and crimson lines; H., much the same, some black picked out with white; N. B., olive green, broad lines of black, edged with red, name gilt, number-plate polished brass. This colour is now dying out among the N. B. passenger-train, and will soon be seen on the goods only. Now the colour is light yellowish green (or greenish yellow), and frames and lines ruby colour. G. W., green, yellow lines, frames dark brown; L. C. and D., olive green, dark green borders, picked out with red; S. E., dark green, with broad lines of darker green and white lines; L. and S. W., dark bluish green, broad black lines, white edges. Those of L. and Y. engines, which I have seen, were like the G. and S. W., or black, like L. and N. W. locos; M. S. and L. engines, green; L. S. W., brown; Furness, iron ore colour; M. and C., dark green; C. passenger, blue, broad black lines, picked out with white. Single engines of this railway have lion of Scotland in gilt and red on splashers of driving-wheel, coupled engines on splashers of trailing-wheel. Of course this only applies to such classes as run main-line traffic.—CARSTAIRS.

[45533].—**The Road Loco. Act**.—Not only is compressed-air used, but steam is also employed for tramways; but the reason why this is allowed is that the Board of Trade and the local authorities agree to grant a license for, say six months, which is renewed as required, allowing the use of the motor under certain conditions. These are, that it shall not emit either smoke or steam; the speed not to exceed 10 miles an hour—in some cases six is the limit—with an automatic governor to prevent the allowed speed being exceeded; also, that such brake-power be applied to stop the engine in a given number of feet—generally its own length—and that the machinery be all inclosed. These are the main points; hence you will see that a private person has not the least chance in the matter, as it would be more costly to apply for a license which would, in all probability, be refused, than the experiment was worth. In the case of Sir Thos. Parkyn, the machinery was so inclosed, and so fully answered the requirements, that to test the question he had to get a friend to lay an information against him. Neither steam nor any other form of motor would be allowed, except under the conditions of the Act. And special permission would not be obtained, it may be relied on. Such is the result of intrusting the power of granting or withholding permission to persons who view the question from their own private and selfish standpoint. I do not protest against any rules to confine the speed to given and reasonable limits, and to rational restrictions against careless driving; but I do most strongly demur to the present sweeping restrictions administered by the class who are always too ready to interfere with private rights.—SUNLIGHT.

[45536].—**Transit at Greenwich**.—You will find a lithograph in Dunkin's "Handbook of Astronomy," and a description of it; but the better way for you to do will be to obtain permission to see the transit at Greenwich and get all the information obtainable from one of the assistants. Unless you have almost every modern appliance and skilled workmen, you will make but a sorry instrument compared with the Greenwich one. The latter has a 12ft. tube, 8in. o.g.; the two cones and central cube weigh nearly 11½ cwt.; this will give you a faint idea of its magnitude. If you wish for more particulars I will give them with pleasure.—W. J. LANCASTER.

[45537].—**Crank-pin Running Hot**.—I have no doubt that your engine has got the fault of a great many others; that is, the crank-pin or the flywheel is not set true with rest of engine, or one of the slide-blocks is worn down more than the other. The brasses may be of bad composition, or the common evil of being keyed-up too tight. Try a little genuine red-lead mixed with some lard-oil. If you want a device for oiling it without stopping, I will give you the idea.—ENGINEMAN.

[45537].—**Crank-pin Running Hot**.—Surely it must be a case of bad fitting in the brasses that is the cause, and, I expect, could be traced to the brasses fitting in places only. What I should do is to get the crank-pin again turned up true and polished. Then fit the brasses and carefully scrape them until they fit all round on the crank-pin. And be sure not to use too much red-lead, so as to mislead you as to the contact surfaces. When this is so, couple all up together, and ~~and~~ ~~and~~ ~~and~~

plenty of oil. See that the brasses also do not tend to pinch on the edges. If this does not cure it, either the work must be badly done, or the brasses are too weak and spring together, with the thrust of the engine, and so squeeze out the oil from part of the surfaces in contact, and so set up cutting.—**SUNLIGHT.**

[45538.]—**Refulgent Lamp for Magic-Lantern.**—Sell your lamp and get a triple-wick lamp; this, of the right kind, will give you double the light you have ever obtained from your duplex refugent. You cannot alter your own—better sell it. Of course you have used paraffin, have trimmed the wicks, and drawn out the chimney to its full length; if not, it will smoke very much, and be an intolerable nuisance.—**W. J. LANCASTER.**

[45538.]—**Refulgent Lamp.**—There is something decidedly wrong somewhere. Do you use a front shutter of glass to close the end next the condensers? Also, is the lamp the right height for the lantern? The class of lamp you have with me always works well, though not giving the light which the lamp I designed for my own use does; but then it has 2½ in. wicks. As the lantern is an instrument I take great interest in, if you already use a glass shutter in front with the result you name, the only way I could help you is to say that if you like to go to the expense of sending it to me I would see what is the matter, and, if but trifling, my assistant should put it right for you, free of charge, of course. This is the only practical way I see of helping you. I may add that the class of lamp is generally very well liked, and neither smokes or gives trouble.—**SUNLIGHT.**

[45539.]—**Cracked Driving-Wheel.**—The arms are certainly very light; but there should be but little difficulty if the job was set about properly. The way I should get over it would be as soon as the casting was made to uncover the rim, and so cool it off quickly. This will make it contract, if anything, quicker than the arms and boss. The cracking is caused by the arms contracting quicker than the rim, hence the fracture. Uncover the rim, and I think you will then get a sound casting.—**SUNLIGHT.**

[45539.]—**Cracked Driving-Wheel.**—In my experience, this wheel is just like a number of jobs that come into the moulding-shop. Your pattern is far from being proportionable. Fancy the boss: at top, 2 in. metal; at bottom, 3½ in.; arms, 6 in. by 4 in. at centre, 4 in. by 3 in. at rim, by 1 in. metal. Again, your rim increases in thickness. If you have any hematite in your works, put in a little, say, 1 pig to 3 or 4. If you have none, put in some malleable iron turnings into the ladle before you tap the furnace, and after wheel is cast, take off the top part and bore the boss; and also take out the core to allow the boss to cool with the rest of the wheel.—**CAST-IRON.**

[45540.]—**Model Locomotive.**—In proportion to the size of boiler and driving-wheels the cylinders are much too small in diameter as it takes 30 lb. of steam to move it; from 5 lb. to 10 lb. ought to move such an engine with the proper piston area; the heating surface of the boiler may be defective, but a good boiler would soon lose steam if the engines are put in full gear when the wheels are clear of the ground on account of the speed or revolutions not being so limited, but it should maintain the pressure of steam when the valves are set to cut off early in the stroke. If the boiler will not do this, the heating surface must be deficient. In this case your locomotive is labouring under two defects—viz., small cylinders and insufficient heating surface; both should be remedied to make a good engine of it. The easiest way to get over the difficulty would be to double the pressure of steam in the boiler; but if it will not stand that safely, and the heating surface is really at fault, it will be necessary to make larger cylinders, say, 1½ in. diam., and a new boiler, if it is impossible to improve the present one in any way. I should very much like to see the engine, and if Mr. Huntley is near London, and will advertise his address, I might be able to suggest a remedy which would not otherwise occur to me.—**E. L. P.**

[45541.]—**Launch.**—A single cylinder, 4 in. bore and 5 in. stroke, will not drive a 20 ft. boat very fast; but with a hull with fine lines, possibly eight to nine miles an hour could be got. I would gladly give you all particulars of lines of hull if you like to communicate with me through the "Address Column," as the information needed is far more than it would be reasonable to expect space for in this journal. If you like to communicate with me I will put you right on the matter of construction and lines of hull. If you have a good builder at hand, I should say have the screw in the dead wood aft; if the builder be a novice, then I should say perhaps it would be better to place it as shown in issue for November 4th. To your next question I may say that either a horizontal return-tube or a "Cochrane" or "King" boiler would either of them allow the firing to be done from next the engine, which would also allow the steering to be done by the person driving and firing. As you

require to run in salt water, see my remarks to query 45521, which bear directly on the question. If a vertical boiler be used, I should decidedly use a boiler of one of the makes I have named. If a "Cochrane," I should advise one of the "Mayfly" class, 3 ft. total height, 2 ft. 6 in. in diameter. It has 30 sq. ft. of heating-surface, and the list price is £42, without fittings. But a horizontal could be made for much less if you went to the right place for it.—**SUNLIGHT.**

[45545.]—**Fretwork.**—Either naphtha or methylated spirit would remove the varnish.—**SUNLIGHT.**

[45546.]—**Microscope Magic-Lantern.**—I think, from the information I have on lantern lights, that, with the exception of Mr. Hughes's new light, which I cannot speak of from personal experience, that there is neither oil, or, certainly not gas-light, that would be of any service; and, most decidedly not in a way I should consider satisfactory. Further still, both Mr. Lancaster and myself have more than once stated that a micro-objective is next to useless for the purpose. What is needed is a properly constructed lantern micro-objective, or better still, the form I described, which does not destroy the slides by the concentration of heat. If you want to show ordinary micro-slides the best way known to scientists is to use Browning's new form of lantern-microscope. Certainly it is a somewhat costly matter, but I should like you to see some slides I have, as shown with it, and the best ordinary achromatic form. The difference is so striking that it is impossible to hesitate over the question, as a less costly arrangement would probably suit you. Would not the combination Mr. Lancaster mentions be the thing? But I certainly greatly prefer the lime-light for such a purpose. And some slides of marine specimens I have look very different with an oil-light to what they do with the whiter, and more concentrated lime-light, especially with a mixed gas jet.—**SUNLIGHT.**

[45551.]—**China Painting.**—Robertson's medium is not to be recommended for china painting when such paintings are to be "fired"—i.e., burnt in a kiln or muffle; turpentine, with a little "fat" oil of turpentine, is generally used; the latter can be bought at artists' colourmen, or can be made at home by pouring a small quantity of ordinary turpentine into a wide shallow vessel, such as a saucer, and covering it loosely with paper to keep out dust, but to admit the air. After having been left thus for days, the turpentine residue is called "fat," and takes the place of maglip or the medium referred to for ordinary oil-painting on canvas, &c. To make a medium for ordinary oil-painting, take equal parts of light drying-oil and mastic varnish, or copal varnish may be substituted for the mastic; but if really good work is to be produced, the less maglip used the better.—**W. T. BASHFORD.**

[45554.]—**Experiments with Induction Coils.**—Obtain Dyer's book on the "Induction Coil, and How to Use it," price 1s. It gives a variety of simple experiments that would probably be of interest to you.—**SUNLIGHT.**

[45557.]—**Chemical Paper.**—The paper is not prepared at all. It contains a piece of the metal potassium screwed up in it, which, on being moistened with water, bursts into flame and sets light to the paper.—**MOMTS.**

[45559.]—**Steam-Canoe.**—It is as much as ever you will be able to get five miles out of a canoe 17 ft. by 4 ft. beam. I should try a horizontal boiler, say 2 ft. 6 in. long by 18 in. diam., with internal furnace 8 in. diam.; return tubes to the fire-door end, say a dozen 1½ or 1¾ inside diam.; engines might be two cylinders, each 2 in. bore and 3 in. stroke. Further information with pleasure.—**SUNLIGHT.**

[45561.]—**Saturn.**—As to the possibility of seeing Encke's division in Saturn's ring, with a 4 in. refractor, as much depends upon the observer's eye and the state of the atmosphere as upon the excellence or non-excellence of the glass itself. I may remark, however, that the querist's glass would indeed be a marvel of excellence and accuracy if with it he really can distinguish Encke's division. With a refractor of 5½ in. clear aperture, I have—on exceptionally clear nights—but just glimpsed the division, and even this was unsatisfactory. Perhaps Mr. Dennett—whose eye and telescope, by the way, must be simply the *ne plus ultra* of excellence—will inform us as to whether he is able to discern the division with, say, 3½ in. of aperture.—**ACONITE.**

[45565.]—**Photographs in Natural Colours.**—To answer this querist fully would occupy many columns of "ours." Heliochromy was studied by Becquerel and Niépce de St. Victor. They were able to produce perfectly the solar spectrum. The latter also experimented with dolls dressed in many colours, and the photographs successfully reproduced these, the colours of precious stones being remarkably brilliant. Unfortunately, no certain

mode of permanently fixing these heliochromes has been discovered. They were produced on a film of sub-chloride of silver.—**W. T. BASHFORD.**

[45565.]—**Photographs in Natural Colours.**—The best results so far produced were obtained, I believe, by M. E. Becquerel on daguerreotype plates, which were coated with a film of sub-chloride of silver by immersion in a bath of dilute HCl, and passing a current of electricity; but as the pictures had to be kept in the dark, no means of fixing them being discoverable, the process was of no practical value. This was many years ago, and, so far as I am aware, no further progress has been made, the more modern processes which have been heralded with a great flourish of trumpets from time to time being nothing more than a species of photo-chromo-lithography, if I may use such a term.—**PHOTOS.**

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if all unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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USEFUL AND SCIENTIFIC NOTES.

To Crystallise Tin-Plate.—The figures are more or less beautiful and diversified, according to the degree of heat and relative dilution of the solution. Place the tin-plate, slightly heated, over a tub of water, and rub its surface with a sponge dipped in liquor composed of four parts of aquafortis and two of distilled water, holding one part of common salt or sal-ammoniac in solution. Whenever the crystalline spangles seem to be thoroughly brought out, the plate must be immersed in water, washed with a feather, or a little cotton (taking care not to rub off the film of tin that forms the foundation for the lacquer varnish, otherwise it loses its lustre in the air. If the whole surface is not plunged at once in cold water, but if it be partially cooled by sprinkling water on it, the crystallization will be more variegated with large and small figures. Similar results will be obtained by blowing cold air through a pipe on the tinned surface while it is just passing from the fused to the solid state.

For making cement for leather belts take of common glue and American isinglass equal parts, and place in a glue-pot. Add water to cover the whole. Soak ten hours. Then bring the mixture to boiling heat, and add pure tannin, till the whole becomes ropy or like the white of egg. Apply warm. Buff off the grain of the leather where it is to be cemented; rub the joint surfaces together; let it dry a few hours, and it is ready for use. If properly put together no rivets will be needed, as the cement is as strong as the leather.

Logs and planks split at the ends because the exposed surface dries faster than the inside. Saturate muriatic acid with lime, and apply to the ends like whitewash. The chloride of calcium attracts moisture from the air and prevents the splitting.

PAINT and varnish brushes should never be used as dusters, nor used dry. If, from any cause, brushes have shrunk, they can generally be restored by putting them for a short time in a cellar of moderately damp place.

QUERIES.

Rope.—I have a 30 horse water-lift 25 yards distance from the wheel, ing mills by the use of a steel wire and me no end of trouble through its use on the pulleys it is driven off, eter covered with wood which takes use slips. I now intend trying a con- used on ships, say about 2 1/2 in. or 3 in. of the many readers of the ENGLISH MECHANIC it will be strong enough! Will it go with the wet and dry weather? I do experience in ropes will be kind to be required information it will be I by—JOS BLAIN, Albert-square, Car-

ity of Water in Sewers.—Will vious correspondents kindly show me in figures, of the following:—(1) What in feet per minute, and (2) the dis- per minute, of water flowing through pe running two-thirds full when laid following formula:—

I. in depth in feet.
r mile.
t per minute.

—S. W. T.

Bars Cutting of Loco.—What locomotives cut more when running on running engine first?—C. O.

ed Firebox of Loco.—For what engines of the L. and Y. inclined

lation.—Could any reader of the oblige me by describing some prac- to illustrate the rule water plays in

Will "Lockstitch" (letter 19500, p. me what size to make the pulley and 'ould cog-wheels do! And, what size V. H. J.

ing Grindstone.—Will anyone t way of turning grindstones about and, what speed to use?—CUTLER.

ious Question.—We have some 4 in. cast iron pipes which have been actions, incrustated, through bad water, more. Kindly oblige by saying how?—PWA.

Launch.—I am building a steam by 3 ft. 6 in., the engine to be of the type. Will someone kindly inform inders, what sized boiler, and what ould require to get up a speed of ur! Any suggestions will oblige—

urrents.—It is desired to place a gas- lace recess, letting heated products lue, and also drawing fresh air down dlying and warming through stove. al metal outlet pipe to be well taken lue—can a counter current of fresh air ped—upon? Mention of such suc- will be valued.—A. C. G.

e Cutting.—To Mr. F. H. WENHAM. up too great a favour of Mr. Wenham give a drawing of the machine he ting estate, with a plain description king! I do not understand the swing- sheet is attached to it, nor do I know lusting the sheet.—OSK ANXIOUS TO

lurgical.—I have some designs ing ink on zinc plates. Can I have in relief blocks by any electrolytical es me that it should be possible to r on the bare portions of the plate. t be heightened by a dexterous appli- intaglio, being oiled and blackened, duce the electro I seek. I may say to my own) the zincographic process, to repeat my trials of that process.—

wall.—I have to keep up a sea-wall, which is continually undermined by a er the cement is washed away before t. I have fully four hours between t. in two years, eaten away 4 ft. in depth s further damage to be prevented?—

"L. W." and "W. L."—Many ation in matters referring to lanterns are succeeded perfectly under their uld like to know how thick quartz the complete system of rings on the o, the details of Mitscherlich's experi- axes of the selenite crystal are made t.—L.C.

hate of Ammonia Analysis.—ur me with a description of (1) how to ard acid and alkali solutions for the to work a Liebig's charcoal combustion in the country and cannot obtain a (3) I cannot fuse combustion tubing spirit-lamp. Can anyone recommend t.—SELF TAUGHT.

n Launch.—Will "Sunlight" or please tell me if the following dimen- a steam launch and sailing boat com- over all, 19 ft.; greatest beam, 7 ft.; rom floor to deck beams, 4 ft. Also, if r would drive it? The boiler (vertical) r the stern. What should its size be?—

[45584].—**Weights for Pressure Boards.**—Would "Sunlight" or some of your obliging correspondents, kindly inform me the amount of pressure required for producing the high-pressure linelight with two 10 ft. gas-bags? Also, most portable and convenient kind of weights? Would water confined in india-rubber bags be suitable? If so, what size of bags would hold water sufficient to apply pressure to above sized gas-bags?—LIMELIGHT.

[45585].—**Platinum Residues.**—Will some of our chemical readers kindly inform me of the best and readiest method for treating my K_2PtCl_6 residues to convert them into platinum tetrachloride or spongy platinum?—CHEMICAL STUDENT.

[45598].—**Feed for Small Boiler.**—Could any reader of the "E.M." help me out of a few difficulties?—(1) What is the best plan for feeding a small boiler 1 ft. long and 9 in. diameter? Space is an object, as it is a marine engine. (2) What is the best kind of fuel for so small a boiler? I have tried charcoal, but failed to get a good result. I have put the exhaust at funnel, but still it does not steam well. Any information will be esteemed by—STICK-IT-TAK-MIN.

[45587].—**Horse Clippers.**—To "Essan."—In reply to your answer to my query upon sharpening horse-clippers, I may say that the kind of clippers that I have had most experience of are Clarke's Patent, and the Newmarket Clipper. I do not think that a file would be of any use upon these, as they are too hard for any file to cut; and, besides, the file would not leave a smooth enough surface. Surely some of the readers of this journal could supply me with some information on the subject. How are they made properly level on the surface of the teeth when they are new?—CUTLER.

[45588].—**Artificial Light.**—To "Sunlight."—Many thanks for your kind answer to my query, No. 45449. Yours is a splendid idea, but for me a gas lantern is out of the question, there not being gas in the house where I am living. Would it be possible for me to "rig up" a simple form of electric light for bust portraits? I thought that a lamp constructed with thumb screws would answer, as I should only require the light for a few seconds at a time. Would be glad of information as to how I am to make lamp and Bunsen batteries? How many? And, with what are they charged? Should like to be able to raise elements out of existing fluid when not in use.—PYRO.

[45589].—**Noise in Engine.**—Will our esteemed friends, "Tubal Kain" or "Sunlight," kindly tell me the cause of the bumping noise in my engine at each end of the stroke? The engine is a horizontal, about six horse power, nearly new; the top cap and brass of the main shaft bearing nearest the crank moves a little with every stroke, and when I tighten down a little the bearing gets very hot. Should like to know how to prevent it, and stop the bumping noise, and oblige!—A CONSTANT SUBSCRIBER.

[45590].—**Power for Fan.**—My shop is onward; I have a fan to fix, and should like to work it with a lever before I get other power attached. Could not something be done to let the fan keep running when the lever is stopped? Without something being done like that, one would have to keep the lever in motion. Also, I propose using a heavy flywheel of a lathe with an eccentric attached. Would "Sunlight" recommend any good plan?—POOR OLD JEFF.

[45591].—**Deafness.**—To Dr. EDMUNDS.—I have been suffering from deafness for some two or three years; at first it was scarcely noticeable, but it has increased so that I cannot distinguish words spoken in an ordinary tone in a quiet room—out of doors, or in any noise, I seem to hear perfectly. I have been attended to by several hospital surgeons but without the least relief, and some four months ago an incision was made into the tympanum of the left ear, which has served only to increase the deafness in that ear. I have a constant tinnitus; a catheter has been passed into both eustachian tubes. The cause of the deafness is given as chronic inflammation of the tympanum and an accumulation of mucus in the cavity. I have taken quantities of alteratives, such as iodide of potassium, nux vomica, &c. Could you suggest anything that would be likely to benefit me? I have exhausted all the hospitals in this city, and I cannot afford to go to any specialist in the disease, so I venture to address you on the subject, seeing your kind replies to other queries.—AGUS.

[45592].—**Automatic Musical Instruments.**—Can any of our correspondents give me any idea of the construction of the pianist, mentioned by Mr. Brixton last week? Is it a thing that could be made by an amateur? And, is it the same as the attachment that is made to play the organetto? If anyone could give me a few instructions in the making of one to play an harmonium, I should esteem it a great favour. Being unable to use my feet, of course, I cannot work the treadles; therefore, the above attachment would be a very great boon to me, and, I have no doubt, to others as well. Cannot our clever correspondent, "Fiddler," tell us about it? Or, does he not approve of reeds?—H. KING.

[45593].—**To Mr. Lancaster.**—I am extremely obliged to Mr. L. for his reply to my query, re Electro-Motor for Vacuum Tubes, but I am sorry I do not understand how the arrangement should be put together; I shall, therefore, esteem it a great favour if Mr. Lancaster will give detailed drawings, showing the sizes and exact arrangement of the plates, and commutator showing exactly when contact should be made and when broken? Also, it appears to me that there will be very little space between the eight iron plates in the brass wheel. I should like to make one sufficiently powerful to revolve, say, 12 in. tubes, and use an electro magnet having limbs, say, 3 in. in length. However, I shall be very glad if Mr. Lancaster will make all quite clear, as I am sure it would interest many others besides myself, as I notice many queries and no good answer.—A. A.

[45594].—**Pressure of Water.**—During the great storm of 23d Nov. last, many embankments were swept away, in whole or in part, by the immense pressure of an unusually high "spring tide," driven by a S.S. Westerly gale, averaging about 60-80 miles per hour. Could any

correspondent of ENGLISH MECHANIC kindly explain how the pressure on the embankment could be estimated if exposed to the full fury of wind and wave? And, also, give any hints to the many interested on a question of such public utility as to the cheapest and most effective method of construction and maintenance by private individuals out of ordinary materials to hand—clay and rough stones?—AQUARIUS.

[45595].—**Quantity of Water Flowing in a River or Estuary at a Given Time.**—A query was put on a similar subject some weeks ago, but has not yet, I think, received an answer. Would some of "ours" kindly tell the way in which the number of gallons flowing in any river at a given time and for a given period (say, a minute or an hour) is made out? And, the same for the rise and fall of the tide flowing through the entrance of a landlocked bay or harbour? The question of the calculation of water power is every day becoming one of greater interest and importance from every point of view, so I trust it may not again be overlooked.—AQUARIUS.

[45596].—**Steam Launch.**—I am thinking of getting built one something similar to that of "Canadian Sub-scriber," and shall look with much pleasure to a full description from our courteous and ever-obliging friend, "Sunlight." Would he please say how much horse-power and what speed could be developed in such a small craft? Also, cost? Would "castings," such as frequently advertised in "E.M." for 28s., be any use? Also, whether paddles would be preferable to screw? Or, cheaper to fit up and keep in repair? Or, if at all suitable?—AQUARIUS.

[45597].—**Porcelain.**—I am anxious to make, for experimental purposes, small tubes of about 1/4 in. diameter by 2 in. or 3 in. long, capable of standing a high heat. Fireclay, such as within my reach, is much too coarse, so that I shall be glad of any information as to any composition I can use instead and its treatment? I can get them fired.—IGNORANT.

[45598].—**Lamp Burners.**—"Sunlight," last year, wrote in high terms of a cheap French burner he had. Would he please describe it as to enable me to make one? I am much interested as an amateur in this matter.—FYNMART.

[45599].—**Wood Screw Making.**—Will some reader give me any information as to the making of wood screws for joiners' ploughs, &c.? I suppose there will be machines for that purpose.—AN AMATEUR JOINER.

[45600].—**Improving Gaslight.**—To Mr. ALBERT SMITH.—I shall feel much obliged for any information concerning above letter 19526?—H. B.

[45601].—**Balance Staffs.**—Many thanks to "A Fellow Workman" for his explicit replies to queries. Will he increase the obligation by giving us a few hints on turning in balance staffs?—REVELL.

[45602].—**New Swing Churn.**—Will someone of "ours" tell me if there is any method of removing the scent from the wood of which a new swing churn is made, and which taints the butter prepared in it? The churn seems to be made of Mom? or some species of straight grained deal.—AMATEUR FARMER.

[45603].—**Finding Positions of Moon's Terminator.**—In letter 19508, "F.R.A.S." gives instructions for finding the position of the Moon's terminator. Ought not the divisions he speaks of to be set off on a plan of the Aquator—i.e., on a circle and then projected on to the diameter? Perhaps he will make the above clear to me.—STUD. INST. C.E.

[45604].—**De Meritens Secondary Battery.**—Will A. Trotter (19538) kindly give a sketch showing the position of the plates in the cell of a De Meritens secondary battery, also showing the method of connecting the poles of the plates? Will he also give further particulars of the electromotors described by him in the above letter?—STUD. INST. C.E.

[45605].—**To Mr. Lancaster.**—Will Mr. Lancaster kindly inform me whether, if take two electro magnets as described in his list as capable of sustaining 10 lb. and put the S Poles of each opposite, and the N. Poles opposite, they will repel each other with a force of 20 lb. —STUD. INST. C.E.

[45606].—**Jaquard Loom.**—Would any of the readers of the ENGLISH MECHANIC be kind enough to give some hints how to make a Jacquard machine for weaving patterns of two or three hundred ends?—NEMO.

[45607].—**Verge Watch.**—Will any watch-jobber give me a few hints on repairing verge watch?—i.e., how deep should the escape-wheel be on pallets? Also, should the follower be adjusted after the watch is put together? Also, how to try train depths to know if they work right? I have all necessary tools for the job. I hope "F. W." will not forget his promise.—MECHANIST.

[45608].—**Dissolving Gold and Silver.**—My thanks are due to "Dunrod," "Og," and "Birmingham." I am still, however, not clear on the subject. I wish to make chlorides of gold and chloride of silver to do gilding and "plate" on metals in small quantities. I have tried to dissolve gold in 1 of nitric acid and 2 of hydrochloric acid with gentle heat, but there always remains undissolved gold at the bottom. No back numbers.—GEYOR.

[45609].—**Contracted Finger.**—Owing, I think, to a strain some years since, the third and fourth fingers of my right hand are contracted, and will not open flat with the palm. The sinews of the palm at the base of these fingers are much enlarged and hardened, and it is there that the mischief lies, as I can bend the fingers perfectly well. I shall be grateful if Dr. Edmunds, or any medical correspondent, will tell me if anything can be done to loosen the sinews, as it is very awkward in handling tools, &c., and quite spoils piano-playing!—CONTRACTOR.

[45610].—**To Mr. Lancaster.**—(1) Can I, by increasing the surface of the faces of an electro-magnet and correspondingly the faces of the revolving cores, obtain any greater power than if the plain surfaces were used? (2) Will the Lancaster Incandescent Lamp work with Léclanché batteries? If so, how many to give light

to equal ordinary gas-jet? (3) Will Mr. Lancaster oblige by stating the battery power required for the electro-magnets, of which he gave the dimensions of core, wire, &c., the week before last?—E. BURLING.

[45611].—Boiler Pressure.—To "SUNLIGHT."—The rivets and brazing are first-class, the spelter having run inside and outside, covering the seams, and rivet-heads flush. I want to know the bursting pressure if you could tell me. Would 6 lb. be a safe working pressure? I have had 85 lb. on; I have also had 100 lb. water pressure, it being the limit of my gauge. I then shut the gauge off, and pumped another 100 lb. on, as near as I could tell, by the working of the pump, the ram being in. In diameter, and pressed down direct by hand.—W. W. E.

[45612].—Silvering Reflectors.—In the report of the meeting of the R. A. S. in last week's MECHANIC, Mr. Common, in his paper on Silvering Reflectors, says that he makes use of a silvering solution composed of glucose, water, and nitrate of silver, and obtains a good film in forty minutes. Will Mr. Common oblige the many readers of the MECHANIC who own reflectors, and who silver them themselves, with the proportions of the chemicals employed? and thereby help many besides—NIPPI.

[45613].—Water-Motor.—Can any reader who possesses a Thirlmere or other water-motor, inform me what percentage of the whole quantity of water used in these engines passes down the casing or is otherwise wasted? I am aware that they do not give out the full theoretical energy of the water, and, if it has been ascertained, I should feel obliged by being informed of the proportion wasted in this method of using water.—W. AINSWORTH.

[45614].—Industrial Insurance Policies.—Will "Sperans," or any other legal reader, kindly say if A., who holds an industrial policy on his own life, can nominate B., who is no relation, to receive the money due on his (A.'s) decease? And, can an Industrial Insurance Office legally pay on a policy issued in B.'s name on the life of C., providing B. has an insurable interest?—S. BARR.

[45615].—Piano-Tuning.—To Mr. W. H. DAVIES.—I have tuned my piano several times, as I live some distance from any town, and I find that, after the operation, the flat keys sound very flat, but this is scarcely noticeable in the sharp keys. I understand the theory of tuning. If you will kindly tell me where I am wrong, and help to set me right, I shall feel very grateful.—A. W. D.

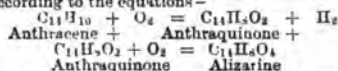
[45616].—Boring.—Will some correspondent assist me in the following?—I have got two holes to bore through a 12 in. iron shaft, and I have no other means of doing it but with a ratchet-brace. They have to be 2 in. diameter, and what I want is a sketch of a good cutter that can be worked by hand-brace. I myself purpose to drill an inch hole through first, then to 1 in., then to 2 in.—DUNN.

[45617].—Chatterton's Compound for Insulating.—Can any of our veteran friends tell me how this stands the test of time? Does it peel after a few years like gutta-percha? I believe it is all right for sub-aqueous purposes, but am a little doubtful about it for general work. I am dissolving it in chloroform; it is much cleaner and richer than melted paraffin wax, and can be used cold. My doubtful point is its durability and permanency. The composition is—gutta-percha, three parts; Stockholm tar and resin, of each one part.—JONAH.

[45618].—Lodgers and their Landlords.—The *Cabinet Lawyer* for 1877 says:—"It has been decided that a landlord is not liable as in the case of an innkeeper for any goods or property lost or stolen from the apartments of his lodger. Common Pleas Easter Term, 1880." This is very hard. Has there not been some law passed lately to protect lodgers from the carelessness of their landlords, who leave their houses unprotected when the lodger happens to be out or absent for a time from his lodgings?—L. DORR.

[45619].—Electric Light.—I want to light up a room (about 30 sq. ft. by 10) with the above for 6 or 7 hours, and should be glad of an answer to the following questions:—(1) Would 8 gallon Bunsen cells (about 200 square inches of zinc per cell) be sufficient to give a light equal to about eight gas-burners? (2) Is there any varnish or coating that will withstand the acid? (3) Would it do to fill the porous cell with lumps of carbon, as it would then economise the nitric acid, and, as far as I can see, give more surface of carbon to be acted upon? (4) What form of lamp would answer the purpose? The simpler the better.—W. E. K.

[45620].—Quantity of Coal Carbonised Annually.—To "SIGMA."—I should be glad if "Sigma" could inform me if it is possible to obtain a reliable estimate as to the quantity of coal carbonised in the British Isles annually. Prof. Hull gives the total annual produce of coal in the British Isles as 134 millions of tons. Dr. Mill, in his little work on Destructive Distillation, estimates that 12 per cent. of the coal raised is used for the production of gas. This would give us about 16 millions of tons of coal used annually for producing illuminating gas. Prof. Roscoe, in his address to the members of the Society of Chemical Industry, states that 1,400 tons of pure alizarine were produced in 1880. Now, according to the equations—



one ton of pure anthracene would produce about 27 cwt. of alizarine, so that 1,400 tons of pure alizarine would equal 1,037 tons of pure anthracene; this would equal about 3,456 tons of 99 per cent. anthracene, or about 2,674,000 units. Now, taking what I believe to be a fair estimate of yield, 6 units anthracene per ton tar, this equals 365,000 tons of tar, or 73,000,000 of gallons. Now, the average yield of tar per ton of coal is about 15 gallons, so that 1,400 tons of pure alizarine equal 1,037 tons of pure anthracene, 1,037 tons pure anthracene equals 73,000,000 gallons of tar, which equals 7,300,000 tons of coal, but the London Anthracene Brokers estimate that the total quantity of pure anthracene annually pro-

duced in the British Isles is about 2,000 tons, which would equal about 14,000,000 tons of coal.—CHEMIST-ANA.

ANSWERS TO CORRESPONDENTS.

* * * All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 31, Tavistock-street, Covent Garden, W. C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

* * * Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 21, and unacknowledged elsewhere:—

J. AND H. GRACE.—Orderic Vital.—William Peek.—Spencer and Son.—H. C.—R. Johnson.—N. Wright.—Mensicus.—F. E. H.—W. H. W.—Wm. Jeans.—J. W.—Anxious One.—T. J. Scutt.—Mersey.—Miller.—A. Novice.—C. P. T.—Dr. Edmunds.—Centaur.—E. P.—Ubellak.—Artificial Lighting.—Analyst.—L. Warner.—Albers.—A. N. H.—W. H. Plymouth.—Anglo Dane.—Jack of All Trades.—W. P.—W. S.—A Civilian.—H. T.—B. R.—L. B. B.—E. T. J.—Fiddler.—J. H. Evans.—A Fellow of the Royal Astronomical Society.—D. H. G.—Chemistiana.

G. W. R. (If you mean the composition for the mouldings on picture-frames, here is a good one.—25 lb. glue, 14 lb. rosin, 1 lb. pitch, 5 pints linseed oil, and 5 quarts of water. Soak the glue until soft, and then boil together until dissolved. Then add whitening until of the required consistency.)—TUNSTALL. (No doubt if you applied to one of the debating clubs they would lend a copy of their rules.)—POTTERIES. (Such a question should be put to those who undertake such work. It is quite "possible," but scarcely "cheap.")—AERATED. (Obtain Gould's "Receipts," of Messrs. Barrett, Sons, and Co., Seething-lane, E.C.)—R. F. (See p. 531, last volume; or ask an oilman for suitable paint.)—J. GILLIS. (It will not be fully open until January: two or three months. Admises on to the Palace, one shilling, but some days a higher price is charged. 2. Quite practical, but the "energy" would need a tolerably large mill.)—ELUSSA. (The common, tin 80, lead 20. Antim. is added to better kinds, and to the best 2 per cent. each of copper and bismuth. 2. One is a little brass pillar; the other is for holding the battery plates together. 3. Carbon rod in porous jar, surrounded by cylindrical zinc. Either zinc to carbon, or all zinc and all carbons, according to the purposes.)—L. L. (The gelatine is made by boiling down skins after steeping in caustic lye and exposing to sulphur fumes. The clear liquid is run on to cooling slabs, and is cut into sheets before becoming dry.)—SUNSHINE, Wigan. (See p. 341, Vol. XXX. It is one of those things which is much better bought.)—PATHOLOGIST, Dublin. (See p. 351, Vol. XXVIII. They are made of the finest washed whitening, and the powder pigments sold at the oilshops mixed with gum-water.)—J. G. BOWEN. (Thanks for sketch, which want of space prevents us from using. We are obliged to confine ourselves as much as possible to astronomical observations recording special features of interest.)—CAST IRON. (Too late in the day now; and, besides, there is no doubt in the minds of engineers as to the real causes of the disaster. The slide-holder sent is a very familiar one to us, and simple enough, but not, in our opinion, equal to others we have given.)—MECHANIC. (Must ask such questions of Mr. Lancaster privately.)—M. M. L. S. S. (Of course, the calculations occupy many pages of Bourne's book, or any other worth buying. We cannot just now spare space for a history of the steam-engine, which is what a reply to your query would involve. Longman and Co., Leadenhall-street, and Spon and Co. publish many more or less elementary treatises, which you would do well to read.)—HEATHSTOP. (We cannot advise commercially with regard to inventions.)—S. BUCHHEIM, Jun. (Can you not give the "glossy black" as a "coat"? If so, try indiarubber dissolved in bisulphide of carbon. 2. Make a mould in gutta-percha, in two pieces, and then take the plaster cast from that. Or you can make the mould in plaster, and after soaking in melted wax, that will answer. 3. Wheeler's book, published at 170, Strand, is a useful manual; but for the chemical branch, probably you would find it better to get some of the manuals issued by Piper and Carter, Castle-street, Holborn.)—J. C. A. (Don't bother yourself about it; but eat light suppers and see that the bedroom is well ventilated.)—D. BROWN AND SON. Melt 13 lb. of rosin and 1 lb. of beeswax together; add, if for black, 3 lb. of powdered ivory-black; if for red, about same quantity of Venetian red or red-lead.)—RHEUMATISM. (The best remedy would be to hang in a full supply of fresh air around the fireplace. Darts are possible only where there is an outlet, and if you supply plenty of fresh warm air to occupy the outlet, that will keep the cold air out, and then you may make the windows, &c., airtight.)—WATCHMAN. (If in brass they must be cast, which would be difficult. Why not take electrotypes of them? You will find

instructions in many back volumes.)—FAITHFULLY INQUIRITIVE. (The Post-office authorities would not decide your object. We do not see the utility of reproducing when newer and better devices are coming to hand.)—DAN LKA. (The verb "pollard" in an "up" at the top, and a pollard (or pollard) oak is simply an oak that has been lopped. *Quercus pedunculata* and *sessiliflora* are the principal oaks of this country, but we should not assist you to learn nothing if we gave a list of all the known species.)—W. H. PAUL. (The felt or canvas is merely to keep the lead in position, so two thicknesses are unnecessary. See p. 273.)—RUYRS. (Many recipes in back volumes; but your query is so very general that we cannot reply more definitely. Of what material are the "clothes," and what colour do you wish to dye them?)—A. LEAS. (Is it a permanent magnet or an electro-magnet with coils of wire round the limbs? If the former, it is magnetised by drawing another powerful magnet from end to end several times, always in the same direction. The process is described in all textbooks, and frequently in back volumes.)—B. S. (The process of making bisulphide of carbon consists in passing the vapour of sulphur through incandescent carbon (charcoal), and condensing the gas in suitable chambers. There are several methods of carrying it out, but in all the charcoal is placed in the retort, and heated to a bright red. Portions of sulphur are then pushed through a tube into the bottom of the "retort," or a chamber provided for the purpose, where they are melted, and the vapour passes through the charcoal. Some of the methods have been patented, but it is an industry which can be entered into only by skilled chemists. See such works as Payen's "Industrial Chemistry," and Ure's Dictionary.)—BASSA. (Type-founding is now done mostly by machine; as to the best shape of type, it depends on the work.)—J. W. (Presuming the billiard-ball is ivory, the aniline dyes will answer, and as they are cheap, the process can be easily repeated; but the red is obtained by making an infusion of cochineal in liquor ammoniac. The balls are first immersed for a few minutes in water slightly acidified with nitric acid, and are then soaked in the cochineal liquor. See instructions for making rubber stamps have been frequently given. You require prepared rubber, and something in which you can heat it and subject it to pressure at the same time. A cast of the type is taken in plaster of Paris, and the rubber is forced into it by the pressure, while the heat vulcanises the rubber.)—J. A. THOMAS. (The only difference would be a trifling saving in coals—perhaps 6 lb. per hour instead of 8 lb. For small power the gas engine is much the cheapest of all things considered.)—CHROMOLITHOGRAPHY. (Possibly a sheet of clear gelatine pressed on; but there are so many things of the kind that the query could hardly be answered definitely.)—CHIMBO. (Subject seems worth pursuing further, especially as no one else appears to have noticed it.)—L. WARRER. (See Vol. XXXI. Different varnishes are used. Stan of French polish is perhaps the best.)—F. A. M. (We do not know of a book especially devoted to them. 2. Patent Office is in Southampton-buildings; the office for the sale of specifications in Curator-street, W.C. We have no means of knowing without searching, but that a patent agent will do for a small fee. 3. We have not seen it.)—LANCASHIRE. (Why don't you read up back numbers? The battery is not "strong enough"; at least 40 quarts are required, and the steel rod is altogether wrong; it must be carbon.)—ANXIOUS ENQUIRER. (See No. 244, Nov. 26, 1890, p. 1. The publisher will send it for five halfpenny stamps.)—ELECTRIC. (How can any one answer without knowing the "current" used and the resistance? It is a matter for experiment.)—R. N. (Gülcher's specification has been recently published. It is No. 208,381, price 6d., under name of Haddon, who is the agent.)—W. H. G. (Fresh-burned lime mixed with white egg.)—G. D. G. (It does not radiate heat, and that reason is so well suited for lighting purposes. The light is radiated, and there is no difficulty about a "radiator.")—ZANONI. (Will you explain what you mean? We have heard of a polarised cell, but you write "bell.")—ONE IN A MIDDLE. (A fine watch, perhaps, best; but as you object to the smoke, a gas-stove. See the indices of back volumes for hints.)—A. NOVICE. (shall be inserted.)—J. C. R. R. (We can obtain no better information than you will find in back volumes. Even those most intimately acquainted with the business have only a few rules which they have found to work well, and they are not likely to publish them. The principle are understood; their application requires experience.)—GASSY. (When Stephenson placed in charge of a steam-engine he found out for himself what its various parts did, and thereby probably learned more than a whole number of the ENGLISH MECHANIC could have taught him. See p. 565, last volume, and look through the other indices, but if you have an engine under your charge you will be wanting in intelligence if you fail to find out the different parts are for. They may appear complicated to you. Study them, and perhaps you will be able to introduce improvements.)—LAWYER. (pp. 203, 223, Vol. XXIV. Converting a verge into a lever is nowadays much like a waste of time.)—R. (Get Lutechaun's book on Hall-marks. Hall-marks of the Assay office, Liverpool. The hall's used in date letter, apparently out of "pure vanity." W. J. S. (92,300,000 miles. 2. 21st of June and 21st of December; but it varies if you go a far as of a second.)—J. W. T. (Look in the last publication of the Journal issued by the Patent Office on Friday, or in *Engineering*. 2. Yes; the subscription keep the £5.)—BOOTH BROS. (Send, and we will send.)—R. HENDLEY. (Please send.)—E. T. J. (We will permit.)—GURDO. (Received, but we hardly think the suggestion sufficiently practicable. We are sorry, however, for overlooking the query, which has been repeated.)—Y. UNO VULCAN. (Mitchell's "Manual of Assaying," published by Longmans. We do not know where you will get such drawings as these.)—L. L. L., A. M. C. (In type.)

PRINTER'S ink is a good adhesive for belts. One application will keep a belt in running order for a year.

lish Mechanic

AND

SCIENCE AND ART.

DECEMBER 30, 1881.

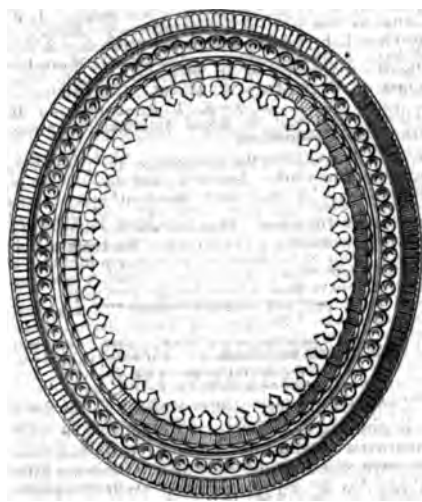
VIATURE FRAME.

J. H. EVANS.

I requested to give an illustration of an ivory frame for photos, made one for the purpose, to form a good subject of the kind not to be found beyond the most amateur turners. Before explaining the most chuck work of this character, reference to back numbers of this from the rough material of ivory being cut from a low, which is very easily acquired for oval turning, as rally run that shape; it to the face of a beechwood piece turned out at the back of the chuck. To do this, of course, must be used, and paid to the height of the ivory one of which must be used. Should there be any difference in the position of the ellipse will not be. There are several ways of using the tools, but I think the best that fits into the bed of the line marked accurately to the centres of the instrument that all turners use is the use of it may save a great deal in the shape of work. When turning out the back of say two or three frames, a great deal of trouble if the small tool is used to keep the picture in its place, out of one and fitted to the back of the ivory, when finishing a small moulding, and then with a gouge-tool of ordinary shape cut the piece, and it can be turned in another way, saving the material, expensive, it is well to save as much as possible.

I take it for granted that the work is finished, and the work may be done on a boxwood chuck while the work is turned. When it is fitted, the work is secured to its more than one advantage in the principal one being that the work remains on the chuck almost without fear of its dropping off if left simply to the work, not finished off at once, it is easily spoiled, as the wood of the work come off its surface preliminaries being seen to the turn and ornament edge, the latter being the work, and it is cut with a deep tool with a fillet on the end, vision cutting at every hole, a deep pattern it is better to use a plain tool as much as possible, so that as little work is left for the drill to cut. This is about this frame that is not so simple forms a finish to the work, not take the trouble to do the work round the extreme outside with a fixed bead tool, and the work is done. The tool must

now be changed for a round-nose one, and the small concave curve turned. This done, a round-nose drill must be selected to match this curve as nearly as possible, and a cut made at each hole of the 192 division plate, if the drill is in proper cutting order. The work should be as bright as if polished, and it must be a point with all turners, especially in doing ornamental work, that the tools are perfectly sharp, and free from anything in the shape of a rough edge; without particular attention is paid to this point, it will be impossible to do really good work. To proceed, it will be seen that, following the last series of cuts, a convex curve is turned: this is done with what is termed a left quarter-hollow tool with a sharp point. The reason the quarter-hollow tool is used is that only a portion of bead is left plain. It will be seen that round the other portion a series of separate beads are cut 72 in number: these, it will be observed, are, as I say, compensated; that is, they are all the same relative distance apart, and this is accomplished with the aid of the segment apparatus. It is not at all a difficult thing to do, and will only require patience, to set out the work before cutting, and if any difference at the last cut



OVAL MINIATURE FRAME.

is likely to occur, to compensate for it, I explained this in the description of the hand-mirror, and, with a little practice, it can be well done, and do away with the necessity of such an expensive piece of apparatus as the compensator for the oval chuck, many of which, however, I have made. But as I am explaining how my work is done, I give the preference to the segment in this case. The bead tool used in this case was one I made especially for the purpose, as I wished to have the beads as close together as possible, and being made with points and not astragal, I had to clear away the superfluous material with a small round-nose tool. We now come to another moulding which is cut with a moulding drill, and is a very simple thing to do. There are 60 cuts in this part. On the top, it will be observed, is a small, plain bead: this is cut with a fixed tool, and forms a set off to the mouldings. I think I may say that we now arrive at, perhaps, the most difficult part of this piece of work, and that is the inner series of points. These are also compensated, and, to be nicely cut, will require great care. There are 46, and, to form the points, a flat-ended chisel-drill must be used; and I must impress upon any turner making one like this, or anything of the kind, to be quite certain that the ivory is flat upon the chuck, and that every part is glued to the chuck. If any part should be free, the points at that particular spot will be sure to break off when being cut. I wish

this to be made a great point of, as it may save the loss of many points in doing such work. The settings must be so arranged that the desired shape is obtained in the front, and then a drill of the same shape, but of smaller diameter, must be inserted at the inner portion. As I have before stated, this is a difficult part to do, but, when done, amply repays, as it is very effective; and, when done, I think and hope it will be appreciated.

The illustration is exactly one-half the real size of the frame.

THE MOST ECONOMICAL STEAM-ENGINE.

A NOTABLE trial of a remarkable steam-engine has been made recently by Mr. E. A. Cowper, the President of the Institution of Mechanical Engineers, and, as really trustworthy records of engine-trials are scarce, it is worth while paying special attention to the results obtained in the case in question, more particularly so because they show an economy which has rarely, if ever, been equalled in a properly conducted trial. As every one who has looked into the question knows, there is a very large margin for possible improvement, if we compare the actual efficiency of a steam-engine (which, in that case, includes boiler) with the absolute value of the fuel in heat-units; for the best Cornish engines rarely utilise more than 14 or 15 per cent. of the potential power of the coal, and it is clearly seen that, under any circumstances, so long as we employ heat to convert water into steam, there must, of necessity, be a loss of by far the larger portion of the energy latent in the fuel. The loss is, in fact, so great, that it is tacitly ignored, and we compare steam-engines by calculating the number of pounds of coal consumed for each indicated horse-power. Not many years ago, and where coal is cheap it is still the case, as many as seven pounds were consumed to obtain one horse-power from the engine, and it is no uncommon thing—indeed it is too common—to find engines that, nowadays, consume five and more pounds for each indicated horse-power. When the pumping-engines in Cornwall were regularly tested, and it was shown what the “duty” might be made, a flip was given to the pursuit of economy; but the era of steamships undoubtedly gave the greatest stimulus to engineers, for owners speedily discovered that if a vessel had to carry more coals than were absolutely necessary, there was not only the loss of the wasted fuel, but a more serious loss on the contracted cargo space. With the introduction of higher pressures, compounding, and the other improvements which have been employed during the last thirty years, the consumption of coal has been steadily reduced, until it now stands on the average of good examples of marine engines at about two pounds per horse-power. Cases are indeed on record where one pound and a half has sufficed, but the statements made have not the weight of those we are about to give, which have clearly established the fact that for pumping purposes the consumption of coal need not be much more than a pound and a half for each indicated horse-power. The trial in question was made with a couple of compound pumping engines, erected at Ditton for the Lambeth Waterworks Company, by Messrs. Simpson, of Pimlico, the well-known makers of engines adapted for the purposes of water companies. They are of the rotative type, with beams and flywheels, the cylinders having a stroke of 5 feet 6 inches, and the pumps worked by rods attached to the beams, a stroke of 4 feet. Each pair of cylinders drives cranks placed at right angles on the ends of the fly-wheel shaft, and each cylinder stands under its

to equal ordinary gas-jet! (3) Will Mr. Lancaster oblige by stating the battery power required for the electro-magnets, of which he gave the dimensions of core, wire, etc., the week before last?—E. BURTON.

[45611].—Boiler Pressure.—To "SUNLIGHT."—The rivets and brazing are first class, the spelter having run inside and outside, covering the seams, and rivet-heads flush. I want to know the bursting pressure if you could tell me. Would 6 lb. be a safe working pressure? I have had 60 lb. on; I have also had 100 lb. water pressure, it being the limit of my gauge. I then shut the gauge off, and pumped another 100 lb. on, as near as I could tell, by the working of the pump, the ram being in diameter, and pressed down direct by hand.—W. W. E.

[45612].—Silvering Reflectors.—In the report of the meeting of the B. A. S. in last week's *Mechanic*, Mr. Common, in his paper on Silvering Reflectors, says that he makes use of a silvering solution composed of glue, water, and nitrate of silver, and obtains a good film in forty minutes. Will Mr. Common oblige the many readers of the *Mechanic* who own reflectors, and who silver them themselves, with the proportions of the chemicals employed? and thereby help many besides—NIPUR.

[45613].—Water-Motor.—Can any reader who possesses a Thimble or other water-motor, inform me what percentage of the whole quantity of water used in these engines passes down the casing or is otherwise wasted? I am aware that they do not give out the full theoretical energy of the water, and, if it has been ascertained, I should feel obliged by being informed of the proportion wasted in this method of using water.—W. AINSWORTH.

[45614].—Industrial Insurance Policies.—Will "Sperans," or any other legal reader, kindly say if A., who holds an industrial policy on his own life, can nominate B., who is no relation, to receive the money due on his (A's) death? And, can an Industrial Insurance Office legally pay on a policy issued in B's name on the life of C., providing B. has an insurable interest?—S. SMITH.

[45615].—Piano-Tuning.—To Mr. W. H. DAVIES.—I have tuned my piano several times, as I live some distance from any town, and I find that, after the operation, the flat keys sound very flat, but this is scarcely noticeable in the sharp keys. I understand the theory of tuning. If you will kindly tell me where I am wrong, and help to set me right, I shall feel very grateful.—A. W. D.

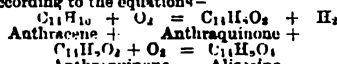
[45616].—Boring.—Will some correspondent assist me in the following:—I have got two holes to bore through a 12in. iron shaft, and I have no other means of doing it but with a ratchet-brace. They have to be 2 1/2in. diameter, and what I want is a sketch of a good cutter that can be worked by hand-brace. I myself purpose to drill an inch hole through first, then to 1 1/2in., then to 2 1/2in.—DITILL.

[45617].—Chatterton's Compound for Insulating.—Can any of our veteran friends tell me how this stands the test of time? Does it peish after a few years like gutta-percha? I believe it is all right for sub-aqueous purposes, but am a little doubtful about it for general work. I am dissolving it in chloroform; it is much cleaner and nicer than melted paraffin wax, and can be used cold. My doubtful point is its durability and permanency. The composition is—gutta-percha, three parts; Stockholm tar and resin, of each one part.—JOSAH.

[45618].—Lodgers and their Landlords.—The *Chancery Law* for 1877 says:—"It has been decided that a landlord is not liable as in the case of an innkeeper for any goods or property lost or stolen from the apartments of his lodger. Common Pleas Easter Term, 1860." This is very hard. Has there not been some law passed lately to protect lodgers from the carelessness of their landlords, who leave their houses unprotected when the lodger happens to be out or absent for a time from his lodgings?—LADDER.

[45619].—Electric Light.—I want to light up a room (about 30 sq. ft. by 10) with the above for 6 or 7 hours, and should be glad of an answer to the following questions:—(1) Would 8 gallon Bunsen cells (about 200 square inches of zinc per cell) be sufficient to give a light equal to about eight gas-burners? (2) Is there any carbide or other gas that will withstand the acid? (3) Would it do to fill the porous cell with lumps of carbon, as it would then decompose the nitric acid, and as far as I can see, give more surface of carbon to be acted upon? (4) What form of lamp would answer the purpose? The simpler the better.—W. E. K.

[45620].—Quantity of Coal Carbonised Annually.—To "SIGMA."—I should be glad if "Sigma" could inform me if it is possible to obtain a reliable estimate as to the quantity of coal carbonised in the British Isles annually. Prof. Hull gives the total annual produce of coal in the British Isles as 134 millions of tons. Mr. Mills, in his little work on Destructive Distillation, estimates that 12 per cent. of the coal raised is used for the production of gas. This would give us about 16 millions of tons of coal used annually for producing illuminating gas. Prof. Roscoe, in his address to the members of the Society of Chemical Industry, states that 1,400 tons of pure alizarine were produced in 1889. Now, according to the equation—



one ton of pure anthracene would produce about 27 cwt. of alizarine, so that 1,400 tons of pure alizarine would equal 1,037 tons of pure anthracene; this would equal about 3,456 tons of 30 per cent. anthracene, or about 2,074,000 units. Now, taking what I believe to be a fair estimate of yield, 6 units anthracene per ton tar, this would make 865,000 tons of tar, or 73,000,000 gallons. Now, the average yield of tar per ton of coal is about 1 to 2 1/2 lbs., so that 1,400 tons of pure alizarine equal 1,037 tons of pure anthracene, 1,037 tons pure anthracene equals 73,000,000 gallons of tar, which equals 7,300,000 tons of coal, but the London Anthracene Brokers estimate that the total quantity of pure anthracene annually pro-

duced in the British Isles is about 2,000 tons, which would equal about 14,000,000 tons of coal.—CHEMIST—ANA.

ANSWERS TO CORRESPONDENTS.

* * * All communications should be addressed to the Editor of the *ENGLISH MECHANIC*, 31, Tavistock-street, Covent Garden, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

* * * Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 21, and unacknowledged elsewhere:—

J. AND H. GRACE.—Orderic Vital.—William Peek.—Spencer and Son.—H. C.—R. Johnson.—N. Wright.—Mensicus.—F. E. H.—W. H. W.—Wm. Jeann.—J. W.—Anxious One.—T. J. Scott.—Mersey.—Miller.—A. Novice.—C. P. T.—Dr. Edmunds.—Centaur.—E. P.—Obelisk.—Artificial Lighting.—Analyst.—L. Warner.—Alberis.—A. N. H.—W. H. Plymouth.—Anglo Dane.—Jack of All Trades.—W. P.—W. S.—A. Civilian.—H. T.—H. R.—L. B. B.—E. T. J.—Fiddler.—J. H. Evans.—A Fellow of the Royal Astronomical Society.—D. H. G.—Chemistiana.

G. W. R. (If you mean the composition for the mouldings on picture-frames, here is a good one.—28lb. glue, 14lb. rosin, 1lb. pitch, 5 pints linseed oil, and 5 quarts of water. Soak the glue until soft, and then boil together until dissolved. Then add whitening until of the required consistency.)—TUNSTALL. (No doubt if you applied to one of the debating clubs they would lend a copy of their rules.)—POTTERIES. (Such a question should be put to those who undertake such work. It is quite "possible," but "scarcely cheap.")—AERATED. (Obtain Gould's "Receipts," of Messrs. Barrett, Sons, and Co., Seething-lane, E.C.)—R. F. (See p. 531, last volume; or ask an oilman for suitable paint.)—J. GILLIS. (It will not be fully open until January; two or three months. Admiss on to the Palace, one shilling, but some days a higher price is charged. 2. Quite practical, but the "energy" would need a tolerably large mill.)—ELUSSA. (The common, tin 80, lead 20. Antimony is added to better kinds, and to the best 2 per cent. each of copper and bismuth. 2. One is a little brass pillar; the other is for holding the battery plates together. 3. Carbon rod in porous jar, surrounded by cylindrical zinc. Either zinc to carbon, or all zincs and all carbons, according to the purpose.)—L. L. (The gelatine is made by boiling down skins after steeping in caustic lye and exposing to sulphur fumes. The clear liquid is run on to cooling slabs, and is cut into sheets before becoming dry.)—SCUBAIBAH, Wigan. (See p. 341, Vol. XXX. It is one of the things which is much better bought.)—PATHOLOGIST, Dublin. (See p. 351, Vol. XXVIII. They are made of the finest washed whiting, and the powder pigments sold at the oilshops mixed with gum-water.)—J. G. BOWEN. (Thanks for sketch, which want of space prevents us from using. We are obliged to confine ourselves as much as possible to astronomical observations recording special features of interest.)—CAST IRON. (Too late in the day now; and, besides, there is no doubt in the minds of engineers as to the real causes of the disaster. The slide-holder-cent is a very familiar one to us, and simple enough, but not, in our opinion, equal to others we have given.)—MECHANIC. (Must ask such questions of Mr. Lancaster privately.)—M. M. I. S. S. (Of course, the calculations occupy many pages of Bourne's book, or any other worth buying. We cannot just now spare space for a history of the steam-engine, which is what a reply to your query would involve. Lugsman and Co., Lo wood and Co., and Spon and Co. publish many more or less elementary treatises, which you would do well to read.)—HEATHERTOP. (We cannot advise commercially with regard to inventions.)—S. H. CRICKER, Jun. (Can you not give the "glossy black" as a "coat"? If so, try indiarubber dissolved in bisulphide of carbon. 2. Make a mould in gutta-percha, in two pieces, and then take the plaster cast from that. Or you can make the mould in plaster, and after soaking in melted wax, that will answer. 3. Wheeler's book, published at 170, Strand, is a useful manual; but for the chemical branch, probably you would find it better to get some of the manuals issued by Piper and Carter, Castle-street, Holborn.)—J. C. A. (Don't bother yourself about it; but eat light suppers and see that the bedroom is well ventilated.)—D. BROWN AND SON. Melt 13lb. of rosin and 1lb. of beeswax together; add, if for black, 3lb. of powdered ivory-black; if for red, about same quantity of Venetian red or red-lead.)—RHEUMATICIAN. (The best remedy would be to bring in a full supply of fresh air around the fireplace. If nights are possible only where there is an outlet, and if you supply plenty of fresh warm air to occupy the outlet, that will keep the cold air out, and then you may make the windows, &c., airtight.)—WATSONKERN. (If in brass they must be cast, which would be difficult. Why not take electrotypes of them? You will find

instructions in many back volumes.)—FAITHFULLY INQUIRITIVE. (The Post-office authorities would most decidedly object. We do not see the utility of reproducing when newer and better devices are coming to hand.)—DAN LEA. (The verb "pollard" means "to lop at the top," and a pollard (or pollarded) oak is simply an oak that has been lopped. *Quercus pedunculata* and *sessiliflora* are the principal oaks of this country, but we should not assist you to learn grafting if we gave a list of all the known species.)—W. H. PAUL. (The felt or canvas is merely to keep the red-lead in position, so two thicknesses are unnecessary. See p. 273.)—RUFFS. (Many recipes in back volumes; but your query is so very general that we cannot reply more definitely. Of what material are the "clothes," and what colour do you wish to dye them?)—A. LEA-S. (Is it a permanent magnet or an electro-magnet with coils of wire round the limbs? If the former, it is magnetised by drawing another powerful magnet from end to end several times, always in the same direction. The process is described in all textbooks, and frequently in back volumes.)—B. S. (The process of making bi-sulphide of carbon consists in passing the vapour of sulphur through incandescent carbon (charcoal), and condensing the gas in suitable chambers. There are several methods of carrying it out, but in all the charcoal is placed in the retort, and heated to a bright red. Portions of sulphur are then pushed through a tube into the bottom of the "retort," or a chamber provided for the purpose, where they are melted, and the vapour passes through the charcoal. Some of the methods have been patented, but it is an industry which can be entered into only by skilled chemists. See such works as Payen's "Industrial Chemistry," and Ure's Dictionary.)—BASS. (Type-founding is now done mostly by machine; as to the best shape of type, it depends on the work.)—J. W. (Presuming the billiard-balls are ivory, the aniline dyes will answer, and as they are cheap, the process can be easily repeated; but the best red is obtained by making an infusion of cochineal in liquor ammoniac. The balls are first immersed for a few minutes in water slightly acidified with nitric acid, and are then soaked in the cochineal liquor. 2. Instructions for making rubber stamps have been frequently given. You require prepared rubber, and something in which you can heat it and subject it to pressure at the same time. A cast of the type is taken in plaster of Paris, and the rubber is forced into that by the pressure, while the heat vulcanises the rubber.)—J. A. THOMAS. (The only difference would be a trifling saving in coals—perhaps 6lb. per hour instead of 5lb. For small power the gas engine is much the cheaper, all things considered.)—CHROMOLITHOGRAPHER. (Possibly a sheet of clear gelatine pressed on; but there are so many things of the kind that the query could scarcely be answered definitely.)—CHROMO. (Subject scarcely worth pursuing further, especially as no one else appears to have noticed it.)—L. WADE. (See p. 45, Vol. XXXI. Different varnishes are used. Stan and French polish is perhaps the best.)—F. A. M. (We do not know of a book specially devoted to them. 2. The Patent Office is in Southampton-buildings; the office for the sale of specifications in Curator-street, W.C.)—We have no means of knowing without searching, and that a patent agent will do for a small fee. 3. We have not seen it.)—LASCARINE. (Why don't you read up back numbers? The battery is not "strong enough"; at least 40 quarts are required, and the steel rod is altogether wrong; it must be carbon.)—ANXIOUS ENQUIRER. (See No. 244, Nov. 26, 1890, p. 202. The publisher will send it for five halfpenny stamps.)—ELECTRIC. (How can any one answer without knowing the "current" used and the resistance? It is a matter for experiment.)—R. N. (Güller's specification has been recently published. It is No. 2383, price 6d., under name of Hadden, who is the agent.)—W. H. G. (Fresh-burned lime mixed with water and egg.)—G. D. G. (It does not radiate heat, that reason is so well suited for lighting purposes light is radiated, and there is no difficulty "radiator.")—ZANONI. (Will you explain what we mean? We have heard of a polarised cell, write "bell.")—ONE IN A MIDDLE. (A fine perhaps, be best; but as you object to the smog gas-stove, see the indices of back volumes.)—A. NOVICE. (shall be inserted.)—J. C. R. can obtain no better information than you will back volumes. Even those most intimately acquainted with the business have only a few rules which I found to work well, and they are not likely to them. The principle are understood; their application requires experiment.)—GASSY. (When Stephen placed in charge of a steam-engine he found himself what its various parts did, and he had learned more than a whole number. *ENGLISH MECHANIC* could have taught him 565, last volume, and look through the other but if you have an engine under your charge be wanting in intelligence if you fail to find the different parts are for. They may appear complicated to you. Study them, and perhaps be able to introduce improvements.)—LANA. pp. 203, 228, Vol. XXIV. Converting a vertical lever is nowadays much like a waste of time.) (Get Lutechaun's book on Hall-marks. It is of the Assay office, Liverpool. The book is a date letter, apparently out of "pure vexat." W. J. S. (92,300,000 miles. 2. 21st of June 21st of December; but it varies if you go in a fraction of a second.)—J. W. T. (Look in the list published in the *Journal* issued by the Patent Office on *Thursday* and Friday, or in *Engineering*. 2. Yes; the authorities keep the £5.)—BORN BASO. (Send, and we will send.)—E. H. H. (Please send.)—E. T. J. (Please send before and hold over for insertion if possible when we will permit.)—GIUNO. (Received, but we hardly thought the suggestion sufficient, practicable. We ask pardon however, for overlooking the query, which had been repeated.)—YRSE VULCAN. (Mitchell's "Manual of Assaying," published by Longmans. We do not know where you will get such drawings as those referred to.)—L. L. L., A. M. C. (In type.)

Printer's ink is a good adhesive for leather belts. One application will keep a belt in running order for a year.

Mars.

Right Ascension.	Declination North.	South.
m.	h. m.	
15.4	27 4.0	11 29.4 p.m.
7.4	27 9.1	11 1.8 "
0.5	27 10.5	10 35.2 "
14.8	27 9.0	10 9.8 "
10.5	27 5.4	9 46.9 "
17.7	27 0.5	9 23.5 "
16.5	26 55.1	9 2.6 "

retrograde arc indicated by the eris carries Mars from the confines of Gemini into the extreme north of Taurus.

Venus

being Star during the whole of the she has great South Declination, diameter insensibly diminishes the 1st of the month to 9.8" at the er disc is almost circular, and, in very badly placed and a most un- subject in the telescope.

Right Ascension.	Declination South.	South.
m.	h. m.	
15.1	23 21.8	11 11.0 a.m.
22.5	23 28.3	11 18.7 "
19.9	23 16.8	11 26.4 "
17.2	22 47.1	11 34.0 "
14.2	22 0.0	11 41.2 "
10.8	20 56.3	11 48.1 "
17.0	19 36.9	11 54.6 "

indicated above, will travel from into Capricornus, through a region of any size.

Jupiter

uring all the working hours of the ill be of course, best observed at convenient time of his Meridian s apparent diameter, like that of eading, being 42" at the beginning and 38.2" on the last day of it. plendid object in the sky.

Right Ascension.	Declination North.	South.
m.	h. m.	
16.7	15 44.5	8 11.2 p.m.
16.3	15 44.1	7 51.1 "
16.2	15 45.1	7 31.4 "
16.4	15 47.7	7 11.9 "
17.0	15 51.7	6 52.9 "
17.9	15 57.0	6 34.1 "
19.1	16 3.7	6 15.7 "

ie naked eye, Jupiter will seemingly nary in a barren and uninteresting

Saturn

ing Star also, but is approaching the ould be looked for as soon as it is he early nights affording consider- for a pretty prolonged examina-

His apparent angular diameter rom 17" at the beginning of the " by the end of it. He is in so- sture with the Sun at 10 p.m. on he appearance of his ring system sensible alteration, although, of hadow of the ball upon the ring the opposite side of the pole to what o his coming into opposition.

Right Ascension.	Declination North.	South.
m.	h. m.	
16.5	11 2.8	7 31.1 p.m.
16.3	11 3.7	7 11.3 "
16.4	11 5.5	6 51.7 "
16.6	11 8.3	6 32.3 "
17.0	11 12.0	6 13.0 "
17.6	11 16.5	5 53.8 "
18.4	11 21.9	5 34.9 "

An arc imperceptible to the naked eye is shown above to be described by Saturn in a perfectly blank region in Aries.

Uranus,

Southing as he does between 4 and 5 a.m., will scarcely come into a moderately convenient position for the observer until next month, when we shall commence our Ephemeris of him.

Neptune.

Is an Evening Star, and the remarks made above with reference to the visibility of Saturn equally apply, *mutatis mutandis*, to him.

Neptune..

Day of Month.	Right Ascension.	Declination North.	South.
	h. m.	°	h. m.
1	2 48.0	14 17.9	8 2.6 p.m.
6	2 47.8	14 17.2	7 42.7 "
11	2 47.6	14 16.8	7 22.8 "
16	2 47.5	14 16.6	7 3.1 "
21	2 47.5	14 16.6	6 43.4 "
26	2 47.5	14 17.0	6 23.7 "
31	2 47.5	17 17.5	6 4.1 "

Hence it will be seen that Neptune remains to the East of σ Arietis.

Jupiter's Satellites.

Day of Month.	Satellite.	Pheno- menon.	H.	M.	S.	Day of Month.	Satellite.	Pheno- menon.	H.	M.	S.	Day of Month.	Satellite.	Pheno- menon.	H.	M.	S.
1	I	Ec R	7	6	44 ^{PM}	14	I	Oc D	1	5	A.M.	22	I	Ec R	12	54	30 ^{PM}
2	I	Sh E	4	23	"	14	II	Oc D	9	59	P.M.	23	I	Tr I	6	39	"
2	II	Sh E	4	31	"	14	III	Tr I	10	14	"	23	II	Tr I	7	16	"
5	II	Tr I	12	58	"	14	I	Tr I	10	18	"	23	I	Sh I	7	57	"
6	I	Tr I	2	0	A.M.	14	I	Sh I	11	33	"	23	I	Tr E	8	51	"
6	I	Sh I	3	9	"	14	III	Tr E	12	11	"	23	II	Sh I	9	50	"
6	II	Sh I	3	14	"	14	I	Tr E	12	31	"	23	II	Tr E	9	54	"
6	I	Oc D	11	14	P.M.	15	I	Sh E	1	46	A.M.	23	I	Sh E	10	9	"
7	I	Ec R	2	33	41 ^{PM}	15	I	Oc D	7	33	P.M.	23	II	Sh E	12	28	"
7	III	Tr I	6	32	P.M.	15	I	Ec R	10	58	33 ^{PM}	24	I	Ec R	7	23	33 ^{PM}
7	II	Oc D	7	32	"	16	II	Tr I	4	43	"	25	I	Sh E	4	38	"
7	III	Tr E	8	26	"	16	I	Tr I	4	46	"	25	III	Oc R	5	51	"
7	I	Tr I	8	27	"	16	I	Sh I	6	2	"	25	II	Ec R	6	54	4 ^{PM}
7	I	Sh I	9	38	"	16	I	Tr E	6	59	"	25	III	Ec D	9	19	42 ^{PM}
7	I	Tr E	10	40	"	16	II	Sh I	7	11	"	25	III	Ec R	10	57	26 ^{PM}
7	III	Sh I	11	16	"	16	II	Tr E	7	21	"	29	I	Oc D	11	20	"
7	I	Sh E	11	50	"	16	I	Sh E	8	14	"	30	I	Tr I	8	32	"
7	II	Ec R	12	24	30 ^{PM}	16	II	Sh E	9	49	"	30	II	Tr I	9	61	"
8	III	Sh E	1	8	A.M.	17	I	Ec R	5	27	36 ^{PM}	30	I	Sh I	9	52	"
8	I	Oc D	5	42	P.M.	18	III	Ec D	5	18	1 ^{PM}	30	I	Tr E	10	45	"
8	I	Ec R	9	2	37 ^{PM}	18	III	Ec R	6	55	6 ^{PM}	30	I	Sh E	12	5	"
9	II	Sh I	4	33	"	21	I	Tr I	12	10	"	30	II	Sh I	12	29	"
9	II	Tr E	4	50	"	21	II	Oc D	12	28	"	30	II	Tr I	12	30	"
9	I	Tr E	5	7	"	22	I	Sh I	1	28	A.M.	31	I	Oc D	5	49	"
9	I	Sh E	6	19	"	22	III	Tr I	2	1	"	31	I	Ec R	9	9	31 ^{PM}
9	II	Sh E	7	10	"	22	I	Oc D	9	26	P.M.						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon.

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappear- ance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappear- ance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°		h. m.		°	
2	α Tauri	5	3 26 a.m.	Dark	88	129	4 24 a.m.	Bright.	262	302
2	105 Tauri	6	5 45 "	Dark	153	188	6 5 "	Bright.	199	232
2	ζ Tauri	3 $\frac{1}{2}$	7 5 3 p.m.	S.	4	323				
3	16 Geminorum	6	53 37 "	Dark	133	100	4 15 p.m.	Bright.	225	188
3	ν Geminorum	4 $\frac{1}{2}$	3 58 "	Dark	65	30	4 47 "	Bright.	293	254
4	B.A.C. 2432	6 $\frac{1}{2}$	5 15 "	Bright.	110	72	6 6 "	Dark	240	200
6	29 Canceri	6	3 15 a.m.	Bright.	117	142	4 2 a.m.	Dark	195	228
6	B.A.C. 2872	6	6 44 "	Bright.	21	61	7 24 "	Dark	197	237
8	14 Sextantis	6	7 50 "	N.N.E.	156	195				
10	ϵ Leonis	5	3 56 "	Bright.	57	55	5 17 a.m.	Dark	242	255
27	ρ^s Arietis	6	1 0 "	Dark	149	187	1 34 "	Bright.	225	262
27	ρ^s Arietis	6	1 4 "	Dark	71	110	1 52 "	Bright.	303	338
29	ζ Tauri	3 $\frac{1}{2}$	12 46 p.m.	Dark	20	61	1 18 "	Bright.	323	4
30	16 Geminorum	6	10 52 "	Dark	97	117	12 6 p.m.	Bright.	238	272
30	ν Geminorum	4 $\frac{1}{2}$	11 43 "	Dark	44	74	12 46 "	Bright.	289	327

† Near approaches. § Star rising.

In the above table the angles of Disappearance and Reappearance are given from the apparent North (the real South) point of the Moon's Limb as seen in an inverting telescope, or that intersected by a circle passing through the North Pole and the centre of the Moon's image. They are also given from the Moon's Vertex, i.e., the point where a circle passing through the Zenith and through her centre cuts her limb, this latter angle being useful when the telescope of the observer has only movements in Altitude and Azimuth. In each case the angles are measured round the Moon's limb to the right, or in the direction in which the hands of a watch travel. All this is obviously merely conventional. In the case of near approaches, however, under the head of "Moon's Limb," we have given the *real* point of the Moon's Limb to which the Star most closely approaches; since a Star which the Moon can pass just clear at Greenwich, she may cover as observed from another station. Thus, on January 2nd, as viewed from Greenwich, her South Limb will just clear ζ Tauri, whence it will be apparent that, as seen from a Northern Station, she may actually occult that Star.

Shooting Stars

Should be looked for between the 1st and 3rd (the Bootides); as also between the 15th and 19th.

Greenwich Mean Time of Southing of Eighteen of the Principal Fixed Stars on the night of January 1st, 1882.

Star	Souths.
	h. m. s.
α Andromedæ	5 17 17.63 p.m.
α Cassiopeie	5 48 44.67 "
β Ceti	5 52 34.32 "
Polaris	6 30 42.60 "
η Piscium	6 39 57.34 "
α Arietis	7 15 13.04 "
α Ceti	8 10 39.35 "
α Persei	8 30 24.73 "
γ Eridani	9 6 54.95 "
Aldebaran	9 43 27.01 "
Capella	10 22 11.01 "
Rigel	10 23 3.35 "
α Leporis	10 41 39.87 "
α Orionis	11 2 52.03 "
μ Geminorum	11 29 50.17 "
Sirius	11 53 53.43 "
Castor	12 40 53.53 "
Procyon	12 46 55.40 "

As the Stars, supposing them to be absolutely fixed, would South 3m. 55.91s. (or 235.91 seconds) sooner every day, we have only to multiply this quantity by the number of days which have elapsed since the beginning of the month, i.e., by the number of the day of the month — 1, and subtract the result from the time given above, to obtain the time of Meridian Passage of either of the Stars in the above list for any other night in January. For example, At what hour will Sirius South at Greenwich on the night of the 21st? Here we say, 21 — 1 = 20 and 20 $\times$ 235.91 sec. = 4718.2sec, or 1h. 18m. 38.20s. If, then, from 11h. 53m. 53.43s. we take 1h. 18m. 38.20s., we finally get 10h. 35m. 15.23s. as the Greenwich Mean Time of Transit of Sirius on January 21st, a result only 0.03sec. in defect. The times given in our table are correct to the nearest hundredth of a second. The accuracy obtained by the use of the method just explained in the case of Sirius, however, does not extend to the Pole Star, or any close circumpolar Star, although this mode of calculation will, even in this case, give practical results sufficiently correct for all ordinary purposes. If we wish to find our local Mean Time of Transit of any of the above Stars we may do so by taking 9.8566 seconds from the time given in the tables for every hour of Longitude (and proportional parts for minutes and seconds), when our station is to the West of Greenwich: and adding the same quantity when it is to the East of that Meridian. Thus: What will be the Oxford Mean Time of Transit of Capella on the night of January 1st, 1882? Oxford is 5.05m. West of Greenwich. Then 60m. : 5.05m. :: 9.8566s. : 0.83sec. Subtracting this, according to our precept, from 10h. 22m. 11.01s., we finally get 10h. 22m. 10.18s. as the Oxford Mean Time of Southing of Capella on January 1st. Had Oxford been East of Greenwich to the same extent this quantity must have been added.

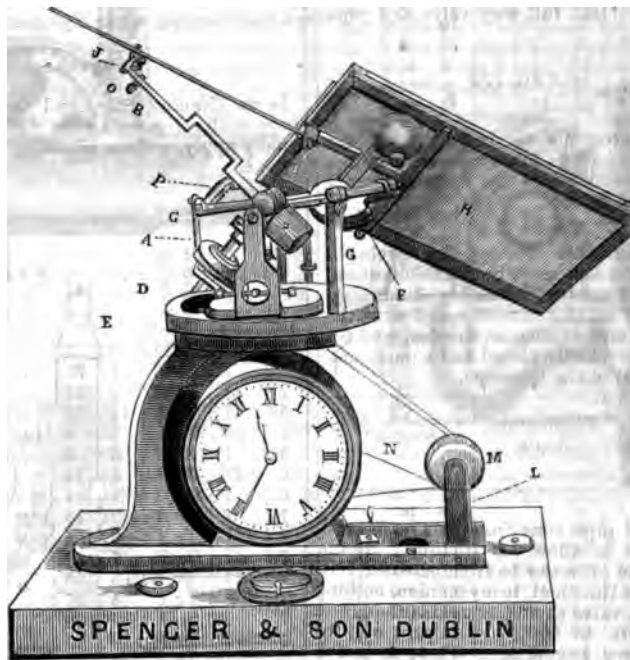
THE STUDENT'S HELIOSTAT.

THE engraving represents a new heliostat, contrived by Mr. James Spencer, of the firm of Spencer and Son, Dublin. It may be briefly described as follows:—

(1) A metal support screwed to a rectangular mahogany base, with a spirit-level and levelling-screws, carries all the working parts of the instrument. (2) The polar axis A is driven by clockwork, and makes one rotation in the space of 24 hours; and as it rotates it carries the declination arm B with it. (3) The support in which the polar axis works is constructed so as to admit of the angle of the polar axis A being altered to suit the latitude of the place where the heliostat is to be used. (4) The alteration in the angle is effected by means of a graduated arc C and milled-head adjusting screws D. The range of adjustment extends from 45 degrees of north latitude up to 57 degrees, which includes the whole of England and Ireland, and Scotland as far north as Aberdeen. The adjusting screws can be seen in the engraving. The arc, which is attached to the base, is concealed by the

clock. (5) Round the support, a horizontal stage E revolves in the plane of the horizon, through a distance of nearly 360 degrees. (6) In a stirrup-shaped piece F, supported by pillars GG on the stage, a T-shaped axis, K, pivoted to the back of the reflector H, works, and a steel rod, I, attached to the upper end of the reflector connects it by means of a universal joint J to

box may be used to find the position for the heliostat. (16) The sun's light shines upon the reflector H, parallel to the declination arm B, and is reflected from the mirror in the direction of the axis K, which carries it. This second arm is accordingly to be brought into whatever direction the observer wishes the reflected beam to take. It will be found to be readily



the end of the declination arm B; motion is in this way communicated to the reflector. § 2. (7) The declination arm B, the axis K pivoted to the back of the reflector H, and a line parallel to the plane of the reflector H make an isosceles triangle, and when the polar axis A is set on the meridian, and the declination arm B pointed towards the sun, the plane of the reflector H is at right angles to the plane of the triangle; and these relative positions are preserved, while the instrument is in motion, without regard to the position of the reflector, in either a horizontal or vertical direction. (8) The reflector H measures eight inches by four inches. All the parts are carefully counterpoised, and the motions are very smooth and steady. (9) Within the limits of its range, which is about 200 degrees in a horizontal, and ten degrees in a vertical direction, a beam of light can be reflected towards any point in the horizon; and as, when the instrument is properly adjusted, the reflector H, when in motion, always presents the proper angle to the sun, a beam of light reflected continuously in the same direction is the result. § 5. (10) When the heliostat is taken out of the box, the axis K on the back of the reflector H is to be attached to the support, and the steel rod I is to be slipped through the joint J at the end of the declination arm B, and screwed into its place. § 6. The pin which locks the free end of the bent lever L, which carries the guide pulleys M, is then to be taken out, and the clock is to be wound. (11) The first thing to be done, in order to place the instrument in position, is to set it to the latitude of the station where it is to be used. This is done by the graduated arc C, and adjusting screws D. § 3, 4. (12) It must then be placed so that the polar axis shall be parallel to the axis of the earth; the base is then to be levelled, and the declination arm pointed towards the sun. (13) This last adjustment is effected by means of a hole in the small disc, O, at the end of the declination arm B; the arm is turned so that the ray of sunlight which passes through the hole may fall on the centre of the small ivory disc P, which is placed to receive it. When the arm B is then left to itself the clock will cause it to follow the sun, and keep the spot of light within the small circle on the ivory disc. § 2. (14) When the heliostat is once brought into position, it is well to make a permanent line along the side of the base, which will serve on subsequent occasions to replace it in position. (15) A moderately sensitive compass in a square

movable, both horizontally by pushing it round, and up and down by means of a screw. § 5, 9. (17) It is best to place the spectroscope at some distance from the heliostat, and to put a lens between it and the heliostat, in the path of the reflected light, so as to form an image of the sun upon the slit of the spectroscope. This lens should have an aperture which is, at all events, as large in proportion to its focal length as that of the collimator lens.

PRACTICAL NOTES ON PLUMBING. XXII.*

By P. J. DAVIES, H.M.A.S.P., &c.

Inside Work, or Sanitary Plumbing, Closets, &c. (Fig. 129).

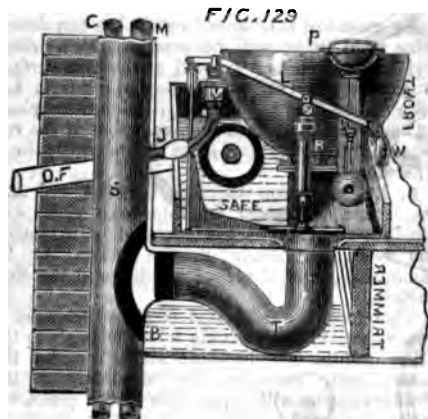
THIS diagram illustrates a valve closet, fixed over the half ∞ -trap (wrongly designated a $\cup$ -trap). This kind of closet, above all others, never should be fixed over this kind of trap, as the momentum of the water in passing from the valve of the closet entirely destroys the water-seal of the trap, which necessarily renders the trap totally useless. Under all such closets, a properly-constructed ∞ -trap is the only one at present invented that will prove thoroughly efficacious.

This closet, like all others, should have an ample supply of water, so that every part of the basin may be thoroughly washed, more especially the front part. A very excellent method for testing the efficacy of the water flushing is to dry the basin by partially opening the closet-valve, and then painting the basin all over with a good coat of plumber's soil; then in the ordinary manner pull up the handle of the closet, and if any part of the basin is not cleansed, the flushing is not perfect.

In order to avoid such a contingency, it is necessary, first of all, to have a proper-sized pipe and valve, and by all means do not make any very sharp bends or a lot of branches. When you are so circumstanced that you are compelled to have branch joints, you should always make them at the easiest possible angle.

* From the *Building News*. All rights reserved. We omit Chapter XXI., as that principally relates to some experiments reported in the *Building News*, which we have not space to repeat here, and the continuity of the series is complete without it. Any reader desirous of reading that chapter, however, will find it in the *Building News* of Dec. 9.

By adhering to the following instructions (which will, in most cases, be found a very good workable table), a very effectual flush may be relied upon for a closet supply. When the head of water is 5ft., use a 1½in. full-way valve with the same-sized pipe; but when the pipe has to be taken in a horizontal direction, in all cases use the next size larger to allow for friction. When the head of water is between 5ft. and 15ft., use 1½in. full-way valve and pipe;

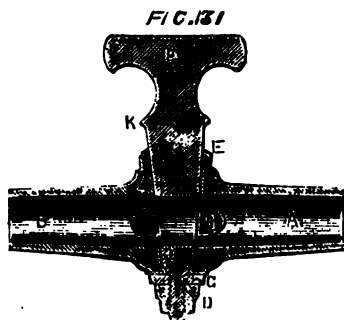
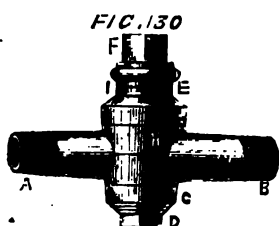


though if the pipe runs from 7ft. horizontal, use 1½in. pipe to allow for friction. Again, should the head of water be from between 15ft. and 40ft., use a 1in. ; and, in my opinion, nothing less than a 1in. valve should be used, although in cases from 40ft. to 60ft., a ¾in. pipe may be used; but larger, according to whatever length of horizontal pipe there may be. Perfect flushing also depends, to a very great extent, upon the kind of closet-basin used.

In my estimation, Sharp's pattern, known as the flushing rim, is the best. In using this basin, care should be taken to prevent any dirt or other foreign matter getting into the rim, as it will prevent the water passing all over the basin, and consequently leave it only partially cleansed.

Closet-Pipe Stop-Cocks.

When selecting stop-cocks to be used on pipes in connection with closets, great care should be taken to select only those having a straight full-way, known as a "round-way,"

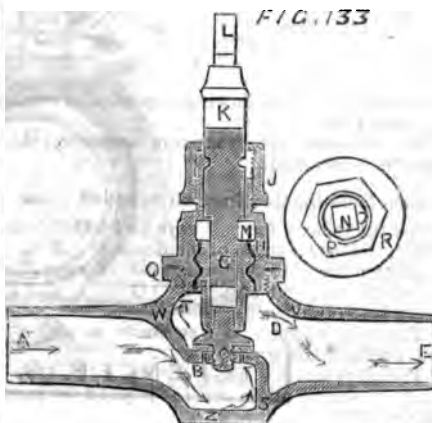
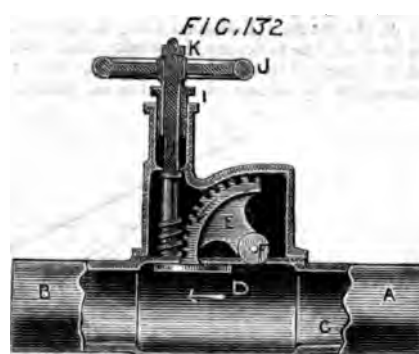


ground-in stop-cock," shown at Figs. 130 and 131.

In cases where it is compulsory to use valve-cocks, always select them with straight ways, similar to that shown at Fig. 132.

On reference to Fig. 133, it will be easily observed that the seating B is so constructed that the water is greatly retarded in its progress for these reasons:—It first strikes against the partition W, and rebounds from there to the bottom Z, from Z to S, thence from S through

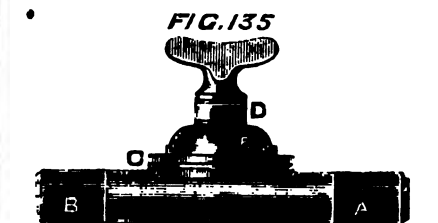
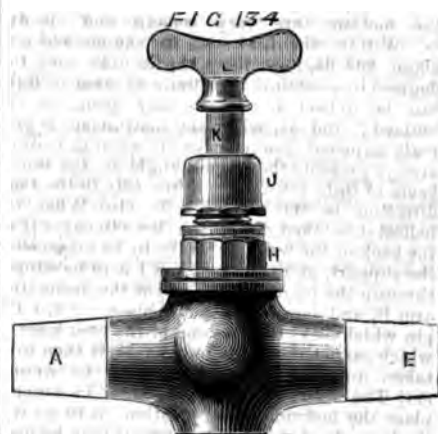
the seating B, and up against T, back to V, from V to X, and finally onward along E. Now



this diagram and explanation shows distinctly that the water has to take no fewer than six different sharp curves before it can pass out of the stop-valve or cock; and, curious as it may seem, the shell and seating of this stop-valve is the one generally adopted by our water companies.

Farther on I shall give the full particulars of a practical test of the loss of head-water by the use of such stop-valves.

Fig. 134 is an elevation of the last-named stop-valve, showing the stuffing, cap, the squares on the tap, and the tinned ends; A the



inlet, and B the outlet. Fig. 135 is another kind of stop-valve, made without the stuffing-box, but having an indiarubber diaphragm at C to answer the same purpose. The water-way is much the same as in Fig. 133.

(To be continued)

ON THE IRRATIONALITY OF THE SPECTRUM IN ITS RELATION TO THE ACHROMATISM OF OPTICAL INSTRUMENTS.—III.

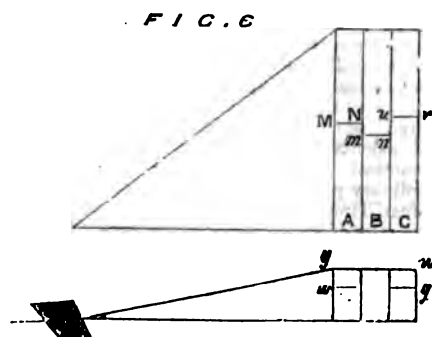
By "ORDENIO VITAL."

(Continued from page 320.)

IN the preceding pages it has been shown that the fringes of colour surrounding the image at its best position, are due to the disproportionate dispersion of the various colours, or as it is called, the irrationality of the spectrum: it will now be proved that this secondary colour admits of reduction, and even of elimination, in some particular cases. The size and position of the prism, has considerable influence on the extent of space allotted to each colour; and in measuring the indices of the colour lines in any medium, the prism must be adjusted to give a minimum angle of deviation. Brewster found that two prisms of the same substance, but of unequal refracting angles, could be practically achromatised, while a faint outstanding colour was seen similar to that produced by irrationality, but opposite to it in position. He names this the tertiary spectrum, and shows that in certain instances, the secondary and tertiary spectra may be caused to correct each other.

There is a distinct difference in the formation of these two spectra; the first arises from the specific action of a substance on the various coloured rays, and the second is caused by the variation in the size or position of the combined prisms. Brewster gives the theory of the formation of this tertiary spectrum, and then shows that it is confirmed by experiment.

The position which the fringes of the secondary spectrum occupy, with reference to the prisms producing them, will be understood from the following considerations. Let A, B, and C (Fig. 6) represent three equal spectra formed



respectively by prisms of crown glass, flint glass, and rock crystal. Let the first be bisected by MN, showing the position of the mean ray. But in a spectrum formed by crown glass, the mean ray is at the junction of the green and blue spaces. In that of flint glass, the green does not extend to the middle, but falls a little below as mn, while, with rock crystal, it extends beyond it as mv. Hence, when the first and second are arranged in opposition, as in the lower diagram, the lower side of the bar is wine coloured from the junction of the extremes; but the flint does not act sufficiently on the green, to counteract the dispersion of the crown, so that the green fringe is formed on the upper side. But with rock crystal its action on green surpasses that of the crown glass, so that with these two media, the positions of the colours are reversed.

Hence, it becomes apparent, that in the secondary spectrum the green fringe always occupies the same side of the bar as the vertex of the prism which has least action on green light.

Formation of Spectra.

Brewster considers that equal-length spectra can be produced principally in four distinct ways, viz. :—

1. By a prism of high dispersive and comparatively low refractive power, requiring only a small refracting angle. Oil of cassia may be taken as an example of this class of media.
2. By a prism of low dispersive and low refractive power, requiring a large refracting angle. Fluor spar is an example of this class.

It is a prism of low dispersion and high refractive power, requiring a small refracting angle. Diamond is an example of this case.

Or, lastly, a spectrum of the same range may be produced by inclining the prism so as to reduce the front incident angle, and thereby increasing the refraction at the second surface.

Hence it appears that some spectra are obtained by using a large angle of refraction, and others by a small one. It is, therefore, necessary to inquire what is the chief difference between spectra so produced.

In the previous remarks on refraction and dispersion, it was stated that $\mu - 1$, and $\mu - \mu'$, are only approximate measures of these quantities. They were arrived at, on the supposition, but an increase in the value of the sine, produced an equal increase in the magnitude of the angle, but this is correct for small angles only. In these investigations the magnitude of the refracting angle is an important factor in the final result; it becomes necessary to find the variation which is caused by taking the ratio of the sines for that of the angles.

If we have two angles A and B, then by a trigonometrical formula we have, $\sin. A - \sin. B = 2 \sin. \frac{1}{2}(A + B) \cos. \frac{1}{2}(A - B)$, or $\sin. \frac{1}{2}(A + B) = \frac{\sin. A + \sin. B}{2 \cos. \frac{1}{2}(A - B)}$.

This shows that the sine of half the sum of the angles is greater than half the sum of their sines, by a quantity depending on the difference $A - B$. And since the angular magnitude of the spectrum is constant, it is evident that the last term is a constant factor; so that the difference between $\sin. \frac{1}{2}(A + B)$ and $\frac{1}{2}(\sin. A + \sin. B)$, varies directly as the magnitude of the sines. In small angles it may be inappreciable, but in large ones its effect must not be neglected. Therefore, the mean value of the sines is not the sine of the mean angle, but is that of one slightly less.

As an example, compare the difference when the spectrum is formed between the angles of 5° and 15° with an equal spectrum formed between 5° and 55° .

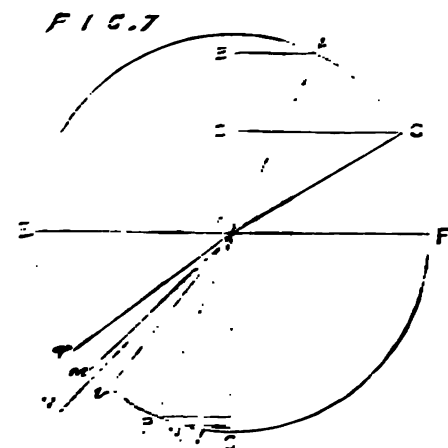
Nat. sine 5°	= .0871557
" " 15°	= .2588190
Divide by 2	
	.3459747
Nat. sin. 9°	$58' = .1729874$
Nat. sin. 45°	= .7071068
" " 55°	= .8191520
	1.5262588
Nat. sin. 45°	$5' = .7631294$

The mean angle of the first is 10° and of the second 50° , so that for the smaller pair the difference is only 2° , but in the other case it is 15° .

By means of a diagram, the application of these results will be readily understood. Let EOF (Fig. 1) be the upper surface of a medium of crown glass, and let a ray AO be so incident, that it forms a spectrum, whose mean ray forms an angle of 10° with the normal BG, R being the red and V the violet extremity. Then under his small angle the sine of the mean angle SOG may be taken as equal to the mean value of the sines of the extreme angles ROG and VOG. But in a spectrum produced by crown glass the mean ray is about the junction of the blue and green. Transferring our attention to the second position, in which the spectrum is formed with a mean angle of 50° ; the law of the sines is still maintained, which causes the junction of these colours to fall below the mean or middle ray MO. The blue and violet part does not occupy half the spectrum as in the previous case, but is contracted, while red and green are in a corresponding degree expanded. The middle ray now falls into the green space, thus showing that the proportional distribution of the coloured spaces is altered by increasing the angle of refraction.

When the ray passes from a dense to a rare medium, the above alteration is reversed—the red and green portion is contracted. Without drawing another diagram similar to Fig. 7, the following considerations will make this apparent. When a ray passes out of a dense medium into air, the emergent angle is greater than the incident angle, and the more refrangible rays occupy the place of R and B in Fig. 7, and the red or least refrangible rays will be V and A. Therefore, in this case, the blue and violet portion is augmented, which causes the mean ray to fall in the blue space. But in

the case of the expansion of the mean ray a more general case is the previous one.



Brewster gives the following numerical examples to prove this.

In each case the maximum amount of dispersion is obtained.

Case I. Refraction from air to crown glass.

Let the index r for red rays be 1.53346, r' for violet, 1.55542; angle of incidence = a , that of refraction for red rays = x , that of refraction for violet = y , and angle $MOG = z$, and its deviation $MOG = 2$.

Then $\sin. x = \sin. r = r$ or $\sin. x = \sin. a / r$ and similarly $\sin. y = \sin. a / r'$.

Therefore $\sin. x + \sin. y = 2 \sin. a \cdot \frac{1}{2} \left(\frac{1}{r} + \frac{1}{r'} \right) = \sin. a \cdot \frac{r + r'}{r r'}$.

The greatest possible value of a is 90° , whose sine is unity.

Dividing unity by r and r' , we have

$$\begin{aligned} \sin. x &= .65 \\ \sin. y &= .6417 \end{aligned}$$

$$\frac{1}{2}(\sin. x + \sin. y) = 1.2917$$

$$z = \sin. (40^\circ 13' 42.7) = .64585$$

$$\therefore x = 40^\circ 32' 29.8''$$

$$\therefore y = 39^\circ 55' 0.8''$$

$$80^\circ 27' 30.6''$$

$$\frac{1}{2}(x + y) = 40^\circ 13' 45.3''$$

$$(x - y) = 0^\circ 37' 29.0''$$

Hence the difference between $(x + y) / 2$ and z , or the value of z , is $2.6''$, so that the red and green extent comprises $\frac{1}{2}(37^\circ 29') + 2.6'' = 18^\circ 47.1'$, and the blue and violet $18' - 41.9''$.

Case II. Refraction from crown glass to air.

In this case the maximum value of a is the critical angle for crown glass for violet rays, which, as determined above, is $39^\circ 55' 0.8''$. In this case $\sin. x = r \sin. a$ and $\sin. y = r' \sin. a$, $\frac{1}{2}(\sin. x + \sin. y) = \sin. a (r + r') / 2$. Multiplying $\sin. a$ or .6417 by r and r' , we have:—

$$\sin. x = .987229$$

$$\sin. y = 1$$

$$1.987229$$

$$\frac{1}{2}(\sin. x + \sin. y) = .993615$$

$$z = 83^\circ 32' 30''$$

$$\therefore x = 80^\circ 50'$$

$$\therefore y = 90^\circ$$

$$170^\circ 50'$$

$$\frac{1}{2}(x + y) = 85^\circ 25'$$

$$y - x = 9^\circ 10'$$

Hence, the difference between $\frac{1}{2}(x + y)$ and z or the value of z , is $1^\circ 52' 30''$, so that the blue and violet extent comprises $\frac{1}{2}(9^\circ - 10') + 1^\circ 52' 30'' = 6^\circ 27' 30''$, and the red and green $2^\circ 42' 30''$.

This is, of course, an extreme case, but it shows that the greatest effect takes place at the emergent surface; for while in the former the spectrum subtends an angle of $37\frac{1}{2}^\circ$ only, in the latter it extends over 9 degrees. In the first instance, the deviation of the mean ray is very minute, being about one-fourteenth of the total dispersion; but in the second, it amounts to more than one-fifth of the entire spectrum.

Brewster gives the results of the investigations somewhat in the following

1. In all refractions from rare to dense red and green are expanded, and blue is contracted by increasing the angle of incidence; but in refractions from dense to rare the contrary effect takes place.

2. If the incident angle be the same in the expansion of red and green in refraction from rare to dense media, is less than the refraction of red and green (or the corresponding expansion of blue and violet) in refraction from dense to rare media.

By means of this second result, we can mine what effect will be produced by a prism. Evidently the action exerted at the first surface is contrary to that at the second; but it has been shown that the chief dispersion takes place on emergence, so that the expansion of the portion falls very far short of its cost. Therefore—

3. By refraction through a prism, green are contracted, and blue and violet are expanded; and this effect is increased by increasing the refracting angle of the prism, diminishing the angle of incidence at the surface.

Therefore, the refraction may be increased in two ways: first, by giving a larger angle prism, while the incident angle remains the same; and, secondly, by diminishing the incident angle, while the angle of the prism remains unaltered.

(To be continued.)

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURE, AND LODGMENT

By JOHN WATSON WARREN,
Associate of the College of Organists, La

b. **THE Material of the Combs will be** Ebony. Sometimes, however, Gothicised Instrument they will be Ivory, or perhaps of wood capped with such a treatment is almost invariably conjunction with a darkening of the for which reason the entire description as *Instances and Selection*, are not given but at *m*, next. For *Artificial Ivory* similar substances see also at *m*, next.

c. **Eyes.**—These are little Loops, some non-rusting wire or other form and firmly affixed to the Key at the point for actuating the latter. Eyes are required when a part of one Manual manent communication with the corresponding part of a second Manual,—as when a Gamut G Swell Section has its Key down to CC, but having no *Pipes* of and so merely acting on the correspons of the Great or the Choir Section. [will in such case (see §11, c) be affixed to surfaces of the tails of the lower Man and to Each Eye will be attached a Ta (see *Depart. KEY-ACTION*), running as to pass through the Key tail of Manual, and carrying a Regulator which beds on the last-named tail, allows of the Dumb Keys' being adjusted uniform level and proper depth of fall

d. Care must be taken that the E only sufficiently strong and solid in that it be attached in such a way that possibly be turned during the operation Adjusting, however stiff the Regulator may become.

dd. Some *Instances of the Eye are the Depart. BORROWING* (see 22, A).

e. **Loading.**—The Loadings consist pieces of Lead, inserted into either the fore ends of the Keys, for the bringing their "balance" correct,—are Key requiring, as already partly seen to be a trifle—and only a trifle—heavier than at its tail end, so as to just keep it to a bearing against its Action to Fall of course, true that such preponderance always be insured by simply posting the Pin at a sufficient and proper distance Key fore end; but it will often occur cularly with Instruments having more

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l, that some more important consideration does such determination of the Pin position. It is hardly required to observe the placing of the Mid Pin so as to avoid necessity for Loading, should be practised in circumstances admit of it, and thus material and labour be economised. It is added that in all cases of "balancing" the Key it is essential also to ascertain and the weight furnished by any portions of Action proper or Coupling Action which on the Key, either constantly or only a Coupling: such portions will include Backfall Noses, Square Noses "Drum- and occasionally Levers, &c.

In cases where the structure of a Coupler in the Manuals brings about a liability in laying ends to be tilted up during action, it may be sometimes advisable to such Key at its Center,—as near to the as is practicable. In such event, if Key receives but one Leading, latter will not act most effectively if placed in of the Mid-Pin: but as this will tend to a Dancing of the key (see *k*, ante), it is best to Lead (Load) on both sides of it.

The best form for the Loading is that small solid drum or cylinder, that is to an approximation to a true cylinder,—the being preferably slightly tapered in order to its insertion into the Key. The Working is made in the latter for the reception of it is merely a centre-bitt Hole bored horizontally, at the desired point, quite through the stock, the bitt being of such size that the will be tight when driven or riveted into the. When more than one Lead is required for the Key, let their borings be, as a rule, as close together as is possible without the splitting of one hole into the other; the reason for this being that the nearer the splitting is to the Key end the less of such work will be demanded.

As respects the Material of the Loadings it should be of the softest nature possible; to say, it should not be alloyed with any other metal harder than itself. For this Tea-Lead is not desirable for Key Loadings; it usually contains a proportion of Solder, at least one-half of it Tin,—which not hardens it, but renders it valuable enough better employed in the making of the Pipes. It will, however, commonly be purchase the Leads ready cast for use: more suitable Houses for this will be given in *Depart. Bought Portions* (at The same shops will supply, if desired, Rod Lead for the like purpose; but this is not recommended by the writer, except in special case in which it is important the Loading be as much extended laterally as possible.

The present Head Loading should be consistent with that of Centering,—comm. at 89, *h*.]

Mortise and Boring.—Under these terms are intended all Holes and Sinkings which are the reception and traverse of the Mid and Bed Pins. The cutting for the Mid Pin (1) of a Mortise at the top face of the and (2) of a Hole at the under face of ditto, hole being made at the point exactly beneath the Mortise, so that the latter is run into and led by the Hole; the smaller dimension of the Mortise and the diameter of the Hole are of the same as just to admit the Pin, and, in order to the more perfect fitting and action of (3), the whole of the central portion of the Mortise, between Mortise and Hole, is so laid away, with a suitable special tool, that it is entirely clear of the Key substance, leaving at such actual Hole and Mortise: this is termed the *Clearing-Hollow*. Note: [Mid] Pins (see 87, *g*) are employed, the and Clearing-Hollow must be a little longer and the Mortise a little longer. The for the Fore or Bed Pin takes the form of a Mortise, just admitting the Pin as made at the under face of the Key, and made at the Centre-bitt Hole bored at and from upper face of the Key, and at vertically in the Mortise, so as to meet and continue the and the diameter of this *Clearing-Hole* such as to insure the Pin's touching the distance only at the Mortise. This Hole course, always finally covered, and so, by the Ivory or other Plating attached to

the Playing part of the Manual Natural; but, in addition to this, and to prevent the possibility of the Holes being ever visible through the Plating (which is sometimes semi-transparent), each Hole is also roofed over with a thin slip of some suitable wood, say of the same kind as the Key Stock, which slip I have termed a *Tile*. This Tile will be set so that its grain crosses the grain of the Key, and will be let into a shallow groove so that its top surface comes flush with the top surface of the Key Stock. The length of each Tile will thus be equal to the lateral width of the broad or Playing part of the Natural; its width will be equal to the diameter of the Clearing-Holes; and its [vertical] thickness will be about 1-16th in. in ordinary cases, and a trifle less if it be of importance to keep the vertical width of the Key Stock as small as possible,—as where vertical space for the Organ itself is restricted. In an extreme instance of this last kind the Tile might even be omitted altogether. Remember, as before, that when *Oral* [Fore] Pins (see 87, *g*) are used, the Mortise must be a little longer, and the Tile therefore a little wider.

At this stage see further under Head of Plating (at *m*, next).

In the whole of the preceding description of the Mortise and Boring it has been assumed that all the Workings are formed in the solid substance or Stock of the Key,—the latter being made of a wood sufficiently hard or spongy (see 87, *x*) to afford the desired resistance to the wear of the Pin: and it is to be understood that a very large number of Organ Manuals are, and probably will always continue to be, constructed in this way. But when the Key Stock is made of some light and soft wood, such as Pine, it becomes necessary to have the Mortises formed in suitable little pieces of sufficiently hard wood, such piece being then firmly attached to the Key Stock: these pieces I have termed *Caps*. The slight modifications necessary for the Workings in the cases where Caps are employed will readily occur to any ordinarily intelligent operator.

For the actual points at which the Pin Workings are to be made see *S.-S.-Dir. of DESIGN PRINCIPLES*, under Head of Centering (*h*, next). As regards the point of the Fore Pin in a Manual which *Overhangs* another (see *n*, next), bear in mind that there will remain in such cases a sufficient amount of the Natural broad part to accommodate its Pin—even if latter be of the Oval kind,—all the while such broad part is as much as 1½ in. long, and the amount of Overhang and consequent cutting into Key nose does not exceed 1 in. (the Normal allowance) horizontally. See here at 91, *o*.

i. The Material of the Caps will usually be either Sycamore, Birch, or Mahogany.

As respects the relative Merits of the Cap and the Hard Stock Treatments of the Key, it will be sufficient to observe that the object of the former is the permitting of the Key to be of some lighter (and therefore softer) wood. On this point consult what is said at *x*, ante.

ii. It will be seen that no mention has been made of the method, often adopted in Piano-fortes, of lining the Pin Mortise with Cloth, in order to ensure quietness. The reason is, that where the Pin accurately fits the Mortise there cannot possibly exist any rattling of sufficient amount to be of consequence in so loud-voiced an Instrument as the Organ; and, as such accurate fit can always be easily insured by the employment of the *Oral* Pin, all need for Cloth is at once got rid of. Besides this, in the comparatively damp atmosphere to which many Sanatory and other Instruments are exposed, there would be danger of the Cloth's absorbing sufficient moisture to destroy the freedom of the Key upon the Pin.

j. Some Modification in the foregoing—and ordinary—method of Centering and Mounting the Manual Keys has been devised and Patented by a Mr. G. F. Stidolph. The Number of the Specification is 2920, and the Year 1859.

k. *Nosing.*—By this is meant the Ivory, Ebony, or other plating which is attached to the extreme front noses or ends of the Naturals, for the furnishing to them of a proper finish. The exact treatment adopted must, of course, depend upon the actual form which is given to the Key-end itself; on this point see what is directly said under Head of Projection (at *n*, next). Ivory or Ebony Veneer affords a good effect: whenever it is used it should, remember, not be attached directly to the [end grain of the] Stock (Key),

but to a piece of wood which itself is fastened to such Key-end; this piece will be cut and set the same way as is the Veneer (that is, flat grain against the Key end grain), but it will be about 3-16 in. thick, and of the same wood as the Key Stock. An Instance of plain Ebony Nosing occurs in the Organ, by H. Jones, in the Wesleyan Chapel, Canterbury. In old Manuals the Nosing is often a single piece of Sycamore, or some similar wood, worked to a Molding, and set directly against the Key end grain; but the lack of the intermediate piece—which may obviously be easily fastened with brads or pins in addition to the glue—is a real defect; also the Molding would now be considered old-fashioned. Where the Key-Projection is of the *Curved* form (see *o*, next) the Nosing should generally be of the thinnest possible Veneer, so as to admit of readily bending to such Curve. Where the Key-Projection is of the *Notched* form (see *oo*, next) it is usually only the extreme end of such Projection which will require the Nosing.

The Natural-Nosing, of whatever nature, has generally been "stopped" up against the under face of the Plating proper,—the latter thus always slightly overhanging the Nosing (see *m*, next); but in some of the later specimens such overhang may be seen dispensed with, the Nosing being set and jointed against the end of the Plating, and at the same time made of sufficient thickness to admit of being *Rounded off*,—the actual Nose therefore forming a small semi-circular molding of solid Ivory. An Example of this Treatment occurs in the large Organ, by Hill, presented to Worcester Cathedral by Earl Dudley, in 1874-5. As regard the Merits of this Round Nosing, we may say that its appearance is good—provided the joints be close,—and also that it facilitates the rapid passing of the hand from one Manual to another.

(To be continued.)

ELECTRICITY IN VACUO.

THE attention of physicists has been engaged not a little of late with the propagation of electricity in rarefied space, and a profusion of experiment in this relation has contributed materially to the elucidation of a difficult subject. We propose here to give a brief account of the recent researches of Herr Goldstein and Herr Eidlund, wherein these investigators have arrived at very much the same conclusion. (For fuller details the reader is referred to the *Annalen der Physik*, the *Annales de Chimie*, and *Naturforscher*.)

By a series of experimental results, Herr Goldstein shows that the discharge in rarefied tubes is not well explained by motions of ponderable particles, either of gas or of the electrodes, or of the glass wall, or of dust. If that be so, we seem to be shut up to the ether as the substratum of discharge. "In my opinion," says Herr Goldstein, "the discharge is a process which occurs in free ether."

In investigating the matter, Herr Hittorf observed that the resistance of the positive light always diminished with increasing rarefaction; but in the kathode-light and at the kathode-surface he remarked an increasing resistance with increased rarefaction. Changes of form and size of the anode had no influence on the resistance. Herr Hittorf concluded that the great resistance to discharge in highly rarefied tubes was caused only by the resistance at the negative electrode, and in the space filled with negative light. Herr Goldstein has found, however, that the kathode light behaves quite like the positive, in that its resistance with small densities of gas is considerably lessened. Now, since there is no specific resistance at the positive electrode; since, further, the resistance in the positive and kathode-light are extremely small as against the entire resistance, Herr Goldstein concludes that with great evacuation the resistance to the discharge lies essentially at the kathode surface. "Thus we see" (he says further on) "that the resistance of the whole gas-mass of a discharge-tube is less the more the density of the gas is diminished; the space conducts better the less gas it contains; and since this variation, so far as the experiments can be pushed, in progressive rarefaction, is always in the same sense, we must infer that the best conductivity will occur after complete removal of the gas. But when this is done, the space contains only free ether; which, therefore, I regard as the essential substratum of the discharge. The gas seems to act as a hindrance." As evidence for the ordinary view that the gas mass is the substratum of the discharge, the behaviour of the discharge in presence of magnetic force has been adduced. When a magnet acts on

the positive light of a vacuum-tube (placed equatorially) the light, which formerly filled the width of the tube, is driven against one side; and it has been assumed that it is the gas particles that are thus driven. Herr Goldstein obtained results which seemed to him against this view. In a tube filled with dry nitrogen was some sodium, which could be vaporised by heating. The positive discharge-light had a purple red colour, but near the vaporising sodium it was golden yellow; and with suitable heating the upper half of the horizontal tube could be made red, the lower yellow. When a strong magnet was brought near the tube in equatorial position, the discharge-light was pressed against the upper wall as a thin thread; but this thread was pure purple, and had no trace of yellow. The sodium vapour was not displaced by the magnet; the current here seemed to follow the magnet without adhering to the gas particles.

A like result was yielded by experiments in which the author inquired into the supposed condensation of the gas, in consequence of the transport of gas particles through a magnet. The intervals of the layers of light served for measurements, which are sensibly affected by a change of pressure of 0.01mm. But the result was negative; magnetisation of the discharge has no influence on the gas density.

A further objection to Herr Goldstein's view is based on the fact that each gas in the discharge has its own spectrum, which could not be the case (it is alleged) if the ether were the conductor, for then all gases must have the same spectrum. To this Herr Goldstein replies, that the ether is without optical emissive power, and the absence of a spectrum of the ether is no proof of its non-conductivity. "The discharge produces a movement of free ether, and is, in itself, non-luminous. This motion of the ether disappears, while it is imparted to the gas-molecules and their constituent atoms; the particles of each molecule then vibrate, according to the specific structure and elasticity of the molecule, and re-transfer the transverse vibrations so excited in them, as such, to the ether; thus the originally electric motion appears as light, and as light whose periods of oscillation depend on the specific nature of the gas-molecule. Thus the conduction in ether no way contradicts the difference of the spectra of chemically indifferent gases. The luminosity of gases traversed by electricity I thus regard as a phenomenon of resonance."

The same view as to the conductivity of vacuum is arrived at by Herr Edlund. He makes the following interesting remarks in stating the case:—

"It has been generally supposed that empty space is quite without electric conductivity, and we have long had experiments adduced to prove the correctness of this view. From time to time many researches have been conducted with a view of determining the question, which is, in various ways, of much importance. The heavenly bodies are separated from each other by space, which, so far as we know, contains no other material than the luminiferous ether. It is now generally known that the sunspots have a marked influence on the aurora, and the magnetic state of the earth, or that all these phenomena depend on a common cosmical cause. But if the space between the heavenly bodies were absolutely non-conducting, we should find it difficult to conceive the possibility of a direct relation between those phenomena, for we could not at all suppose that a considerable action of electrical induction would be perceptible at so great a distance, and as little can we see in the observed relation a secondary action of the insignificant change of heat-radiation, which may be produced by the varying number and size of the sunspots. It is further hard to doubt that the northern lights owe their existence to electrical currents which go through the earth's atmosphere; but polar lights have been sometimes observed, which must have originated so high above the earth's surface, that the air at that height would be rarefied to a degree far exceeding that attainable with the best laboratory apparatus. These polar lights show that the rarefied air of such high regions must necessarily be conductive, for it propagates electric currents, though the experiments in our laboratories would seem to indicate that air of the corresponding density does not conduct electricity.

"The question whether electricity needs a common ponderable material, in order to its propagation from place to place, has been much discussed, and, from a theoretical standpoint, is of great importance. If it could be satisfactorily answered, the question as to the electric resistance of empty space would likewise be sufficiently settled. Unfortunately, it is not possible to produce an absolutely empty space; so that the former question cannot be determined by a simple experiment; and there are, in experiments, various circumstances which have a disturbing action, and whose influence it is difficult to estimate. It will be well to endeavour, by a survey and discussion of past experiments, to gain some standing ground for the settling of this important question.

Such an attempt is then made by Herr Edlund, in his memoir. From the various facts experimentally determined, and especially from the experiments of Herr Wiedemann and Herr Hittorf, it is inferred, that in passage of the electric current through rarefied gas, the heating of the latter affords positive proof that here a resistance exists: this varies considerably with the length of the gaseous column, and with the degree of rarefaction. From these variations it further follows (as Herr Wiedemann points out), that there are two kinds of resistance to be distinguished, one depending on the nature and condition of the gas, and increasing with the length of the column; and another depending on the passage of the electricity from the solid electrodes to the rarefied gas. The recognition of this "transition-resistance," which is directly proved by a series of experiments, facilitates greatly the explanation and comprehension of all past experiments in this connection. Herr Edlund concludes with the following résumé:—

"It is thus proved by direct experiments that the proper resistance of the rarefied gas, or r , steadily decreases with the pressure of the gas, till the pressure has sunk to an insignificant fraction of 1mm., and that, simultaneously, r , or the resistance which the current experiences in its passage from the gas to the solid electrode, continuously increases in amount. Now the question stands thus: Does the known fact, that the current is unable to pass through the Torricellian vacuum depend on a sudden and great increase of r , after it has continuously decreased with the pressure—this increase taking place on removal of the last molecules? Or is it more probable that the increase r at the electrodes further increases? In other words, which of these two quantities is it that increases when the very rarefied gas gives place to absolute vacuum? Without any doubt we must suppose that the resistance r further increases, as the rarefaction is pushed further, and, doing so, is so largely augmented, that the current cannot pass. Only in this way, too, can the fact be explained, that a current can be produced in a space quite empty of gas without electrodes, by induction, while it is not possible for a current to pass in the same space with electrodes. The experiments described, then, lead (in our opinion) to the remarkable result that *vacuous space is a good conductor of electricity.*

"This removes at once the difficulty of explaining how one heavenly body can have an electric action on another, as is the case, e.g., between the sun and the earth. The heavenly bodies are thus in a sphere of reciprocal action, not only by virtue of gravitation, and light, and heat radiation, but also of electric force. The contradiction which was supposed to be found between the electric nature of the polar light and the sometimes very great height of this phenomenon above the earth's surface, thus loses all force. Finally, the belief must be given up that the presence of ordinary matter is necessary for an electric current to pass from place to place. If it be conceded that it is possible for an electric movement to be propagated with the greatest ease in empty space, the designation of conductivity is deprived of physical meaning. The different material substances merely present a greater or less resistance to the propagation of electricity. Their action in this respect is not active, but passive."

THE SKIN, AND ITS MANAGEMENT IN HEALTH.*

IN commencing his lecture, Dr. Jamieson described the anatomical structure of the skin, and the functions or office which it performs in the body. Its structure, he said, they might consider in three respects—(1) the skin proper; (2) the glands which were imbedded in it, and which supplied oil and perspiration; and (3) the appendages which it bore, as the hair and nails. The skin proper consisted of the cuticle or scarf skin and the true skin. Of the cuticle, the outer part was made up of an infinite number of fine scales or plates, which were firmly united together and laid on the top of one another, except at the very outside, where they became gradually loosened and were constantly being thrown off. Underneath this, which was called the horny layer of the cuticle, lay the mucous layer, which was more thin and soft, and consisted of cells that were united together by means of a transparent cement substance, and that secreted the plates of the outer or horny layer. The colour of the skin was due to pigment or colouring matter in the deepest cells of this mucous layer. Passing still deeper to the true skin, they found that it was not smooth but was raised, on its surface, into little elevations or papillae, and that it was made up of a mesh-work of fine fibres, united together very much like a piece of felt, and in this way they had a structure

which was tough and elastic—delicate and close at its external surface, and looser and more open deeper down, where the sweat-glands and roots of the hairs were embedded in it. Besides giving the glands room, this more open structure permitted the skin as a whole to move, and it was the part in which, in dropsy, water accumulated. In the deeper layers, also, of this true skin there was fat, partly to give roundness and plumpness to the figure, partly to pad and protect, and partly also, by its great conductivity, to maintain the normal heat of the body. In this true skin, besides, were the blood vessels, with which it was largely supplied, and which formed three networks. Two of these lay horizontally—one near the surface, which sent loop-like projections into the papillae already mentioned, and another pretty deep down in the skin; while a third network lay round about the glands in the substance of the tissue. The mucous and horny layers did not contain any blood-vessels, but fine nerves passed into the mucous layer. Then, also, the skin contained elastic fibres, which gave it elasticity, and muscular fibres, which were of the two kinds, striped and non-striped, and were in part under the control of the will, and in part acted without voluntary control. These last were of the greatest importance in the discharge of the functions of the skin, contracting or relaxing in response to alterations of temperature or to mental states, as fear or shame—in the one case blanching the countenance, and in the other causing the tell-tale blush by increasing or diminishing the blood supply of the part. By the action of the skin muscular fibres also the sweat was squeezed out of its glands, the hair made to stand erect, and the body maintained at its proper temperature. In this action, the muscles did not exclude, but were aided by, the walls of the blood vessels, which were themselves both elastic and contractile, and were partly under the influence of the will, but were far more automatically induced to contraction or expansion so as to regulate the blood supply of the skin as the conditions of the body should require. The glands of the skin he described as being sweat, oil, and hair glands as follicles; and said they might get some idea of the importance of the sweat-glands, and of the function which they discharge in the body, by considering that the pores or openings of the glands on the surface of the body had been estimated at 2,300,000. The normal secretion of sweat in the adult was 2lb. or 2 pints a day, and this was largely increased by exercise in warm weather or by remaining in hot rooms. They would thus realise how important it was that perspiration, when being freely poured out, should not be suddenly checked, as the lungs and kidneys, in that case, were called upon to do an extra amount of work, and they and the other internal organs were apt to become all at once too full of blood, and inflamed. Thus, if the perspiration were suddenly checked, as by sitting in a draught of air, some internal organ became congested, and they "caught a cold," as it was called. Hence arose jaundice, acute indigestion, and diarrhoea, as well as inflammation of the lungs and kidneys. These might sometimes be warded off by taking a hot bath, supplemented, it might be, by a tumbler of toddy, before going to bed. This was really so, because the effect of alcohol was to cause dilatation of the blood-vessels, and so restore the skin function; but if taken before going out to the cold again, the reaction would be such that the cold, which they wished to prevent, would be much more likely to occur than before. Speaking of the material excreted by the oil or sebaceous glands, he pointed out that poisonous and infectious particles of all kinds strongly adhered to this excreted oily matter, and that washing first with turpentine, which dissolved the oily matter of the skin, and afterwards with soap, was required to remove the particles and prevent the spread of infection. Proceeding next to a description of the structure of the hair follicles and nails, he adopted the view that these, instead of being appendages, as some considered them to be, were as much skin excretions as were the scales of the horny layer of the cuticle or scarf-skin. The condition of the hair was, he added, often a good indication of the state of the health of its owner. Dealing, finally, with the management of the skin in health, Dr. Jamieson laid it down that cleanliness and a suitable covering from cold were the two great means by which to preserve the skin in active and healthy function.

COLOURED TRANSPARENCIES FROM SILVER IMAGES.*

IT has long been known that a pleasing chocolate-brown tone can be given to transparencies by pouring over the film, after it has been fixed and washed, a solution containing a salt of uranium

* Abstract of one of the Edinburgh Health Lectures, delivered in the Free Assembly Hall by Dr. W. ALLAN JAMIESON.

* By C. R. Woods. Paper read before the Photographic Society.

and the ferricyanide of one of the alkalis. The formula usually used is—

Uranic nitrate or sulphate.....	4 grains,
Ferricyanide of potassium.....	4 grains,
Water.....	1 oz.,

to which a few drops of a solution of chloride of gold is sometimes added. It may not be so generally known, however, that a solution of ferricyanide of potassium and a ferric salt is reduced in a like manner; the deposit, as might be anticipated, being of a bright blue colour. A little uncertainty attending some of the results at first obtained, it may, perhaps, not be out of place here to describe two of the experiments carried out in the investigation of the reaction. If a solution of ferric chloride be poured over a silver image in collodion, and the solution be poured off into a test-tube and a few drops of ferricyanide of potassium solution be added, a precipitate of Turnbull's blue is formed, showing the reduction of the ferric salt to the ferrous state; the character of the image is altered by the formation of chloride of silver, producing a picture of an agreeable soft-grey tint, which may keep for a time but would not be permanent. This image is of course removed by ammonia or hyposulphite of soda. If a silver image be treated with a solution of potassic ferricyanide, and the solution be poured off and tested with ferric chloride, a precipitate of Prussian blue is formed—this reduction, however, taking place much more slowly than that of ferric chloride. Although ferric salts form a definite compound with ferricyanide acid, the foregoing experiments may nevertheless be considered to indicate that in the formation of a blue image in the manner referred to, whilst both Prussian blue and Turnbull's blue are formed, it is the latter which makes up the larger proportion of the resultant image. If the toning solution used contains ferricyanide of potassium in considerable excess, soluble Prussian blue (in which, as you are aware, the potassium is only partially replaced) is liable to be formed, and this, in addition to colouring the whites of the picture, is likely to lead to the disintegration of the film during the subsequent washing. On the other hand, if the ferric chloride be in excess, the precipitate is formed too much on the surface owing to the rapid formation of chloride of silver, and in this case easily carried off by a flow of water. The ferric nitrate would be the best salt to use; but as this is seldom to be found in a photographer's laboratory, the following formula will be found most useful:—

Make two solutions, the first containing—

Ferric chloride.....	4 grains,
Water.....	1 oz.;
the second containing—	
Ferricyanide of potassium.....	9 grains,
Water.....	1 oz.;

mix equal quantities of the two solutions immediately before using, or, if they are kept mixed, the bottle must be placed in the dark room. Although the quantities seem rather disproportionate here, the ferricyanide of potassium is only slightly in excess. Excess of the ferric salt is advisable, if the nitrate be used. From a blue picture thus prepared transparencies in yellow, yellowish-brown, and green may be obtained. To obtain a yellow picture, flood the blue image with a dilute solution of sodic or potassic hydrate; the blue compound is thus decomposed, and ferrous-ferric hydrate left in its place, giving it a yellow appearance; this turns a little darker on drying, the picture still appearing yellow when held up to the light, but when projected on to the screen appears, when all the silver has not been replaced, of a rather pleasing rusty-brown tint. To obtain a green picture, treat the silver image with the blue toning solution till the greater part of the silver is replaced by the ferrous ferricyanide, leaving, however, a thin substratum of silver. When it has reached the proper stage, may be judged from the appearance of the back of the film. Convert this blue picture into a yellow-brown one by the use of sodic hydrate, wash, and again pour over the plate the ferric-ferricyanide solution. The picture thus obtained is dark green. In preparing these uranium or iron pictures, if the solution be dilute and kept on the film for but a short time, the picture may be only lightly toned, or with the solution of full strength the silver may be entirely replaced and the transparency be rendered completely brown or blue. By combining the two salts various intermediary tones may be produced, from an olive-brown to a dark green bordering on black. It must be recollected, when combining the two solutions, that the iron compound is reduced more readily than the uranium one. The blue transparencies are particularly suitable for astronomical diagrams, sea-views, &c. Amongst other subjects to which the brown tones are particularly applicable may be mentioned pictures of insects. Some copies taken from insects mounted in Canada balsam for the lantern look surprisingly like the originals when projected on to the screen, and photo-micrographs similarly treated would have very much the same appearance as the objects themselves viewed under

the microscope by transmitted light. With the exception of the brown and green pictures requiring the use of sodic hydrate, these processes are equally applicable to wet plates, collodion emulsions, and gelatines. With wet plates a very weak developer should be used. In all cases the one thing needful is the careful removal of all traces of hypo; otherwise the whites are not left pure. With collodion plates, traces of hypo may be completely eliminated by dilute hydrochloric acid, though thorough washing is preferable. After the picture is sufficiently toned, dilute acid may be poured over it to thoroughly fix it before it receives the final rinsing with water. With gelatine plates the use of acid is out of the question, but the colour is held sufficiently firmly in the film. In conclusion, these pictures may be regarded as permanent, neither exposure to bright sunlight for five hours, nor heating in an oven for twelve hours, having produced any alteration in the colour.

NOTES ON THE PROPERTIES OF DYNAMO-ELECTRIC MACHINES.*

By Prof. ELIHU THOMSON.

THE subject of the properties of dynamo-electric machines attracts, at present, considerable interest. Perhaps, therefore, the following observations may be of interest as exhibiting some unusual phases of their behaviour. The machines with which the experiments were made were of my design, and consist of an armature of spherical outline revolved between two magnet poles, constituting two nearly hemispherical concavities enveloping the armature. The field coils are two in number and surround the field cores and also the armature itself. The armature has three coils only wound upon it, and the commutator, three insulated segments of a ring, the slots between the segments allowing them to overlap, so that each segment covers over 160° of the outside circle of the commutator. A full description of this machine and its performance is in preparation. The machines experimented with could sustain from four to ten arc lights in series, at about 800 revolutions per minute.

The first experiments to be described illustrate the tendency of the magnets, which were of cast iron, to prolong the generated current even after stoppage of the machine.

Motion of about 150 revolutions per minute was given to the machine while on closed circuit, until it had charged its magnets and had shown, in consequence of a development of current, a considerable resistance to rotation. It was then suddenly stopped and immediately thereafter its circuit opened, when there appeared a small but distinct spark at the break. Other evidences of the circulation of current were obtained immediately after the complete stoppage of rotation. A smart shock could be felt by grasping the wires on each side of the break in the circuit at the time it was made.

The origin of this after-current or current after stoppage of the machine is, of course, the gradual loss of magnetism of the field-magnet cores, which induce a current in the encircling wire during the time that such magnetic change is taking place. The duration of the current is about ½ second, but increases with the size of machine used. The current, of course, endures only until the machine magnets have lost all except what is termed their residual or permanent magnetism.

A more curious effect, however, is produced by putting the same machine, with its bearings perfectly free and well oiled, upon closed circuit and then revolving it as before at a moderate speed. The motive power is now suddenly removed, as by quickly throwing off the driving belt. The armature of the machine in this case rapidly comes to rest and then, singularly, takes about ½ of a turn in the opposite direction.

I have repeatedly verified this result, but do not know whether it would be obtained with other dynamo-electric machines. The armature must be very light and free. Here, again, the residuary current not only stops the machine but reacts upon it so as to work it for a moment as a motor in the contrary direction—just as if a current had been applied from a source outside the machine. What, then, is the source of this current which is able to reverse the movement of the armature? It is, as before, a current generated by and continued during the loss of magnetism of the field-magnets of the machine, and this current is, of course, in the same direction as when the machine was revolved by the applied power.

Another observation made with these machines was as follows:

A single machine driven by power was connected to two others in multiple arc, so as to drive them as motors; but these latter, although relatively nearly alike in proportion, were of different sizes—the electromotive force of one being double that of

the other when driven at equal speeds. The smaller could maintain four, and the larger eight arcs in series, the character of the arcs being alike. When joined up to the first machine or generator in parallel circuit as above indicated, both the other machines acted as motors and revolved. The speeds which they acquired, while not performing work, were, however, very unequal, and were found to be approximately in the inverse ratio of their electromotive forces as generators when driven at an equal speed. This observation was repeated with other sizes, with results very nearly agreeing with the above statement. It would seem from the above that both machines, working as motors without retardation other than air resistance and friction, attain such speeds that the counter-electromotive forces developed by them are nearly equal and the current traversing each of them also nearly equal. The different electrical resistances of the two machines is no doubt a modifying influence; but it seems to have little effect and, in fact, counts for little in comparison with the counter-electromotive forces developed under the conditions.

The effect of running the two machines in series as motors is very different. When so used, and with their shafts very free to turn, the larger, or one capable of producing the highest counter-electromotive force to that of the generator, alone revolves, while the smaller remains at rest. If, however, the former or larger machine be made to perform mechanical work—that is, to furnish power—its running speed is, of course, retarded and the other machine turns with a speed depending on the amount of work abstracted from its companion.

SCIENTIFIC NEWS.

THE Dun Echt Circular, No. 44, gives elements of Swift's comet (*p* 1881), calculated by Dr. H. Oppenheim:— $T = 1881$, Nov. 19-7402 Berlin M. T.; $\alpha = \Omega 117^\circ 52' 13''$, $\delta = \Omega 181^\circ 19' 51''$; $i = 144^\circ 49' 17''$ (mean equinox. 1882); $\log q$, 0.28468. The ephemeris for Jan. 2nd, Berlin midnight, is R.A., 23h. 36m. 8s., N. Dec, $22^\circ 46' 3''$. Circular No. 43 also gives elements compiled by J. Palisa, which agree closely. It also contains a note from Prof. Pickering, in which he says:—"On the evening of Nov. 24th, I noticed that the spectrum of D.M. + 30° 3987 has a bright band in the blue, so that the star seems to belong to the small class of objects like Rayet's stars in the same neighbourhood. The next evening I found a very small planetary nebula (place for 1880, 20h. 6m. 26.38s. + $37^\circ 3' 25.2''$ south $3^\circ 10'$ of B.-W. XX, 200—1 and following it 8.38s. Except by its spectrum the nebula is undistinguishable from a star of the fourteenth magnitude. Two other faint stars follow it 2.6s. and 2.3s. respectively, north $37'$ and south $20'$ of the nebula."

We have received the *Annuaire de l'Observatoire Royal de Bruxelles*, for 1882, the 49th year of publication. Besides the usual tables and astronomical notes, it contains some interesting papers on subjects of interest to astronomers, notably an "Etude sur les Taches Solaires," by René Tamine, and "Les Signes symboliques des Planètes." A useful feature of this year's annual is a table of the "positions géographiques des chefs-lieux de cantons de la Belgique."

From the British and Foreign Blind Association we have received a report and a specimen page of the magazine *Progress*, which is printed on both sides of the paper with Braille characters from stereotype plates prepared by the blind themselves. The Braille system is much superior to the old one of embossed letters, and quite a library of books and music are now on sale. We described the system at length in No. 341, with the alphabet. Further particulars can be had from Dr. Armitage, the hon. sec., 33, Cambridge-square, Hyde Park.

A paper describing Mr. Henry Sutton's new storage battery, which we mentioned last week, has been read before the Royal Society. The paper has not yet been published, but it is stated that Mr. Sutton has obtained the best results with a negative electrode of copper and a positive of lead amalgamated with mercury, using a solution of sulphate of copper as the excitant. Mr. Sutton has experimented with many elements, but for several reasons the combination mentioned is the best. When the cell is in action, and decomposition of the sulphate of copper is going on, the solution gradually loses its blue colour, becomes more acid, and finally,

* From the *Journal* of the Franklin Institute.

tain markings on Jupiter. In recently comparing my observations and drawings of 1880 and 1881 (to Nov.) with the valuable series obtained by Mr. Gledhill in the years 1869-72 (published at the time in the *Astronomical Register*), and with an equally important digest of similar results by the Rev. T. W. Webb in the winters of 1869-70, and 1870-71 (detailed in the *Popular Science Review*, April 1870 and July 1871), I was much struck with the great similarity in appearance and disposition of the markings then observed with those now visible. Either the chief features must be more permanent than is generally supposed, or they must reappear periodically in nearly identical aspect and position. Some of the markings certainly indicate the period of eleven years, and there seems little reason to doubt that the great southern ellipse discovered by Gledhill on November 14, 1869, at 11h., and afterwards (January 5, 1870) seen by A. M. Mayer, was really the present red spot in its first stages of development.

As to the narrow ruddy streak branching from the great southern belt, which I first noticed on Sept. 9, 1881, that was seen by Mr. Gledhill between Jan. 23, 1870, and Feb. 2, 1872. Its position N. of the f. end of the red spot has remained stationary since September last. Mr. Gledhill delineates the sloping arm of this belt immediately N. of the f. end of the ellipse on Jan. 23, 1870, and Oct. 10, 1870; but this, though agreeing precisely with its present place, was not its invariable position, for in discussing his observations of Nov.-Dec., 1869 (*Register*, Vol. VIII., p. 82), he says: "Just under the central point of the ellipse it was seen touching the great southern belt."

I have embodied these and other details in a paper which I had intended shortly to lay before the R. A. S., but have been awaiting further confirmation to this theory of periodic variation before completing it. I am carefully watching the region of Jupiter west of the red spot for the reappearance of a conspicuous sloping streak seen by Mr. Birmingham, Mr. Gledhill, and others in January and February, 1872, and represented in the *Register* for February, 1872. Mr. Birmingham says of this: "Jan. 11-13, 1872. One of the most striking forms is the belt-like streak that descends from the south, crossing the truncated end of 5 (Gledhill's numbers are here employed) at a sharp angle and reaching down to No. 4."

This streak, should it reappear, as it may almost certainly be expected to do, either during this or the next opposition of Jupiter, must be looked for sloping to the N.E. from the p. dark spot of the broken belt on the immediate S. of the red spot to the great S. belt a little in advance of the p. end of the red spot. I trust your readers will endeavour to note the earliest reappearance of this curious slanting streak, for it is likely these recurring markings on Jupiter will open up some important considerations.

I may add that this idea of periodical variations has been previously mooted by several observers, but the subject has not been sufficiently ventilated, owing to the want of continuous and reliable observations. Mr. Webb, whose opinion in such matters cannot fail to command respect, in summarising his results of 1869-71, mentions that (*Popular Science Review*, July, 1871, p. 283) "A comparison of the sketches taken by myself during the years 1869-71, with the exquisite views of Dawes in 1857 (*Monthly Notices of the R.A.S.*, Vol. XVIII.) presents so much similarity in various respects as to lead to a curious suspicion that the whole atmospheric shell of the planet, without any material disturbance in its relative arrangements, may have been shifted southward by more than half the breadth of the equatorial zone." The forms distinguished by Dawes were, in fact, still apparent, but occupying more southerly positions. And many of the features which in 1869-72 were observed by Webb and Gledhill are distinctly apparent at the present time; indeed, the key diagrams of the latter observer, with their numbers attached to facilitate reference (*Register*, Vol. VIII., p. 81, and Vol. X., p. 63), are equally applicable to the planet in 1880-81 as in 1869-72.

W. F. Denning.

Ashley Down, Bristol, December 23.

P.S.—Mr. E. B. Kuobel, F.R.A.S., sent me two drawings of Jupiter in 1872, as observed by him with a 8in. reflector, power 212, on Jan. 5 and 6 of that year. These show the remarkable slant-streak then visible. The sketches were published in the *English Mechanic* (No. 390) for September 13, 1872, p. 664.

W. F. D.

ENCKE'S DIVISION IN THE OUTER RING OF SATURN.

[18553].—In reference to the letter of your correspondent, "Brickwall" (45561), it may be of interest to mention that on Sept. 15th I, observing with an excellent 4in. achromatic by Merz, power 250, glimpsed Encke's division in the outer ring of Saturn. It appeared slightly nearer the outer edge, as a lead-coloured line not so black as Ball's

division. The definition was very fine. I have not seen this line since, but on several occasions have noticed a line of light running around the ansæ nearly in the centre of ring A. I should like to know whether any of your correspondents have noticed it with better instrumental means than I possess.

J. M. Offord.

STAR MAGNITUDES BY SEQUENCES IN URSA MINOR AND DRACO.

[19554].—We beg to forward to you the magnitudes of some circumpolar stars obtained by independent sequences. Opera-glasses were used for all estimations, the stars being placed slightly out of focus—

Name.	Espin.	Read.	Difference.	Concluded Magnitude.
(1) α Ursæ Minoris	2.4	2.4	0.0	2.40
(2) γ "	3.5	3.0	+ 0.5	3.25
(3) δ "	4.6	4.3	+ 0.3	4.45
(4) ρ "	4.7	4.35	- 0.35	4.52
(5) ε "	4.45	4.4	- 0.05	4.42
(6) ζ "	4.5	4.4	+ 0.1	4.45
(7) θ "	5.0	4.9	+ 0.1	4.95
(8) η "	5.3	5.1	+ 0.2	5.20
(9) φ "	5.2	5.1	+ 0.1	5.15
(10) ι "	5.2	5.1	+ 0.1	5.15
(11) λ "	5.7	5.5	+ 0.2	5.60
(12) γ Draconis	2.5	2.5	0.0	2.50
(13) β "	3.2	3.0	+ 0.2	3.10
(14) α "	4.8	4.6	+ 0.3	4.65
(15) δ "	5.0	4.8	+ 0.2	4.90
(16) ω "	4.5	4.6	- 0.1	4.55
(17) τ "	4.6	4.7	- 0.1	4.65
(18) ν "	4.9	4.9	0.0	4.90
(19) κ "	3.8	4.0	- 0.2	3.90
(20) θ "	4.0	4.0	0.0	4.00
(21) λ "	4.3	4.2	+ 0.1	4.25
(22) 59 "	5.5	5.3	+ 0.2	5.40
(23) 56 "	6.8	6.9	- 0.1	6.85
(24) 50 "	5.6	5.2	+ 0.4	5.40
(25) ν "	3.9	3.8	+ 0.1	3.85
(26) μ "	4.8	4.7	+ 0.1	4.75

We thus find that considerable accuracy may be obtained by simple sequencing with an opera-glass. The above magnitudes were determined on different nights by each of us, and in different sequences—these stars being the ones which chance to occur in both sequences. Our comparison stars were taken independently also. The stars were compared with each other by rapidly moving the opera-glass from one star to the other, and this was repeated a great number of times. It will be seen that the predominating sign is a +. Tabulating the differences we obtain the following results:—Out of a total number of 26 stars we find

Difference.	Number of Stars.
0.0	5
0.1	10
0.2	6
0.3	3
0.4	1
0.5	1

So that out of 26 stars the difference between the observed magnitudes of 21 is less than a quarter of a magnitude.

T. E. Espin.
T. Read.

DARK SPOTS ON JUPITER.

[19555].—On Dec. 13, I detected a large dark spot on Jupiter, situate on the south equatorial dark belt. It was very dark, at times appearing almost black, of a slightly oval form, and projected slightly into the equatorial belt. This spot, which is the darkest and most prominent one I have seen on this belt, was noted as being on the centre at 9h. 16m. on Dec. 13. Following this spot was another much fainter one, which was on the centre at 9h. 46.5m. Clouds prevented further observation of this spot till Dec. 21st, when it was again observed on the centre at 13h. 34m.

The spot appeared rather fainter than it did when first seen, but it was still very conspicuous, and preceding it closely was a much fainter one. The position of this spot with regard to the white spot was now quite different from what it was on Dec. 13, the dark spot having evidently gained on the white spot, thus showing a more rapid motion. This spot was again observed on Dec. 22, when it appeared on the centre at 9h. 15m., the fainter spot preceding having been seen on the centre at 8h. 53m. It had evidently gained still further on the white spot. The following table shows the difference between the dark and white spots in time:—

	White spot.	Dark spot.	Difference.
	h. m.	h. m.	h. m.
Dec. 13	8 12+	9 16	1 4
" 21	12 54	13 54	0 40
" 22	8 40.5	9 15	0 34.5

The observation of the white spot of Dec. 22 is probably a little late, so that the dark spot seems to gain about 3m. a day on the white spot, and over 16m. on the red spot. The appearance of the

south equatorial dark belt has always seemed to me to indicate a more rapid motion than the equatorial belt, for dusky streamers projecting into the equatorial belt invariably trail back in a following direction. The dark spots were also observed on Dec. 23 and 24, and seemed evidently gaining on the white spot; but the transits over the central meridian could not be observed.

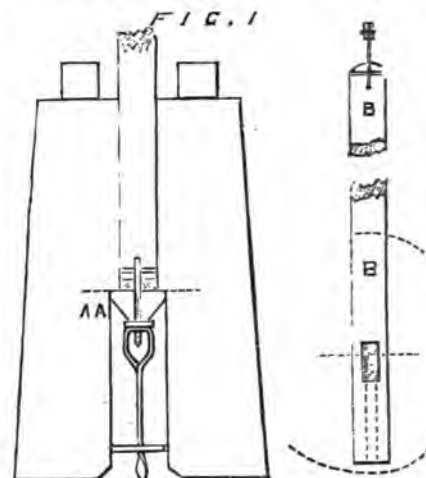
A. Stanley Williams.

Brighton, Dec. 24.

ERRATUM.—In Fig. 1, let. 19536, p. 376, the letter b is omitted. It refers to the light streak south of 1 G⁸²⁵.

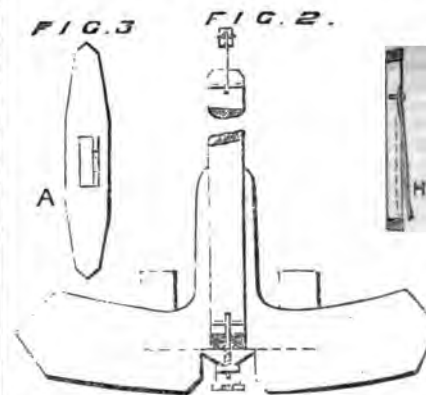
WARMAN'S IMPROVED CLOCK-PENDULUM BOBS.

[19556].—THESE improvements are designed to remedy two very serious defects which at present may exist in all ordinary pendulums having plain metal bobs and wooden or else compensating rods. Fig. 1 is the frustum of an acute cone: its bearing on the regulating nut is so arranged that any expansion or contraction of the bob always goes on



equally at both above and below the centre of gravity of latter; and as the position of such centre determines the real length of the pendulum, it follows that such length will inevitably remain always unchanged, in so far as concerns the position of the bob on the rod. The thick (metallic) cushion (AA) is for the purpose of compensating the variations of the spring which carries the rod. This type of pendulum also demands less space and material than does the ordinary kind, and has several other minor good points.

Fig. 2 is a still further improved bob. It is a circular disc of metal, slightly dish in correspondence with its arc of motion, and provided with a



neck, to prevent variation by dipping. This form not only retains the advantage of being unvaried by any axial motion of itself, but it offers the very smallest amount of resistance and friction to the retarding and varied-in-density atmosphere through which it passes. It also occupies less vertical space than any other type. The compensation of the suspending spring being here done by the disc-neck, the cushion is not required to be so thick.

Fig. 3 represents the application of the foregoing principles to the ordinary vertically flat bob which is constantly rendered necessary by want of space. B shows the slot through the rod; C shows the smaller slot through the bob; D, E, and F represent a side-view of the whole; G exhibits a side-view from the front. The saddle D passes through

tain markings on Jupiter. In recently comparing my observations and drawings of 1890 and 1881 (No. Nov.) with the valuable series obtained by Mr. Gledhill in the years 1869-72 (published at the time in the *Astronomical Register*), and with an equally important digest of similar results by the Rev. T. W. Webb in the winters of 1869-70, and 1870-71 (detailed in the *Popular Science Review*, April 1870 and July 1871), I was much struck with the great similarity in appearance and disposition of the markings then observed with those now visible. Either the chief features must be more permanent than is generally supposed, or they must reappear periodically in nearly identical aspect and position. Some of the markings certainly indicate the period of eleven years, and there seems little reason to doubt that the great southern ellipse discovered by Gledhill on November 14, 1869, at 11h., and afterwards (January 5, 1870) seen by A. M. Mayer, was really the present red spot in its first stages of development.

As to the narrow reddish streak branching from the great southern belt, which I first noticed on Sept. 3, 1881, that was seen by Mr. Gledhill between Jan. 23, 1870, and Feb. 2, 1872. Its position N. of the δ end of the red spot has remained stationary since September last. Mr. Gledhill delineates the sloping arm of this belt immediately N. of the δ end of the ellipse on Jan. 23, 1870, and Oct. 10, 1870; but this, though agreeing precisely with its present place, was not its invariable position, for in discussing his observations of Nov.-Dec., 1869 (*Register*, Vol. VIII., p. 83), he says: "Just under the central point of the ellipse it was seen touching the great southern belt."

I have embodied these and other details in a paper which I had intended shortly to lay before the R. A. S., but have been awaiting further confirmation to this theory of periodic variation before completing it. I am carefully watching the region of Jupiter west of the red spot for the reappearance of a conspicuous sloping streak seen by Mr. Birmingham, Mr. Gledhill, and others in January and February, 1872, and represented in the *Register* for February, 1872. Mr. Birmingham says of this: "Jan. 11-13, 1872. One of the most striking forms is the belt-like streak that descends from the south, crossing the truncated end of δ (Gledhill's numbers are here employed) at a sharp angle and reaching down to No. 4."

This streak, should it reappear, as it may almost certainly be expected to do, either during this or the next opposition of Jupiter, must be looked for sloping to the N.E. from the ρ dark spot of the broken belt on the immediate S. of the red spot to the great S. belt a little in advance of the ρ end of the red spot. I trust your readers will endeavour to note the earliest reappearance of this curious slanting streak, for it is likely these recurring markings on Jupiter will open up some important considerations.

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W. F. Denning.
Ashley Down, Bristol, December 23.

P.S.—Mr. E. B. Knobel, F.R.A.S., sent me two drawings of Jupiter in 1872, as observed by him with a 3-in. reflector, power 212, on Jan. 5 and 6 of that year. These show the remarkable slanting streaks then visible. The sketches were published in the *English Mechanic* (No. 350) for September 12, 1872, p. 64.

KNOBEL'S DIVISION IN THE OUTER RING OF SATURN.

1855.—In reference to the letter of your correspondence, "Breakwall" (4550), it may be of interest to mention that on Sept. 15th I, observing with an excellent 4-in. astronomical by Meiss, power 25, glimpsed Knobel's division in the outer ring of Saturn. It appeared slightly nearer the outer edge, as a lead-coloured line not so black as Ball's

division. The definition was very fine. I have not seen this line since, but on several occasions have noticed a line of light running around the ansæ nearly in the centre of ring A. I should like to know whether any of your correspondents have noticed it with better instrumental means than I possess.

J. M. Offord.

STAR MAGNITUDES BY SEQUENCES IN URSA MINOR AND DRACO.

[19554.]—We beg to forward to you the magnitudes of some circumpolar stars obtained by independent sequences. Opera-glasses were used for all estimations, the stars being placed slightly out of focus—

Name.	Espin.	Read.	Difference.	Concluded Magnitude.
(1) α Ursa Minoris	2.4	2.4	0.0	2.40
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(4) ρ "	4.7	4.35	+ 0.35	4.52
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(6) δ "	4.5	4.4	+ 0.1	4.45
(7) λ "	5.0	4.9	+ 0.1	4.95
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(9) θ "	5.2	5.1	+ 0.1	5.15
(10) ι "	5.2	5.1	+ 0.1	5.15
(11) ν "	5.7	5.5	+ 0.2	5.60
(12) γ Draconis	2.5	2.5	0.0	2.50
(13) β "	3.2	3.0	+ 0.2	3.10
(14) ν "	4.8	4.5	+ 0.3	4.65
(15) δ "	5.0	4.8	+ 0.2	4.90
(16) ω "	4.5	4.6	- 0.1	4.55
(17) τ "	4.6	4.7	- 0.1	4.65
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(19) κ "	3.8	4.0	- 0.2	3.90
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(21) λ "	4.3	4.2	+ 0.1	4.25
(22) δ "	5.5	5.3	+ 0.2	5.40
(23) ϵ "	6.8	6.9	- 0.1	6.85
(24) ν "	5.6	5.2	+ 0.4	5.40
(25) ν "	3.9	3.8	+ 0.1	3.85
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We thus find that considerable accuracy may be obtained by simple sequencing with an opera-glass. The above magnitudes were determined on different nights by each of us, and in different sequences—these stars being the ones which chance to occur in both sequences. Our comparison stars were taken independently also. The stars were compared with each other by rapidly moving the opera-glass from one star to the other, and this was repeated a great number of times. It will be seen that the predominating sign is a +. Tabulating the differences we obtain the following results:—Out of a total number of 26 stars we find

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So that out of 26 stars the difference between the observed magnitudes of 21 is less than a quarter of a magnitude.

T. E. Espin.
T. Read.

DARK SPOTS ON JUPITER.

[19555.]—On Dec. 13, I detected a large dark spot on Jupiter, situate on the south equatorial dark belt. It was very dark, at times appearing almost black, of a slightly oval form, and projected slightly into the equatorial belt. This spot, which is the darkest and most prominent one I have seen on this belt, was noted as being on the centre at 9h. 16m. on Dec. 13. Following this spot was another much fainter one, which was on the centre at 9h. 46.5m. Clouds prevented further observation of this spot till Dec. 21st, when it was again observed on the centre at 13h. 34m.

The spot appeared rather fainter than it did when first seen, but it was still very conspicuous, and preceding it closely was a much fainter one. The position of this spot with regard to the white spot was now quite different from what it was on Dec. 13, the dark spot having evidently gained on the white spot, thus showing a more rapid motion. This spot was again observed on Dec. 22, when it appeared on the centre at 9h. 16m., the fainter spot preceding having been seen on the centre at 8h. 53m. It had evidently gained still further on the white spot. The following table shows the difference between the dark and white spots in time:—

	White spot.	Dark spot.	Difference.
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" 21	12 54	13 34	0 40
" 22	8 40.5	9 15	0 34.5

The observation of the white spot of Dec. 22 is probably a little late, so that the dark spot seems to gain about 3m. a day on the white spot, and over 16m. on the red spot. The appearance of the

south equatorial dark belt has always seemed to me to indicate a more rapid motion than the torial belt, for dusky streamers projecting into equatorial belt invariably trail back in a following direction. The dark spots were also observed Dec. 23 and 24, and seemed evidently gaining the white spot; but the transits over the meridian could not be observed.

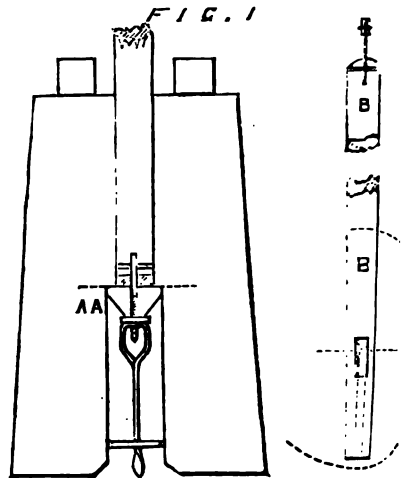
A. Stanley William

Brighton, Dec. 24.

ERRATUM.—In Fig. 1, let. 19536, p. 376, letter δ is omitted. It refers to the light δ south of 1 G²⁵.

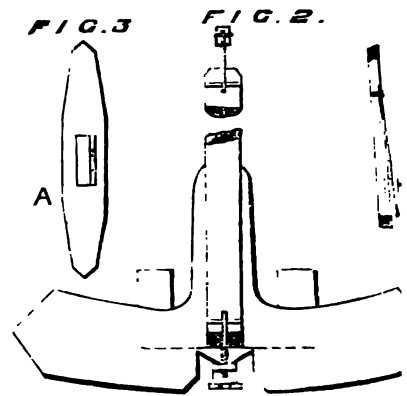
WARMAN'S IMPROVED CLOCK PENDULUM BOSS.

[19556.]—These improvements are designed to remedy two very serious defects which at present may exist in all ordinary pendulums having metal bobs and wooden or else compensating metal bobs. Fig. 1 is the frustum of an acute cone: its lining on the regulating nut is so arranged that expansion or contraction of the bob always goes



equally at both above and below the centre of gravity of latter; and as the position of the centre determines the real length of the pendulum, it follows that such length will inevitably remain always unchanged, in so far as concerns the position of the bob on the rod. The thick (marked) cushion (AA) is for the purpose of compensating the variations of the spring which carries the nut. This type of pendulum also demands less space and material than does the ordinary kind, and has several other minor good points.

Fig. 2 is a still further improved bob. It is a circular disc of metal, slightly dished in correspondence with its arc of motion, and provided with



neck, to prevent variation by dipping. This not only retains the advantage of being unaffected by any axial motion of itself, but it offers the smallest amount of resistance and friction to retarding and varied-in-density atmosphere through which it passes. It also occupies less space than any other type. The compensating the suspending spring being here done by disc-neck, the cushion is not required to be thick.

Fig. 3 represents the application of the foregoing principles to the ordinary vertically flat bob: it is constantly rendered necessary by want of space. B shows the slot through the rod; C the smaller slot through the bob; D, E, and F sent a side-view of the whole; G exhibits a side view from the front. The saddle D passes the

see if a brick or other obstacle can be ridden over by one wheel only with extra momentum. I do not see how either "Sunlight" or myself can state the case more plainly. With regard to "170," it is simply waste of space to merely describe the action of differential gear, which is certainly not new, to say the least. He, however, confesses that there is a loss of power, but states that loss of power to be small. Now, the fact is, no differential gear, in any case, does make a double driving tricycle, excepting when the resistance is perfectly equal, and this may be almost stated as never. If the Salvo is ridden as an Otto machine, instead of driving each wheel over any obstacle, the wheel which has the most work to do, and should, therefore, have perfect driving power, will not drive the least bit. It will not have any better effect against an obstacle or heavy road, or resistance of any sort, than the wheel which is not driving in Meteor or other single-driving machine. The above remarks apply equally to all differential gear, whether in the Salvo, Phoenix, Premier, or others, but not in such machines as the National, Cheylesmore, and Devon of the old style. Your readers can easily test this for themselves, and the better their technical knowledge, the easier they will see the difference and weakness of differential gear, whatever class of machinery it is in. As I said before, it has long been used in workshop mechanism.

56 Inch.

P.S.—Of course, momentum will carry the Salvo as well as the Meteor over a lump or obstacle, even with the wheel which is not driving. This is the cause of riders not perceiving it.

MEDICAL REPLIES.

[19563].—ON INDIGESTION (45460).—"Spasms" about the pit of the stomach and chest, accompanied by indigestion, are largely due to carelessness in feeding. If querist be *fat*, she should read what I have already said on that subject, and starve down to her weight and to her size round the waist when about 30 years of age. If she have defective teeth, no one else can chew her food for her. For this the remedy is, 1st, Take no food that needs chewing. Avoid flesh food, and live on breadstuffs and milk-foods with soft vegetables. If she be a good cook, she will in this way avoid putting things into her stomach that need to be chewed. A little very fat bacon toasted in a Dutch oven, or a slice of well-boiled fat pork, cold, is the only flesh food which she will be likely to digest. On diet of this kind, if she have sense in simple cooking, a poor widow can feed herself perfectly at small cost, and will make the best of her digestive organs. 2nd. If her mouth contain rotten stumps, these should be cleaned out, and two months afterwards when the gums have got hard and solid, a mould should be taken, and the mouth filled up with supplementary teeth. Supplementary teeth are as useful to people who have lost their teeth as supplementary limbs are to people who have undergone amputation. They need not cost very much, and by economising food and increasing the patient's working power their cost is well laid out. For relief in attack of spasms the best remedy is a half-pint of hot ginger tea, drunk like a draught of quite hot tea. If there be also heartburn, add as much carbonate of soda as will lie upon a sixpence—or a teaspoonful of heavy calcined magnesia. Should this not relieve, a teaspoonful of sal-volatile in a wineglassful of tepid water may be taken; but the simple ginger tea is the best. It acts by diluting crude irritating matters in the stomach, and by expelling the gas which is produced in the stomach by the fermenting of indigestible food. Tea and coffee are bad for such patients. Now and then such attacks are so severe, and the contents of the stomach are in such a condition, that the stomach should be emptied at once. A simple way of doing this is to add a dessert-spoonful of mustard to a half-pint or more of hot water, swallow it promptly, and in a few minutes, when feeling sick, to put the finger down to the back of the throat and gently tickle it. This will clear out the stomach forthwith, and a second pint of hot water, followed by a second tickling will rinse the stomach out, and leave the patient in comfort. In case of accidental poisoning also, this is a useful and ready way of emptying the stomach.

CHEST-PAIN (45519).—"Poor Sufferer" cannot be helped by my prescribing for him behind the back of his doctor. If his club-doctor does not attend to him properly, the remedy is to complain to the club-committee, and wake the doctor up. If he is not a skilful and careful man, get a better doctor elected, after proper discussion of grievances at a club meeting. The system of club doctors is a most valuable form of insurance for working men against doctors' bills in time of sickness. One reason why there is often dissatisfaction is that too small a payment is made to secure a good man and to make it worth his while to do the work thoroughly to the members when seriously ill. Whitworth tools cannot be bought at scamping prices.

HEART-DISEASE (45563).—Heart-disease is the result of many causes other than rheumatism.

The other questions refer to mere textbook matters, which would involve my writing a long treatise on heart-disease, and for which querist must refer to a medical textbook.

CONTRACTED FINGER (45609).—The remedy is either to have the finger wrenched straight, when the patient is under chloroform, and so stretch out or break down the adhesions which prevent the full extension of the finger, or to have the tendon divided by the subcutaneous operation—an operation similar to that by which club feet are brought straight. In mild or recent cases, gradual extension by some elastic band or spring acting upon a splint, to which the finger is fixed every night at bedtime, may usefully be persevered in, and will cure the contraction without an operation. Trying a contrivance of this kind, and wearing it always during the night, can do no harm in any case.

I have a heap of letters from young men who do not seem to know that the swallowing of drugs will not cure a man of bad habits, and who, consequently, have been robbed by advertising medical quacks. I cannot undertake personal correspondence with writers whom I have no means of knowing to be proper objects for gratuitous advice. Nor can space in the *ENGLISH MECHANIC* be afforded for mere personal advice, which is not of general interest to other sufferers. Such writers must refer to what I have previously written on this point. But I will find time to say to young men something which can suitably appear in the *ENGLISH MECHANIC*.

Jas. Edmunds, M.D.

Grafton-street, Bond-street.

ON THE TESTING OF CREASOTE OR DEAD OILS USED FOR "PICKLING" OR PRESERVING TIMBER.

[19564].—THE oils used for the purpose of pickling or preserving timber are obtained in the distillation of coal-tar. That portion of the distillate which has a specific gravity ranging from 1.000 to 1.060 is collected in separate receivers, and after a portion of it has been treated for carbolic acid, the remaining oil is considered as creasote or dead oil. But commercial creasote oil does not consist of this portion of the distillate alone; all the oils obtained in the distillation of coal-tar, after they have been exhausted of their commercial products, if not otherwise saleable, are mixed with the creasote oil. Creasote oil is used in immense quantities by the railway companies for pickling railway "sleepers." Some idea of the extent to which this oil is used may be gathered from the fact that the probable annual produce of creasote oil, in Great Britain, exceeds 30 millions of gallons, and the great bulk of this is used by the railway companies and a few large timber establishments. Contracts for the supply of the oils are let by the railway companies and secured by tar-distillers for periods of from six to twelve months, certain conditions as to the quality of the oils supplied being specified in the contract. The following conditions, drawn up, or laid down, by Dr. Lethby some 20 years ago, being the most general.

"It should have a density between 1.045 and 1.055. It should not deposit any crystalline matter at a temperature of 40° Fahr., it should yield not less than five per cent. of crude carbolic acid to a solution of KHO, caustic potash, of the density 1.070 (14 Twaddell), and it should furnish 90 per cent. of liquid oil when distilled to the temperature of 600° Fahr."

The condition to which I wish especially to draw attention is that relating to the yield of carbolic acid. Many analysts, who have had disputed samples of oils submitted to them, have stated in their reports that the oil contained so many per cents. of tar acids, of which so many per cents. consisted of crude carbolic acid. Now, since there is no known method of estimating or separating crude carbolic acid from other tar acids, when dealing with such small quantities as are obtained in the testing of creasote oils, it would be instructive, and, no doubt, interesting, if some one of these analysts would kindly state the method adopted in determining the quantity of carbolic acid present in the crude tar acids. Again, the question arises, What is meant by crude carbolic acid, since crude carbolic acid is not a definite compound, but contains varying percentages of water, carbolic, and cresylic acids, and other higher homologues? The condition, also, that it shall yield not less than 5 per cent. of crude carbolic acid "to a solution of caustic potash of 1.070" is very indefinite, for it is well known that varying volumes of alkali will extract varying quantities of tar acids; and not only is this so, but the yield of acids depends also on the length of time during which the solution is agitated. Discrepancies may also arise from the fact that the solutions of alkali and oil have densities (especially after agitation) so nearly alike that it is impossible to get a fair result, owing to the imperfect separation of the alkali from the oil. This may, however, be obviated by the addition of petroleum or coal-tar naphtha after agitation.

It is usual, I believe, with many analysts to state the quantity of crude tar acids present as that shown by the increase in volume of the potash solution; but this is not so, since the water always present in creasote oils will, of course, during agitation, be taken up by the caustic potash, and would increase the volume, thus reading as tar acids. Some really remarkable results have been thus obtained by analysts, it being a usual occurrence for them to report that the oils contain 5 per cent., 12 per cent., and 25 per cent. of crude carbolic acid. One eminent analyst some years ago reported a sample of oil as containing 75 per cent. of carbolic acid. The remarkable nature of these results may be understood when we note that the price of creasote oil in bulk is about 2d. per gallon, whilst the price of ordinary crude carbolic acid in bulk, as made in the tar-works, is from 2s. to 3s. per gallon; thus the presence of 10 per cent. of crude carbolic acid would increase the value of the oil at least 14d. per gallon, and with the present high price of tar it is not to be expected that the tar-distiller is so blind to his own interest as to leave a £5 note in every 1,000 gallons of oil he sends from the works, which, figuratively speaking, he would be doing if he left 10 per cent. carbolic acid in the creasote oil.

Again, in regard to the quantity of naphthalene deposited on cooling to 40° F., there is no stipulated time during which this exposure to cold shall continue. Hence another reason for discrepancies.

It has never yet, I believe, been practically demonstrated that the presence of carbolic acid is essential for pickling purposes. The preservative property of creasote oil is probably solely due to the fact that the wood saturated with oil is more impervious to water, and in consequence of the pores on the outer surface being filled with oil, is better able to resist atmospheric influences. In my humble opinion, it would be to the interests of the railway companies to institute a series of experiments on the creasoting or pickling of timber with oils of varying specific gravities. If the timber was first pickled with ordinary creasote oil, half the usual quantity, and afterwards with a heavier oil containing, in solution, coal-tar pitch, good results would, I believe, be obtained, though the wood would not absorb so large a percentage of oil. This would be compensated for by the greater length of time the oil would remain unvolatilised in the wood. The oils containing pitch on the surface evaporating on exposure would leave the pitch in the pores of the wood, and would thus, as it were, hermetically seal them, preventing the oil in the interior from reaching the surface and evaporating. Perhaps Mr. A. H. Allen, who so faithfully sticks to "ours," would kindly criticise this communication. Chemistiana.

WHAT IS THE BEST POSITION FOR A MIRROR IN THE SILVERING-BATH?

[19565].—In Mr. Calver's very interesting account of the 37in. mirror, page 351, Vol. XXX., we read that he silvered it *face upwards*. This same mirror, according to your report of the R.A. Society's meeting, page 348, present vol., has recently been resilvered *face downwards*, the owner having used special machinery and appliances for that purpose. He also thinks the film he now has deposited better than the last one (or rather the film that was deposited on it when first made). Doubtless the paper on "Silvering Large Mirrors" was very instructive; but unfortunately I (and I daresay many other amateurs) have not access to the papers of the R.A.S.; so I gladly avail myself of the opportunity afforded me in "ours" of drawing attention to the query that heads this letter.

I expect the almost unanimous reply will be, "Why, *face downwards* to be sure"; and I can always get a film with the mirror in this position. The sides of the glass silvering-vessel also take a good deposit, but the bottom is covered by a muddy sediment. Is this sediment a necessary attendant on a good silvering process?

Now, I should very much like to be able to silver a large surface of glass *face upwards* perfectly, and although a 37in. mirror is a large surface to deal with, yet at our large glasshouses surfaces of twice or thrice that size are constantly being done. I mean the plate-glass mirrors that adorn the homes of those who can afford to pay for them. Can any of our correspondents make interest enough to enable them to give directions how to do it?

I should likewise feel much obliged to anyone who heard the paper read (or even the gentleman who read it, if the request can be made without giving offence), if they will kindly tell me if any mention was made of those large surfaces silvered at our glasshouses *face upwards*? as I think it would be next to impossible to silver them in any other position (of course I am not referring to the old mercury process with tinfoil).

I have repeatedly experimented on pieces of plate-glass silvered at Hall and Co.'s, Bristol; theirs seems to be coated with shellac varnish first, and a coat of brown turpentine paint after.

have first removed the paint with spirits of turpentine, then a little alcohol soon gets off the shellac varnish. The film can then be polished with rouge. Their process will evidently bear very rough treatment.

If we could get a nice process for silvering face upwards, without any sediment, we need not run any risk by suspending our mirrors, or wasting our solutions. A. N. H.

A TRANSIT WITH A PRISMATIC OBJECT-GLASS

[19566.]—It appears from your report of the meeting of the R. A. S. that Mr. Stone has devised a prismatic object-glass for use in the transit telescope. I think such a lens would be very difficult to construct, chiefly on account of the thickness of glass required for a moderately large aperture. Mr. Brashear tells us that Professor Pickering has in use a telescope of similar form, only a mirror is used with an ordinary o.g., instead of a prism. Taking into account the loss of light caused by absorption in traversing glass of great thickness, the mirror-plan seems most likely to yield the best result. And in this case, would it not answer equally well to place the mirror outside the telescope, that is in front of the object-glass, at an angle of 45° with the telescope-axis, instead of dividing the instrument and placing the mirror in the converging cone of rays? A diagonal arrangement for the transit-telescope seems much more convenient than the ordinary form, but can it be as readily adjusted with accuracy?

In connection with this subject, I should like to ask "F.R.A.S." whether he thinks it likely that electricity and photography can ever be utilised in automatically recording the transits of stars?

Orderic Vital.

TELESCOPE STAND.

[19567.]—HAVING had this stand constructed, and found it firm, steady, and convenient in use, I enclose sketch to scale (3in. to the foot), and particulars sufficient for any one to make a similar stand.

DESCRIPTION OF TELESCOPE STAND.

The lower portion consists of a strong wooden frame of the dimensions given, and forming a tripod, of which the stouter leg carries the polar axis. The frame is mortised together, and additionally secured by coach-screws. The polar axis consists of a wrought-iron tube 2in. (full) in external diameter, turned throughout. This rotates in brasses, which are fixed in the top and bottom ends of the outer iron tube, 3in. external diameter, that is seen in the sketch. The upper end of this outer tube also has a turned flange fixed to it, while the polar axis itself has a similar (but somewhat smaller) flange, these two flanges being turned, and ground together. The lower end of the polar axis has a movable ring secured by a set screw, which, however, cannot be seen in the sketch, as it is hidden by the cap which screws over the lower end of the outer tube, and which serves to protect the lower brass bearing from dust and dirt.

Above the flange of the polar axis is the screwed "T" piece, which carries an outer tube like that of the polar axis, within which at the two ends are the brasses in which the declination axis turns. This, which is also a hollow tube, is 2in. (bare) outside, and is sufficiently long to carry the balance weight in the usual manner, being also cut with a long screw to allow of the weight being properly adjusted. The upper end of the outer tube and

the declination axis have flanges like those belonging to the polar axis. The lower end brass, however, of the declination axis has three adjusting-screws, as shown. The ring or collar, with its set-screw, may also be seen.

The tube is all steam-tube (not gas), and all threads of screws were cut in the lathe; in fact, as far as possible, everything in the way of trueing up and fitting and squaring was lathe-work.

As shown, the stand is merely parallaxless; but provision is made for the insertion of circles and worm-wheels between the flanges belonging to the polar and declination axes respectively. Moreover, the whole of the iron work being complete in itself, can be removed, and at any time fixed on a permanent iron pillar as a fixture. By removing the collars the two axes can be entirely withdrawn from the outer tubes for convenience in packing for removal. L. L. L.

TELESCOPE MATTERS.

[19568.]—In answer to "Orderic Vital" (19413) I would just say that the same general principles that govern the grinding and working of specula are applicable to the object-glass, and I hope what I have to impart will help any who desire to make an object-glass, to do so with a machine. I may, perhaps, after I have said all I have to say on specula, and have finished my experiments on them, take up the production of object-glasses by the same means, although I must say that the freedom from chromatic aberration of the reflector has now for many years decided me in its favour; but this is no reason why those who prefer the refractor, should not have all the help we can give them. "Orderic Vital" has gone much into the mathematics of the object-glass, but is he aware that the practical optician can make a good object-glass without all this mathematics, by his skill alone in altering the figure of the surface so as to correct the spherical aberration. I was in communication about sixteen years ago, with one of the greatest living authorities on the mathematics of the object-glass. And he wrote to me, telling me that a certain London optician, one of the greatest, if not the greatest, object-glass maker in town, had ground and polished an 8in. object-glass to curves of his own devising, which curves had they been spherical would not be correct; but "the final result was certainly an excellent object-glass—it ought to have been a bad one." The italics are my correspondent's. He says the great thing is to produce a true spherical surface with certainty. Now this I can do, and hope to tell others how to do it, so as to answer to testings. Now the optician alters his surface in a practical way, so as to do away with the spherical aberration, without thinking of a spherical surface; in fact, he knows how to alter his working so as to throw the outside or inside rays longer or shorter. Now all this knowledge takes a lengthened experience to get, and the small demand for object-glasses of any large size will always tend to keep this knowledge in the hands of a few, and so keep up the price of object-glasses. My correspondent said, that he did not despair getting an 8in. diameter, and 100in. focus for £20. Now this has not yet been done, nor will it be done by hand: it would of course be about £4 for each surface, allowing another £4 for glass and other things. Now this could be done by machinery, by any one who had sufficient orders to this size to get all the necessary appliances &c., and to devote himself to this special work; but where are the orders to come from? and as to amateurs making their own, I am afraid, after all, they would be but poor things. What we want is not amateurs making their own, but a certain and easy mode of producing the spherical surface publicly made known. Then opticians will compete in the use of this method, and produce an object-glass as cheap as the demand will allow them to get a fair profit from. This will always be cheaper than what an amateur can make an object-glass for of equal perfection to the professional opticians; thus all will get the benefit. An amateur like myself may find out the way, but the trade must supply the public if all are to be benefited. I would not mind working an object-glass, say 6in. diameter, to curves given by "Orderic Vital" for spherical surfaces, and let all the world know how I did it, and how long it took, &c., and then we should see if a cheaper object-glass could be produced, when perhaps some optician would take it up. I decidedly do not intend going into the trade for profit. I leave that field to others, who need it more than I do; but I would most willingly give my services for the good of all. I am just now occupied with the speculum, but "O. V." may let me know what he thinks about my suggestion, and perhaps "Prismatic" would give the way the trade works object-glasses.

I would join Mr. Calver in asking Mr. Brashear to describe in detail Steinheil's and Dr. Hasting's mode of working planes. I thank Mr. Calver for his information about the supporting of the 37in. speculum, and would ask his indulgence in asking him further. Did it simply rest in a circular rim or cell, and had it nothing on the top or edge of face

to prevent it falling out if turned beyond the perpendicular,—or, in other words, in what way was it supported round its edge and on its face?

I shall be glad of "J. C. L.'s" offered kindness.

H. A. Wassell.

Addenbrook Villa, Stourbridge.

THE BERLINER VIOLIN.

[19569.]—I see that the inventor has patented this in all the chief European cities and also in America, so that he evidently has faith in it. I should fear to adapt his invention to a violin of ordinary make—as the pressure of bridge on body of fiddle, added to the weight of the body, unsupported at the tail-piece end, must sooner or later break the belly or back away from the end block, which would have to bear the whole pressure of a leverage of about 8in. At any rate, the belly and back should be strongly pegged into the block, and the block pegged or screwed into the neck. Therefore, I say, beware of injuring a good fiddle for a doubtful improvement. C. P. T.

[19570.]—On p. 355 "Glowworm" relates how he renovated a dull Dutch fiddle on the principles of the Berliner patent; but I notice that he attributes the change more to the substitution of a pear-tree bridge, and rejection of the old maple bridge. This might be added to the patent, and also the glueing the bridge to the belly, whereby the E string is improved. But while congratulating our friend, I think these two improvements are dissimilar to the principles of the Berliner violin, that is, that one bridge should be as good as another, and that glueing the bridge is tantamount to increasing the pressure which it is sought to remove. The idea of lightness of contact is better realised in the trumpet marine, a stringed instrument invented



in the 16th century by an Italian artist Marino, which has one string over a corner of the bridge and another through its lower centre, which raises the off foot of the bridge about 100th part of an inch off the soundboard, so that in a state of vibration the said loose leg taps and rattles, causing a loud tone, but always harsh and discordant when the string is fingered, but when touched on the harmonic positions sounds (when bowed) like a trumpet or coach-horn; only harmonics are produced with anything like clearness, and we all know the brazen sound of the trumpet. Well, I conceive that the Berliner violin is to remedy the hoarseness and yet retain the power; but this cannot be done without pressure—viz., the bridge, string, and soundboard must be as compact as unity itself. I'll say no more, but is so. If the ancient Marino had bowed his string on the side instead of the top, and made his soundboard wider, he would have had a clear note, and plenty of power too; but still, it was a great discovery to those who were not blinded by prejudice, for it destroys the idea of the formation of ventral segments on a vibrating string, and also the idea that a string vibrates from end to end, instead of from side to side—in its middle.

Now, the only way in which these belying segments can exist is when an harmonic is found, and it is certain even then that they are not regular, because harmonics are formed only at certain unequal parts of the string—viz., $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}$, &c. The proper understanding of the vibration of all the parts of a violin, and the adaptation of the whole to the one universal form, is necessary before a good instrument can be made. I have a great wish. I want to simplify the violin so that the ENGLISH MECHANIC shall have the best and cheapest violin possible. Fiddler.

SOUTH AUSTRALIAN RAILWAY MATTERS.

[19571.]—WITH reference to the number of engines and carriages fitted with the Westinghouse automatic air-brake, Dec. 31, 1880, letter 1854, page 115, Vol. XXIII, I do not know where or how C. E. Stretton obtains his information; but, as one well posted in South Australian railway matters, I must object to the line in a letter, as above numbered, giving South Australian Government lines engines 23, carriages 18, as fitted with the Westinghouse automatic brake.

I know all the engines on these lines (about 80), and only about 10 engines are fitted with the Westinghouse direct pressure air-brake, that many of your readers will remember as in use on the Greenock section of C.E. many years ago.

There is no such thing as an automatic brake in this colony on Government lines. The air-brake in use is used only on one line—Adelaide, Port

and Semaphore line, a distance of 9½ miles, where the journey between Adelaide and Port Adelaide is performed in twenty minutes, being a distance of 7½ miles, with five stops. Drivers are strictly forbidden to rely on this brake at either terminus, but must come into the docks using hand-brakes only. There is only about 12 miles of private railway in the colony (Glenelg and Holdfast-bay Companies). Of these I can't speak; but I don't think they have the automatic in use, as I never heard it mentioned as on their stock.

I can well appreciate "C. E. S.'s" earnest endeavours to have the automatic air-brake adopted, having had, at different times, to work daily with Clarke and Webb's chain, Westinghouse air-pressure, and Westinghouse and Steel McInnes automatic air-brakes, and know well, by experience, the superiority of the Westinghouse automatic air-brake.

It is a sad thing indeed that private interest or pique should so long have kept the brake question unsettled, for the British public might have had the use of the best brake ever since the trials in 1875. I have only just received my "E. M." as I have been travelling about these last few months, and, therefore just seen the report. I would not have written this, but that I saw the same mistake in last report.

Adelaide, Oct. 20.

Triple Valve.

L. AND Y.R. ENGINES.

[19572].—In reply to Mark Tapson, and others, I inclose a rough sketch of the new bogie express-engines for the Lancashire and Yorkshire Railway. am sorry I cannot give dimensions, except those

7ft. inside bearings only; 2nd., 6ft. 4in., coupled outside bearings, Nos. 226, 256 Cl.; 3rd., 6ft. 6in., 4-coupled, inside bearings for coupled, outside for leading wheels. Nos. 51, 84, 542; cylinders, 17 by 26, 17 by 24, 17½ by 24, varying; 4th, 5ft. 6in. coupled leading and driving-wheel. Inside bearings, Nos. 567, 561, 562, 2874 Cl. The first class, 7ft., are represented by Nos. 236, 269, 233, 232, 268, 267, 240, 230, 235, 240, 231, 264, (289 was in the Abbot's Bipton collision, 21st of January, 1876); the second 7ft. class by Nos. 215, 92, 6, 4, 37, 39, 14, 41, 61, 21, 56, 63, 252: 269 is converted from 7ft. four-coupled engine; No. 92 is a 7ft. 6in. by right, but generally called a 7ft. The driving-wheels were originally under old No. 215 bogie engine. All the numbers I have given are not all, but the numbers are what the different classes are represented by; but in the No. 92 class I have given the complete list. Five of them are at Peterborough, the rest at Doncaster; 215 at Grantham. No. 55 was the first engine fitted with the vacuum brake. I am informed on good authority that the G.N.R. intend to build fifty 6ft. 6in. coupled engines. Two have already come out, Nos. 238, 227, 212. There is an old 227A, inside and outside bearings, raised firebox, brass steam dome, vertical regulator; stationed at Retford.

It was not generally known that when No. 1 bogie engine came out the cylinders were 18 by 26, then 18½ by 28, lastly, as now used, 18 by 28. Two new 8ft. bogies have come out—Nos. 665 stationed at Grantham, 666 stationed at King's Cross, working between London and Peterborough. On the occasion of the Prince of Wales' visit to Welbeck,

towns are engineers and ironfounders who could make the castings to pattern, the patterns made by the amateur. Malleable iron could also be made to pattern, and the fitting (boring, planing, &c.) could either be made by the amateur or by the engineer, according to instructions. An amateur who can make a two h.p. steam-engine, bore cylinders, fit slide-valves, turn the crank and shafting, bore and turn the flywheel, could easily make the above. Then the electrical difficulty. As to resistance and length of wire, the amateur must decide for himself according to his wants. Great length of thin wire means high resistance, but also a great number of turns, and, as might be expected, high E.M.F. (vide Brush machine), and *vice versa*. And there might be wound on several strands of thinner wire, which could be coupled up in series or in multiple arc, and give a variety of different conditions suitable to different purposes. It does not require great exertion to wind the wire on, with a galvanometer in circuit to detect mishaps. I should think it far more difficult to make a large inductorium. The table, page 188 in "Sigma's" book, is a great aid to the calculations, and I boldly assert that any reader who has digested the said book, will be able, by the assistance of the professional papers, and the necessary mechanical skill in either doing or getting others to do, to build a dynamo which ultimately may prove a success sufficiently great to afford promise of further victories.

I shall greet a new edition of "Sigma's" book with the utmost heartiness, and only wish that he would write a book on dynamos entirely. And I am sorry to hear that bad health is a principal reason for his long silence, which lovers of physical science regret very much. I hope it will not be considered immodest when I remind him of his promise, as soon as his health permits, of giving an epitome of Berthelot's thermo-chemical labours. It is so refreshing to turn from technicalities, useful to individuals, to the diffusion of scientific principles, interesting to the multitude of thinking readers.

Anglo-Dane.

PHOTOGRAPHIC.

[19576].—In "ours" of Dec. 9th, "Pyro" (19498) inquires concerning making a tripod stand for the camera, said stand to fold up like an umbrella to all appearances. Such a one has been sold for many years, at some of the shops. I will inquire about the construction of it and let "Pyro" have a sketch. I am at present having a stand made in the North of England, but it is for a small camera, taking plates 1in. square; it is made out of a thick oak walking-stick. The crook has attachments to hold camera, while the stick spreads out into three parts, like the legs of a theodolite, to heighten it. It has brass sliding motion, like a telescope.

To get over "another difficulty," no such will occur if each leg of the stand is made to slide so as each leg can be adjusted to different heights if necessary. I have fitted a ball and socket-joint to the top of a stand, but it was perfectly useless for several reasons.

Concerning "time of exposure," it can only be found by experience, as it varies with—1, lens used; 2, rapidity of plates; 3, time of day; 4, time of year; 5, and quantity of light on the subject. I have given as much as 1 hour and 20 minutes with a rapid plate to an interior.

Concerning the "Merveilleux," I have seen very nice little pictures taken with it, and I am sure that if "Pyro" gives proper exposure and uses good reliable dry-plates, and follows the instructions for development, he will obtain satisfaction with it.

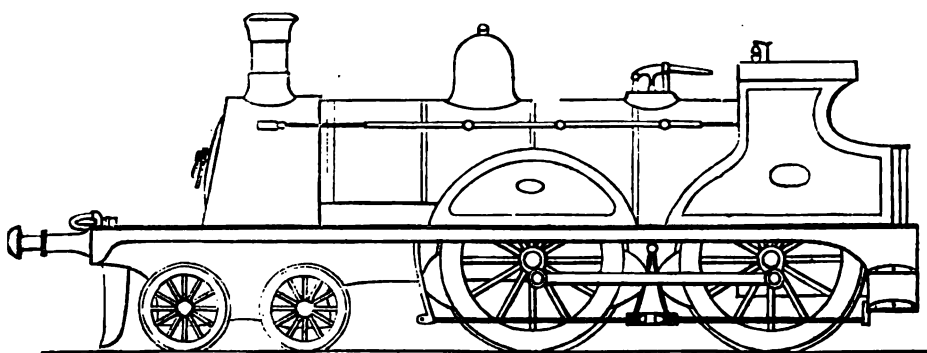
William Peek.

St. Clair, Hayward's Heath, Sussex.

REPRODUCTION A SINCERER FORM OF FLATTERY THAN IMITATION—1881—GOOD WISHES FOR 1882.

[19577].—ONE of the truest tests of the real value of information afforded by any journal or its contributors is, that other papers quote its articles, and republish them word for word. I am well aware that the Americans very frequently make use of information published in English periodicals without acknowledgment of the source. But when we find English works of authority and repute not only quoting and publishing extracts, but stating the source they are derived from as demonstrating the correctness and value of the statements, then I think any journal so quoted must be certainly a very useful one indeed.

Amongst the various annual publications and year-books I find numerous extracts from the editorial matter, as well as contributed articles. Not only so, but our valued contributor, Mr. Wenham, is quoted as an authority in one case, Mr. J. R. Warren in another, "Ploni Almoni" in another. In another place I find Mr. T. J. O'Connor mentioned, whilst, further on, my good friend—if he will allow me so to term him—Mr. W. J. Lancaster is quoted.



of the cylinder and wheels; the former are 17½ in. by 26 in., and the latter are 6ft. It has the Westinghouse brake-pipe extended to the front end, for use with a pilot engine.

E. W.

CAL., HIGHLAND, L. & N.W., G.N. ENGINES.

[19573].—I HAVE read, with much interest, the letters from "Carstairs" on the different classes of locomotives from time to time. In his letter on Cal. min. engines, No. 19429, he makes reference to drawings of L. & N.W. "Bloomers," McConnell's 7ft. 6in. single, and "Cornwall." Will he, or some other reader, kindly say in what numbers of the "E.M." they appeared? Will "Carstairs" also say what classes of engines there are on the Highland Railway? Perhaps "Carstairs," and others may be interested to know that another 8ft. single G.N. engine has come out. I heard so the other day, although I have not yet seen it. Perhaps some reader has seen it, and know where stationed. It is No. 666, and is the second out since No. 664, the Newcastle Centenary engine. I should be glad if some one could give me particulars respecting G.N. 6-coupled goods engines of the 310 class. I think they have either 18 in. or 19 in. cylinders.

Iron Horse.

G.N.R. GOODS ENGINES—PASSENGER ENGINES.

[19574].—SOME short time ago a correspondent mentioned in these pages that he should like to see the goods engines discussed. There are two classes—viz., 5ft. and 6ft. lin.; all 6-coupled. The 5ft. have outside bearings, cylinders 17 by 24. Nos. 453, 431, 363 Cl., the 5ft. lin. have inside bearings, 17 by 24; weight, 32 tons 11 cwt., Nos. 152, 377 Cl. The others are the same as the above, 5ft. lin., except cylinders, which are 19 by 26, inside bearings; weight 40 tons. Nos. 141, 339, 310, 312 Cl. This last class are the only engines with such large cylinders; they are, in all cases, single framed. The saddle tank goods have wheels 4ft. 6in. wheels, 6-coupled. Nos. 606, 153, Cl. On the whole, the G.N. goods engines compare favourably with other Co.'s engines, if not better. Now a word for their passenger classes excepting their 8-footers. There are five classes—1st., 7ft. outside and inside bearings, and

on the up-journey the train was worked by No. 662 8ft., from Retford to London. Grantham to Peterborough, twenty-nine miles, done in twenty-eight minutes, giving a speed of 61 per hour; Peterborough to King's Cross, done in 1h. 20m. The tank passenger engines are 5ft. 6 4-coupled leading and driving wheel, Metropolitan traffic (G.N.) Nos. 243a old class, with steam dome, 274, 279, these two are of the same class, rebuilt, no dome; 119 are a new class, no dome. These last have Adams' radial axle-boxes at the trailing end. No. 119 has inside bearings only for coupled wheels; the other 119 class have outside bearings; 243, 249, 260, 513, 628 are also new class engines, and have bogie at trailing end. No. 3, 225, 256 have cylinders 17 by 22. The 5ft. 6in. 4-coupled, although in the passenger class, are used indiscriminately for both passenger and goods. I hope other correspondents will give other companies' goods engines.

H. P.

DYNAMO-MACHINES.

[19575].—"SIGMA'S" letter (19523) contains very little encouragement, and I think, with all respect for so great an authority, he is going too far in his disparagement of the skill amateurs could bring into the field. I do not doubt that I am very, very far from perfection; but my machine is certainly no abortion, whether I look to the mental and physical labour it has required, or the expense I have incurred, and I rank myself very low in the army of amateurs who contribute to this journal.

One word as to the size of the machines. I do not think it would be worth anybody's while to make a hand-dynamo. If successfully made, it would require somebody to turn it—the experimenter or an assistant—which would either be very tedious or expensive; and in no case could regularity of speed be obtained. And if that is agreed on, the road is clear, and we can overlook the difficulties and specify them. There is the mechanical and the electrical difficulty. First, the mechanic. Readers of this journal are aware of the existence of the many who, armed with both skill and the necessary tools, have built steam-engines, organs, pianos, and a variety of other things which are quite as difficult to make as the mechanical parts of a dynamo, say, the Bürgin type, where many good points are combined with great simplicity of construction. In most

together with the woodcut, as in the original. I have also met with other well-known names, and, lastly, the writer is quoted at full, with a reproduction of the woodcut appended to the original article. All these whom I have named are directly acknowledged as reprints from the "E.M." besides other matter that, although not so stated, I well remember having met with in this journal above various signatures.

I am much averse to any fulsome laudations of either the editor or contributors; but I feel unable to pass these facts over without bringing them to notice, and I cannot but say that it speaks volumes for any scientific journal, which is either itself or contributors so quoted. To those who know the "E.M." already, it will be no matter of wonder that its authorities are thus quoted. But its significance is undoubted.

By the time this is in print the year 1891 will be almost expiring. It cannot be regarded as one of great scientific discovery, but it certainly has shown us the steady advance of the electric lighting systems. One that I may perhaps mention is the Heinrich dynamo machine. If the statements made are correct, we are told that the machine will produce as many as four 2,000 candle-power lights from a machine, that if of the same size and of the usual form would yield but one of that power, thus eclipsing the Brush machine, which I believe to be the best in the market, the Heinrich excepted.

With the advent of 1892 a new and even larger still sphere of usefulness opens upon this journal and its contributors. What help has been personally given by me from time to time to the various querists in these pages has, and always will be, afforded with every possible wish to help them in the respective directions they may be treading in the paths of science. To the varied class who avail themselves of the assistance of your pages, to the ever courteous and obliging and practical Editor of this journal, and my fellow-contributors, allow me to tender them, one and all, my best wishes, usually expressed at this festive season, and to hope that both they and myself may find the coming year productive of less personal trials and difficulties, and at the same time richly endowed with every success and solid advancement, and may we all, when the like period of the coming year again comes round in the circle of ever-moving time, be able to mutually congratulate one another on our mutual achievements, and the continued and world-wide spread of the ENGLISH MECHANIC—at least, that is the hearty wish of

Sunlight.

PURE ZINC.

[18975].—THE question of "pure zinc" has been raised in your columns, and the statement made that it is impossible to obtain it (see p. 329). The following which I find in the *American Engineer and Mining Journal* over the signature A. Har-nickell, claims that pure zinc can be obtained. The writer commences by taking exception to the "statement, also to be found in all the textbooks, that zinc is not freed from impurities, such as lead, iron, and arsenic, by redistillation. It is of general interest to know that this old rule, accepted as it is by all zinc metallurgists, may now be totally and emphatically upset, not only as regards zinc for the laboratory, but for common use in the arts. I point to the fact that I have made over a hundred tons of *pure* zinc, tested on average samples of fifty tons, from very impure galvanisers' zinc bottoms, and from commercial spelter. For the *method* *process* I am compelled, for want of time and of your space, to refer to my patent, preferably the English one; but I will state here, that the principle upon which I work in my invention or system is, that volatile impurities are gained separately in the simplest way, and that metals requiring a very high heat will not distil over when the condition are:—1. Immense pressure on the zinc. 2. Condensation *in vacuo*. I obtain these conditions by an hermetically tight retort, a large weight of zinc therein, great heat, a narrow condensing outlet artificially cooled, a closed receiver in which impurities are also lodged. There is no loss of zinc nor any deposit of zinc-dust. I gain zinc, lead, iron, arsenic separately, and my zinc possesses a greater specific gravity than pure laboratory zinc (7.2), and mechanical properties equal to copper in rolling, drawing &c. I send from the same pile to laboratory purveyors and to brassmakers. All want more. I only worked experimentally, on sufferance, in a copper-works, and am not making it; w. preferring that zinc-producers should learn how to apply my principle in their own works. There is no economical obstacle, and a much greater profit in selling pure than in selling impure spelter. What I have done on a large working scale the college laboratories ought to have the spirit to do on a small scale, since what I have done fully contradicts their assertion in the matter of zinc; and when they do so, they will invite the authors to correct their textbooks."

If the textbooks are wrong, it is certainly of

great importance that they should be corrected, and this note may help to effect the object.

C. F. M.

EXPLOSION ON HEATING IMPURE OXIDE OF MANGANESE.

[19579].—MANY of your readers have, doubtless, noticed in the London papers the report of an inquest on the body of a gentleman who was killed by the explosion of a retort in which he was preparing oxygen gas from oxide of manganese.

Although the cause of the explosion in this particular case does not appear, I would warn such of your readers as are students of chemistry that black oxide of manganese is sometimes, by unscrupulous tradesmen, largely adulterated with charcoal. The result of attempting to prepare oxygen from such a mixture, especially with the addition in the usual way of chlorate of potash, would inevitably be an explosion.

All new samples of black oxide should, before using, be tested by mixing a small portion with chlorate of potash, and heating in a test-tube. If any crackling is heard, or if any small flames are noticed in the tube, or if any part of the mixture becomes suddenly incandescent, the sample should be rejected.

Sulphide of antimony has, before now, been sold in mistake for black oxide of manganese. The effect of heating this substance with chlorate of potash would be even more disastrous.

Alfred H. Soward.

5, Serjeant's Inn, E.C.

REPLIES TO QUERIES.

* * * In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[44758].—Immersion Paraboloid Condenser.

—Among unanswered queries, "Antares" asks (1) "Can you get a real dark field with this, say, of Müller's plate, with high power and high-angled objectives?" (2) "Is there any way of ascertaining if the paraboloid is truncated at the right point?" Replies: (1) You can get a dark field with any object, and with any lens, by means of the immersion paraboloid, if only the object be in air and upon the slide. Under those conditions, the light striking the top surface of the slide outside 41° from the optic axis is returned to total internal reflection entirely, except where an object adherent to—and optically continuous with—the slide, conducts the light into itself. Such an object may be made intensely luminous upon a black ground, and its structure may be displayed as beautifully under a thousand diameters, as common foraminifera may be displayed under a 2in. objective by the ordinary dry paraboloid. As Mr. Wenham long since pointed out, objects when set in balsam may be illuminated by light totally reflected downwards upon them from the top surface of the cover-glass. With an object set in balsam and an air-lens, this factor in illumination is invaluable. But that the structure of the object itself diffracts and retains light, as also to become a self-luminous radiant upon a dark field, is demonstrated by the brilliant illumination obtainable for an object set in air upon the slide. This fact is also demonstrable by viewing a podura scale or a coarser object set in balsam under a homogeneous immersion lens. In this case no light is reflected backwards upon the object; yet beautiful images may be obtained of such object if its refractive index differs sufficiently from that of the balsam to make it visible. In this latter case the dark field is not obtained unless the illuminating pencil be thrown into the object at an angle beyond that which will pass into the lens. Therefore with large-angled immersion lenses the difficulty of getting a black field with objects not set in air is great. With an object set in air upon the slide the black field is insured by illumination beyond 41° from the optic axis. With objects set in balsam under a water-front lens the black field is insured with illumination beyond 49° from the optic axis. Under a homogeneous lens an object set in balsam is seen upon a black ground only when the illumination is beyond half the lens angle from the optic axis, say, 50° to 72°, according to the angle of the lens. To understand this subject perfectly in its practical bearings, the articles on "Aperture" which have recently appeared in the "E.M." and which give the most lucid and accurate summary of that subject that has yet appeared in the English language, should be studied. (2) The immersion paraboloids made by Powell and Lealand I have always found to be accurately truncated. Their point of truncation should be at the thickness of the slide, plus a film of castor-oil below their focus. Castor-oil or cedar oil is the best intermedium. If a slide be covered with a film of milk or tissue-paper, the paraboloid,

when racked up and made optically homogeneous with the substance of the slide by means of a drop of castor-oil, should bring sunlight of a plane mirror or heliostat to a brilliant focal point.—JAMES EDMUNDS, M.D.

[44967].—Steam-Propeller.—To "Sunlight."—The original query was sent in mistake. It should have read: Would it be of any use to attempt to convert my propeller into a double one? Details required, I suppose, are, length over all, 42ft.; beam, 9ft.; draught, 4ft. 8in. aft, and 3ft. forward; lines very fine; boiler, 8ft. 6in. long, 4ft. 8in. diam., 160 1/4in. tubes, internal flues, grate-bar surface, 4ft. 6in. by 4ft.; single engine, 8in. diam., 12in. stroke; propeller of iron, weight 150lb.; diam., 4ft. 4in.; number of revolutions, about 130, with 60lb. steam; has a false keel 8in. deep, which I should like to remove to reduce draught—and in place of present propeller put in two 36in. ones; replace present engine with two 8 by 6 cylinders. Have I sufficient boiler power? If not, would a feed-water heater made as follows help me out? To feed-pipe after it leaves injector, and before it enters smoke-box I propose to attach a T-piece, the outlet to lead to a coil (15ft. of 1 1/2in. pipe) in smoke-box, the feed-water entering boiler just below water-line. The straight part of T leads to bottom of boiler, with check-valve is so placed that when injector is pump is on it is closed, therefore feed-water circulates through the coil, when injector is shut off the water from boiler circulates through coil, preventing it from burning at the usual stop-cock and check being between T-piece and injector. I put a heater, of above description, in back connection of a small boiler two years ago, and another one in a larger one last spring; they are as good and tight now as when first put in, and gives us about 1-6th more steam than we had before they were in use. Present speed of steamer's knots running light, and against a 3-knot current.—BACKWOODSMAN, B.C.

[45163].—Great Western Engines.—807, one of a series of 20 (806-825), was built at Swindon in May, 1873, has inside bearings for the coupled wheels (drivers and trailers), and outside leading wheels. It has inside cylinders 17 1/2in. diam., 24in. stroke. 1010, built at Wolverhampton about 1866. It is a four-coupled engine, the diameter of the driving and trailing-wheels being 6ft., not 6ft. 6in., as the querist states. Outside bearings for all wheels, and inside for drivers. Cylinders (inside), 16in. diam., 24in. stroke; but there are some of this class now running with newer cylinders 17in. diam., 24in. stroke.—T.C.

[45209].—Ostrich-Feather Dyeing.—The manner in which I dye feathers black is, put them into strong logwood for about ten hours (as must be taken to let them get boiled), then put them into a solution of bichromate of potash, giving half-ounce to two gallons of water, keeping them in about one hour, and the bath at about 200 deg.; should they be too light in colour, re-soak them to logwood again, and finish out of chromic bath. To dye feathers maroon, bottom with sub-bear, then top with magenta and purple, according to shade required. On page 356 "T.P." states aniline dyes give good results; but aniline dyes will not dye a good black on feathers. The French blacks are considered the best, and if there is any gentleman in the trade, or otherwise, or give me a better recipe than the one I have described, for dyeing ostrich-feathers black, I shall feel much obliged.—DYER.

[45306].—Iceland Spar—I have polished one spar perfectly on white bees-wax with putty-powder. If "Mag" should not succeed with his putty-powder is not fine enough. I will tell how I wash small quantity if he wishes it, to his address or through the list of answers.—G.W. WALK, Paterson, N.J.

[45307].—Strength of Alcohol.—At 60° Fahr. alcohol of 85-28 per cent. by volume is 67 sp. gr. at same temp. proof spirit contains, in round numbers, 57 per cent. of absolute alcohol by volume. With the aid of these figures, "Dual" will be able to calculate how much really absolute alcohol—that is, 100 per cent.—is above proof.—Approximately it is 74 above proof.—ESSEX.

[45316].—Frosting Gold and Silver.—See Gee's books on gold and silver-smith's work. Sulphuric acid is not used at all, but hydrochloric with nitre, salt, and alum. Properly, that is not colouring; frosting is a term that is now confined to scratchbrush work in lathe.—T.P.

[45325].—Staining Sections of Wheat—I would recommend the querist to make a search through your back volumes. There is a good paper on the preparation of double stainings in Vol. XXX, p. 476; but it does not say that you can colour the starch cells, skins, albumen, &c., different colours. When you discover such a process, you will no doubt send it to the "E.M."—T. J. M.

[45327].—Carbon in Steel.—It is better

percentage can be found when the fly in the furnace. At least I should like to know.—MIDDLEBURY.

Imaging Japanned Goods.—Usually traced on with pencil.—P. P.

Reducing Leather Waste.—This is any with another, which I refer to by "too-too." It is quite justifiable, and to seek information wherever needed; but "Child" will find some query in back volumes, and if he asks what he wants, of course he will see public in these columns, instead.—NUN. DOR.

Indiarubber not to Stick.—I will use up stearite powder (French chalk) and trying that; or wash the mould with water, and dust the powder on.—

Preservative for Iron Ships.—I use a stuff, good red-lead, is as useful as I happen to know that a mere list of preparations would fill a column or more, does Mr. Clifford really know of a composition that would damp iron, be as elastic as oil-few hours, be cheap in preparation, and, that he would give full particulars he had secured it by patent, are tolerably "stiff" as it is; why, that it shall keep the bottom of the ship of barnacles and weeds, without off too rapidly? Then you would that would be of "value," and no being so, I somehow fancy it would for.—NUN. DOR.

Light's Razor-Sharpener.—Was a coal of wheat-straw the real instrument? It contains minute a, and is well-known as a useful one.—NUN. DOR.

Ston Lubricant.—Perhaps "Labor" will let me know how much suet, or how much I should use in my 3ft. stroke, doing 36 strokes per day, and oblige.—J. C.

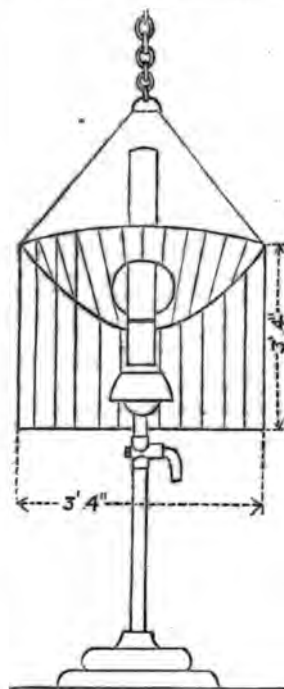
Setting up Lathe.—To the question, I should recommend you to set the lathe with, of course, single gears. Lay the foundation of a good tool is joint, and that is, start with a good if I were starting as you are, have it long at least; or if the pocket other foot will be found handy, you

The bed also should be cast with a saddle and slide-rest could be used, and the whole should be accurate. The bed also should be of ample cast, as that is an important element good base for other attachments. To the mandril-headstock, which is substantial and well-designed casting, a single-gear lathe are usually front end in a cone, and the back conical point; this is a plan I should like to see. The plan I should like to see is a mandril about double the front bearing of ample size with a taper to the front, and tapering towards the back end it runs in a bearing tapering the reverse way, bearing being adjustable to take up wear. Through this the mandril object, and finally bear against a nut by studs in the usual way, thrust in drilling or turning work. Such a headstock costs more to well worth the additional cost, as easy, can always be adjusted to parallel, and the extra long mandril is actual use immensely superior to the sliding poppet. This is fitted, and of any good pattern. Lathe-heads are, of course, double y have splendid proportions, and I have so fully proved the value of the form of head that I have just my further information would be of happy to give same, or, if the advertiser address, I should be him in other ways.—SUNLIGHT.

Lathe-Cleaning.—I shall be glad if the following errors in my reply to the passage commencing on the 1st, "Now turn attention to the unscrew the 'cock,' or bar," &c. &c. is misplaced; in lines 56 and void possible risk of breaking the lathe."—ALFOJOK.

Artificial Light.—In compliance with the request, I send sketch of the arrangement will be fully clear to you. A heavy cast-iron base carrying a top of which is stopcock, and the chimney connected to an iron flue, to carry off the products of combustion. The lantern itself is something like the letter D, the top being slightly domed, and slanting downwards from front to back, so that the back of the lantern is 24in. only high. The depth from front to back is 3ft. The whole is carried by a chain from the ceiling, at the lower end of the chain is a peculiar form of swivel joint, so as to turn easily either way. And from this again are two chains of a fixed length to the two front corners, with an adjustable chain at the back to give a tilt to the apparatus as required. Where the chimney goes through there is a circular aperture 12in. diam., and on the outside of the top spring three wrought-iron arms to carry the chimney. So far you will see by the drawing. But there are two other matters I have not mentioned, and those are that the whole inside of the lantern is glazed with strips of looking-glass, and also, that hinged to the bottom is a frame, filled with strips of blue glass, and the action of turning it up to close the whole of the front also turns on full the gas. A catch at the top holds the frame up until the exposure is taken, when by lowering the frame the gas is lowered until a by-pass only just keeps the jets alive. Further than this, we have since filled in the bottom with blue glass strips, which is found an improvement. The whole lantern, by means of the joint, can be turned to just the right angle to thoroughly flood the sifter with light. One great improvement is the screen being made to turn on and off the gas; as otherwise the flood of light was found very trying to the eye from its volume, to say nothing of the heat reflected on to the sifter. This blue glass effectually obviates. I shall be happy to further elucidate any details of construction, if desired.—SUNLIGHT.

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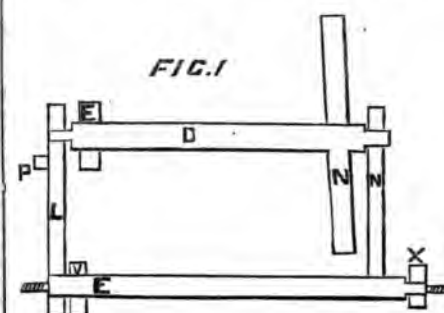
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[45458].—**Pumps.**—I am sure that my plungers do not strike on the bottom. How should the valves require less lift than they used to? The teeth on wheels are not much worn; there is very little back-lash. I had my suction-pipes cleaned, with no better result. By putting my ear to suction-pipes, I fancy it is the valves; doing same to delivery-valves, I also think it is them; by doing same to air-vessel, I hear no noise there. If the air-vessel gets short of air, how am I to get more in? and oblige.—ONE IN TROUBLE.

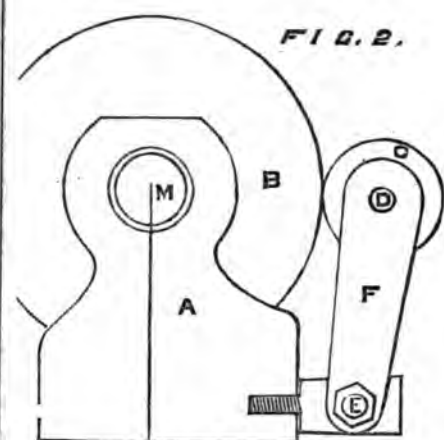
[45473].—**Height of Lathe Centres.**—The height from floor to centre of a fine 6in. back-gear ornamental lathe, by Kennan, of Dublin, is 44 7/8in.—J. E., M.D.

[45475].—**Turning Face-plate for 5in. Lathe.**—You have not stated the speed you used, or whether you used a slide-rest. You will find it very difficult to turn anything of large diameter without back-gear, but try with your belt on largest pulley on mandril, and on a small one 6in. or so on crank to reduce the speed. I have put a back-gear to my 3 1/2in. lathe, which works very well. I have no trouble to turn 6 1/2in. face-plate. As many may wish to put gears to lathes which were not fitted with them, I send sketches which I hope the Editor will find room for. No. 1 shows back view of back shaft *a*, pinion *c*, large gear *N*, with the method of holding the shaft in place; *B* is a shaft on which are keyed two arms, *L* and *N*. It

is attached to lathe-head by two pieces, *v* and *X*, which are screwed into the head (see Fig. 2). When



in place the shaft can be moved into or out of gear by simply pushing the shaft to or from the mandril *M*. When in place it is fastened by a plate hinged on the front of headstock. This plate has two notches, which come on the stud *P* of the front



arm. This keeps it in or out of gear. In getting the pieces *v* and *X* into headstock, they must be screwed so that they are quite upright, and *x* is put in first, as it is to be left, then *v* and a nut at each end of rock shaft. If you wish for lines, write again.—SLEVENOMON.

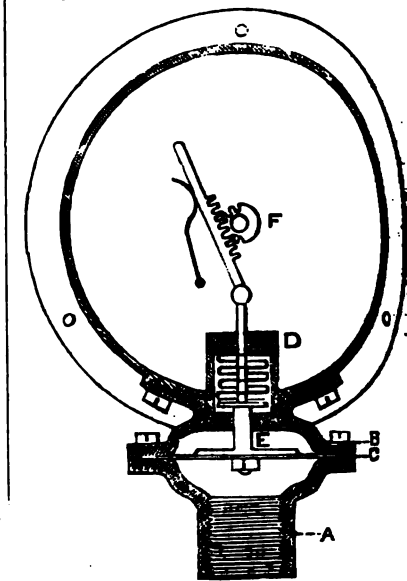
[45480].—**Photographing Microscopic Objects.**—I venture to suggest the following method, with which I have worked for years. I shall offer no reasons for the adoption of certain plans in the arrangement of the apparatus, but hope to show their utility in the subsequent manipulation. Fig. 1 represents the apparatus. The camera *C* has its front orifice enlarged to 4in. diameter. To it is fastened, in any way most convenient, a funnel-shaped bellows made of brown paper with a piece of wood about 1in. thick, *O*, fastened into its smaller extremity; a hole is made in *O* to fit the end of the microscope. The camera, bellows, and hole must be lined with black velvet pasted on with thick starch, not glue. The fine adjustment *F* of the microscope should be fastened to a cork (*A*, Fig. 2); into the cork a wire-staple should be inserted; a piece of wire is then passed through the staple, bent to a U-shape, and firmly tied to a light wooden rod *t*, Fig. 1; a piece of twine is attached to the camera to support the rod when in use. *S*, a cell made as follows, and I believe described in the ENGLISH MECHANIC some time ago: clean two pieces of glass of equal size, get a piece of indiarubber gas-tubing without wire inside sufficiently long to form a ring, Fig. 3, between the glass-plates, leaving a small orifice at the top; two slips of wood are then made the same thickness as the glass plates with the ring squeezed between them; to each side of these slips another slip, slightly larger, is fastened, and the cell wedged between them, as in Fig. 3; it is then filled with a sky-blue solution of sulphate of copper in ammonia. . . . represents the lamp; it should be made to rise and lower to any desired position; this is done by wooden blocks in the diagram. The dotted lines are a large American corn-beef tin with top and bottom removed; a hole is cut in front exactly on a line with the diaphragm-hole in stage of microscope; on the opposite side a square tongue is cut, Fig. 4; a plain mirror, placed horizontally (in Fig. 1) between the tongue and orifice, acts as a reflector. A piece of finest patent plate is substituted for the ground glass of the camera. An indispensable accessory, the focussing-glass, is made as follows:—A stout cardboard tube 6in. long is made to hold the eyepiece of microscope; a cork, *C*, is fastened into one end, in which is screw

a 1, 2, or 3 in. object-glass—the last if possible; another tube is then made (A, Fig. 5), within which the former slides; a round flat disc covered with cloth may be fitted to the bottom of the outer tube to allow of its occupying the same position as the axis of microscope when in use. Everything is now prepared for commencing operations, except the stand for the camera, which must be a tripod and very firm: when the tube of the microscope is removed from the arm (X Fig. 1) a sufficient length, say, half an inch, is left to fit the orifice of bellows (O Fig. 1); if not, a small tube or ring of cardboard, lined inside with black velvet, must be fitted in its place (Z Fig. 1). We will now commence operations, leaving the photographic manipulations for the last. Place the microscope at the edge of your table in the horizontal position, as if about to view an object by direct sight. The tube with its eyepiece is supposed to be on: screw on a lin. objective, as it is the best to begin with. If you possess an achromatic condenser, put it into the diaphragm-tube, place your lamp ten inches from the stage of the microscope with the flat side of the wick forward, now obtain an image of the lamp in the microscope, and make this image coincident with image of an object on the stage by moving the condenser to a greater or less distance as may be required. (I had better mention, *en passant*, that the condenser must be of less magnifying power than the object-glass, and less angular aperture, no matter what the bottom words may mean). Now place the meat-tin over lamp, and see in the microscope that the image of the flame made by the mirror coincides with the flame of the lamp. You now turn your diaphragm-plate till the smallest hole is in the centre of the field, or before doing this, place the bull's-eye, B, so that the whole field is equally illuminated (mind your eyes here—barely glance through); now place the small

for mounting complicate matters, but are easily overcome, as will be shown. A piece of black cloth, or velvet, is now placed gently over the camera and microscope; a last view is now taken, to see that all is right; we remove the focusing-plate, and proceed to place the dark slide containing the dry-plate in its place, having first placed a large card in front of the copper cell. The dry-plate process is absolutely necessary. I always use Swan's plates—twenty times as fast as wet plates—and the pyrogallol developer; but I recommend a beginner on no account to accept it; the difficulties, unless you are an expert, are almost insurmountable. I recommend any of the slower kinds over six times and under ten times, but don't get any that have not the sensitiveness marked on the box; use the developer you are most accustomed to. Open your note-book, which you are about to devote to the subject, and place the name of object on the top of page, next, object-glass; next, sensitiveness of plate, and put it in your pocket; draw up the slide and expose your plate to the darkness of the camera, wait quarter of a minute till all vibration ceases, remove the card from front of copper-cell, having your watch on the table, expose for one-eighth of a minute, replace the card, shut up dark slide, take out your note-book, and mark down distance of lamp and bull's-eye from stage, number of diaphragm-hole, and if fine and coarse adjustments are marked, their numbers. We now proceed to the development of the plate. Full directions are always given with them, which we will omit, and only supply a few hints. Develop thinly, adding an extra quantity of bromide to the developer, no matter which it is; always intensify with bichloride of mercury, and before using ammonia, examine your plate carefully; if uncertain, take a print in the shade; follow out the directions given on the paper to the letter, and

thresher easily. Do you think they would manage when attachment is added? or would you add driving attachment separately? It is a matter of indifference whether chaff passes with straw or not. What I wish is grain to be delivered drum—STREATHAY.

[45523].—Model Steam-Gauge.—A model gauge is a somewhat difficult job, so that I have thought best to send a sketch if the Editor can find

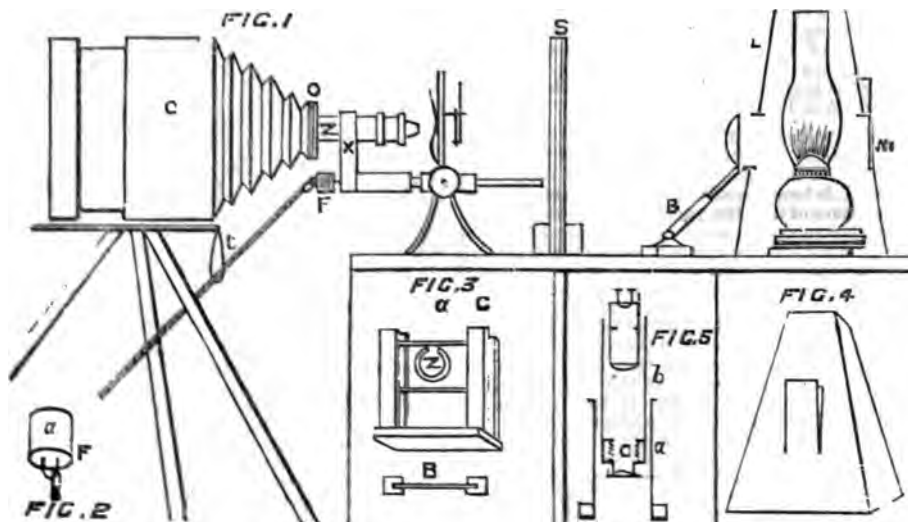


room for it. The gauge, as shown, is one I have designed for some model-makers, and has been found to work well. A and B are two small brass castings of the shape shown, and accurately fitted to a faced joint. Between the two faces put rubber diaphragm, C, and resting on the upper side of this is a broad brass plate, E, which is one with the stem—this is carried through the rubber and fitted with a small nut at the end, whilst above, the stem is turned to two diameters shown. Into the upper casting, B, is screwed a short piece of brass tube, D, into the bottom of which is soldered a piece of metal to form a gully below, whilst above is another piece fitted to screw in. The stem E also carries another plate inside the brass tube, and resting on a shoulder in the stem, and between this plate and the screwed-in piece goes a light steel spring. The siphon-tube screws into the lower end of A, whilst the case is made of a section of brass tube: a piece of pinion wire forms a pivot, on to which fits the pointer at F, and this is actuated by the rack as shown—a light spring keeping the rack up to its work. The screwed piece in the top of D allows of adjusting the spring, and if the gauge is, as it should be, graduated by pressure or steam and marked to correspond to the pressure shown on a standard gauge, it allows of exact graduation. This gauge must be used with siphon-tube, or the rubber diaphragm will at once be destroyed. You will find this a fairly easy-made and a thoroughly good form for a model. If not fully clear, ask me again and I will help you with pleasure.—SUNLIGHT.

[45524].—White Metal Bearings.—Try to tin 2 per cent. copper and 1 per cent. antimony; you can harden by adding more copper if the above is not hard enough.—JACK OF ALL TRADES.

[45525].—Screen for Lantern.—I am unable to tell H. Booker if the composition will chip or crack off if folded up together, but if rolled up in a roller will last in continual good order. However, there is an improved distemper which, as it is applied very thinly with good effect, may also be worth your correspondent's attention. As tapioca flour or some similar farinaceous substance of a glutinous nature as a substitute for sin. If a large quantity the proportions are one hundred weight of powdered whiting, 4 lb. of tapers fine, 1 lb. of ultramarine blue. H. Booker can make small quantities in these proportions, and if it is thinly rubbed on his linen screen, and let it dry, remember there is nothing like a whitened (or whitened) wall for showing photographs on, if you wish to economize light or rather make the most of it in a small room. In a large room, 16 ft. long and upwards, he can arrange his sheet, and get a very clear picture by showing through the lamp light, and this even when the sheet is thick.—P. J. H. SASSY.

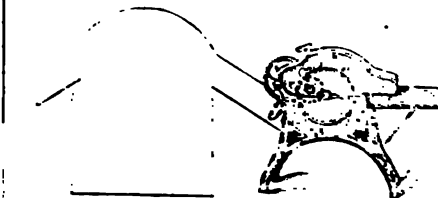
[45527].—Fontaine Engine.—Built by E. Eugene Fontaine, of Detroit, at the Great Lakes motive Works, Paterson, New Jersey, U.S. specially intended for high speed, the engine shaft being above the boiler, and the wheel



hole in centre of field, and then move the bull's-eye to and fro till you obtain the sunlight, that is, till the small hole appears as a bright spot in an almost equally illuminated field—this field must be equally illuminated also: you then place your sulphate of copper: not only saves the eye, but lessens the yellow colour of the light, and cuts off certain rays that cause fuzziness in the negative. Now move round your diaphragm-plate till you get the largest aperture possible with the best definition. Your object being now placed in position, remove the tube of the microscope, and fit the camera and it together, as before described and shown in Fig. 1. The necessity for their independence and movable connection will be now apparent, by raising or lowering the camera-stand. You now make the illuminated disc occupy the centre of the patent plate: the object is now focussed on, with the help of an assistant, by the coarse adjustment. This being done, we seat ourselves comfortably in front of the plate, take the rod, Fig. 1, in our right-hand, or better, suspend it with a piece of twine, as in the diagram: this leaves both hands free—a matter of great importance. Having placed the focusing-glass, Fig. 3, with the bottom end in the figure against the plate, and move the inside tube till we obtain an accurate focus of the roughened side of the plate, we now place it exactly in the centre of the field, and holding the rod F in our right-hand, get the sharpest definition we can at the greatest distance of the object-glass from the object: the reason for having the greatest distance between the object-glass and the object, is that the focus of the sensitive lie in a plane nearer the eye than the visual rays. A great deal depends upon the object. A flat section, mounted dry, bone, &c., is the best to begin with: the different mediums used

failure is impossible. Use no eyepiece in the microscope; if you require anything, use the strongest concave eyeglass you can purchase; this, though lately described, was used by Woodward ten years ago. In using higher powers than lin., place the edge of the flame in front, as in the diagram; always use the adjustment for covering-glass, when focusing, along with the fine adjustment, and spare no expense in your lenses.—A. C. M.

[45516].—Hand-Thresher.—To "SUNLIGHT."—Many thanks for your kind offer of assistance. According to request, I herewith send drawing of thresher. As you use the word "patching," I'm



afraid I was not explicit enough in the reference to attachment: and I have, therefore, roughly sketched outline of what was in my mind. I thought of its being attached to thresher by a kind of funnel fitting into mouth of thresher. The drum is fixed up with strippers, having two rows of spikes each, passing corresponding spikes in breast immediately under feeding-board. Its speed is about twelve times that of crank, or from 500 to 600 revolutions per minute. Two lads drive

mounted on it being forced into frictional contact with a pair of wheels mounted outside the single driving-wheels, increasing the speed of the crank-shaft as 9 is to 7. It has been working on the Canada Southern Railway:—

Cylinders outside, inclined upwards 16in. by 24in.
Four-wheeled bogie, wheel base. 6ft.
Four-wheeled bogie, dia. of wheels. 2ft. 6in.
Upper friction wheels, diam. 6ft.
Lower friction wheels, diam. 4ft. 8in.
Driving wheels, diam. 6ft.
Trailing wheels, diam. 4ft.
Distance between second-wheels and drivers. 8ft.
Distance between drivers and trailers. 7ft. 5in.
Diam. of boiler. 4ft.
Grate. 62 $\frac{1}{2}$ in. by 33 $\frac{1}{2}$ in.
140 tubes, diam. 2in.
Length of tubes. 11ft.
Grate area. 14 $\frac{1}{2}$ sq. ft.
Heating surface, box. 100 } 906 sq. ft.
Heating surface, tubes. 806 }
Weight in working order. 62,000lb.
Weight on drivers. 32,000lb.
Gauge. 4ft. 9in.
Tender, tank capacity. 2,000 gallons.
Essentially American appearance with large cab, smoke-stack with spark arrester, cowcatcher, &c. The principles of course much the same as the old engine, the "Thunderer," on the Great Western Railway.—THE FLYING DUTCHMAN.

[45532].—Colours of Express Engines.—**ERRATA.**—In fifth line, "polished black" should be "polished brass"; further down, "N.B. passenger-train" should read "N.B. passenger-engines"; and 12 lines from foot of paragraph, for "L. and S.W." read G. and S.W.—CARSTAIRS.

[45532].—Colours of Express Engines.—Great Western, Swindon engines, light green with yellow line about 1 $\frac{1}{2}$ in. wide round cab tender, the same divided into two panels, copper moulding round top of funnel, bright, all the broad-gauges above, and a great many narrow do.; Wolverhampton engines, dark green, with black line edged with white; moulding round funnel, black.—N. W. EALING.

[45534].—Condenser, &c. — All well-made modern engines of any dimensions have proper attachments, so that diagrams can be taken at any time with little trouble. I inclose a sketch of usual

presents an exhaustion of 13lb., and a back pressure of 2lb. in a condensing engine, as against 15lb. in a non-condensing one.—W. S.

[45535].—L. Y. R. Tank-Engines.—So far as I am aware, the new six-coupled tanks have not superseded the four-coupled bogie-tanks, except in one instance, and that is in the service of trains between Manchester and Oldham; which trains, previous to the introduction of the bogie-tanks, were worked by six-coupled saddle tank-engines. As to the external appearance of the eight-wheeled four-coupled and the eight-wheeled six-coupled, the boilers are similar; both classes have wing-tanks, but those of the four-coupled (excepting engines Nos. 111 and 112) are shorter than the six-coupled, but the coal-bunkers of the six-coupled, although carrying more coal, are less than the bogie-tanks; in the latter class the bunkers also form part of the water-space. In each class the cylinders, 17 $\frac{1}{2}$ in. by 26in., are inside, as are also the wheel-bearings. "Centaur" will find one of the six-coupled tanks illustrated in No. 871, by Mark Tapson. The engine in the Blackburn collision was, I believe, No. 79, four-coupled bogie-tank.—R. N. H.

[45537].—Crank-Pin Running Hot.—Your brasses are too soft, perhaps. Take them out and turn or cut a groove around the middle of bearing-brasses, and cross from there to outside edge both ways top and bottom. If your brasses are good gun-metal, that is, dark copper colour, tin the inside and make them hot, until the tinned surface becomes oxidised, or the tin sinks into them, forming an amalgam with the brass, which will be considerably short of a red heat. Clean your crank-pin up, and make a fresh start. Put packing pieces of either leather or wood between your brasses, and do not key up too tight.—JACK OF ALL TRADES.

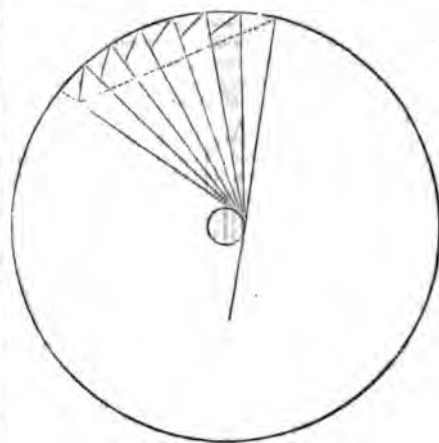
[45539].—Cracked Driving-Wheel.—Why not split your boss either on one side or both? The cause is the contraction of your rim before your boss, it being lighter and more exposed surface to the action of mould. In any case, unearth your boss as soon as you can after pouring. By exposing the boss you may dispense with the split.—JACK OF ALL TRADES.

[45539].—Cracked Driving-Wheel.—I see an editorial reply on this subject under your initials, "A. B.," in the *Engineer* newspaper of December 9, and I indorse the advice there given respecting the mixture of iron for your purpose; and if you

[45545].—Fret-Work.—If you can get it under a dish-cover you may proceed as follows:—Take a large dish and place a smaller one in it; in the larger one put some water, in the smaller one, either spirits of wine or naphtha. Place your letter rack over the latter, and over that, dipping into the water, the dish-cover, and stand by in a warm nook. This will soften the polish or knotting, and with a stencil-brush, or small sash-tool cut short to render it stiff, you may wash it off with the spirits of wine or naphtha; but get far enough from fire or light please, or you may meet with a serious accident. After washing put it up in some cool airy place to dry.—JACK OF ALL TRADES.

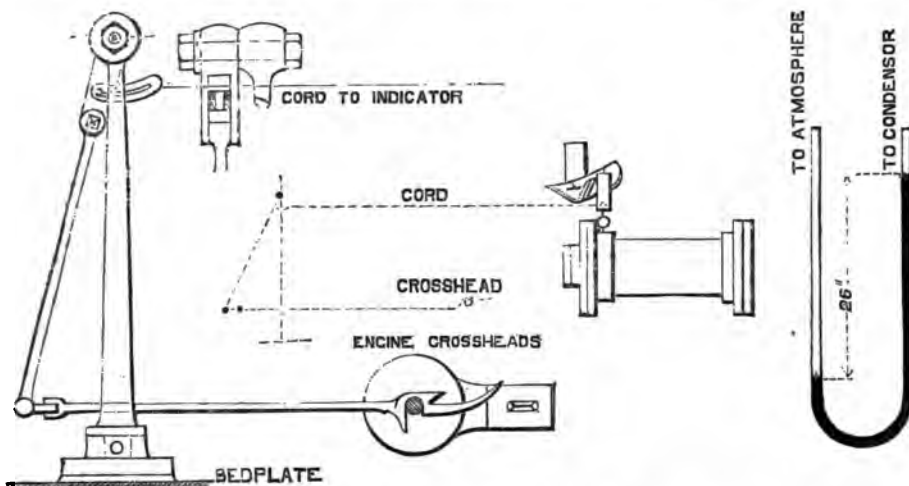
[45546].—Testing for Free Acid.—The percentage of free acid in a solution may be accurately and rapidly determined by titration with a standard alkaline solution. The process is conducted as follows:—Measure out by means of a gauged pipette, a definite quantity, say 25 or 50 cubic centimetres of the solution to be tested, into a beaker, add sufficient litmus solution to impart a distinct red colour, and then add a standard solution of sodic hydrate, drop by drop, from a graduated burette, until the colour of the solution changes from red to blue. The quantity of soda solution used being then read off, the amount of free acid in the solution is readily calculated; thus, if the standard soda solution contains exactly 40 grams of pure sodic hydrate to the litre, every cubic centimetre used will denote the presence of .049 gram of free hydric sulphate, or .063 gram of free hydric nitrate, as the case may be.—ANALYST.

[45549].—The Angle of Teeth of Milling Cutters.—If the "Mechanical Mason" will follow



the sketch, he will find it will give satisfaction.—JACK OF ALL TRADES.

[45561].—Saturn.—In reply to "Aconite," I do not think I could see the Encke division of the outer ring with less than 6 $\frac{1}{2}$ in. at present. Last season I was employing a very fine "bit o' glass," 9 $\frac{1}{2}$ in. aperture, by Mr. Calver, and then only saw the division a few times. Of all other instruments I ever touched, the only one I know of that would be likely to touch the Encke division with anything under 6in. was a superb 4 $\frac{1}{2}$ in. speculum by Harding, which I examined last October, and I very much doubt if that would have any chance. A few stray notes from my observations on Saturn last year may not be unwelcome. 1880, July 22d. 14d. 15m. Only the Ball division visible—that coarse and very clear crossing the planet. 1880, Aug. 2d. 14h. 45m. Occasional traces of the Encke division in the p. ansa. Ball's division certainly not black. 1880, Aug. 30d. 14h. 15m. to 14h. 45m. The "crape ring" mahogany coloured, rather duller or greyish in the f. ansa. Occasionally I thought I could trace Encke's division in the p. ansa, in which Ball's appeared best defined. 1880, Aug. 31d. 13h. 45m. Ball's division best in f. ansa. 1880, Sept. 2d. 13h. 45m. to 14h. 15m. Definition was excellent, crucial. "Ball's division all round: Encke's at the ansae. The outer part of the outer ring dullest. . . . Encke's division nearly 3-5th from the inner edge of the outer ring." 1880, Sept. 5d. 11h. "The Encke division hard and sharp at best moments at the ansae. The boundary between the f. limb of the planet and the southern part of the ring distinct, and as if there was a dark line. The crape ring ruddy brown." 1880, Oct. 7d. 13h. The eccentricity slightly visible, the f. ansa being the largest. The "crape veil" brightest in f. ansa, and was more than half the width of the dark space between the bright ring and the planet. 1880, Nov. 8d. 11h. 20m. The "crape veil" easy in the f. ansa, but only glimpsed in the p. 1880, Dec. 10d. 7h. 30m. Occasionally I thought I could see fairly the Encke division in the p. ansa as a pencil line. 1880, Dec. 15d. 8h. 45m. Encke's



method of attachment for giving motion to cords working drum of indicator, vacuum 13lb. I presume you know form of indicator, and that proper provision is made on top of cylinder for screwing in indicator, so that diagrams can be taken from either side of piston. It is, of course, understood that cord only draws drum of indicator in one direction, and that drum has a spring in it to give it the reverse motion. As to the vacuum-gauge, it is understood that this registers vacuum in condenser; and although a gauge is now used somewhat on the principle of the Bourdon pressure-gauge, still the dial is marked in inches of mercury, although no mercury is used—the principle of the old mercurial gauge being that mercury is poured into the two legs of a bent tube, and both ends exposed to the atmosphere. The mercury will be in equilibrium, and stand the same height in each tube; but if one of the legs be connected with condenser, and the other open to atmosphere, the mercury will rise in the tube connected with condenser, owing to the weight of the atmosphere, and the more or less exhaustion in condenser—the mercury rising 2in. for each pound of exhaustion; consequently, a vacuum of 26in. of mercury re-

wish to take the strain off the rim, in cooling, in the cheapest fashion, splitting the boss will do it; but this is, after all, only a "makeshift." There is no difficulty whatever in making a sound, solid wheel of this size, if its parts are properly proportioned. Your wheel should have eight arms, 1 $\frac{1}{2}$ in. thick, and 5in. deep at the point, increasing in depth half an inch per foot to the boss; the metal in the boss 2 $\frac{1}{2}$ in. thick. I should make the cogs of a first-motion wheel of this pitch 7in. broad, and the arms and boss proportionately deep. This would, however, in your case involve the cost of a new pattern, a somewhat serious outlay, if moulded in the ordinary way.—OAKLAND.

[45542].—Precipitating Copper by Electricity.—In reply to "Ural's" query, I beg to inform him that I can place him in communication with one who carried out some experiments in the same direction as himself some two years ago. I do not think the matter has been dropped, being, I believe, the subject of a patent; so, if "Ural" will address me here, I will place his communication in the channel named, and possibly he may hear something to his advantage.—C. J. O. COBURN, Victoria Villa, Dunstable.

division did not come out so sharp as it is wont. The "crape veil" in the *f. ansa* seemed much broader than usual. *Jupiter*.—The fine belt mentioned by Mr. Calver and others appears to be one which made itself visible last year first of the same colour as the red spot, then changing to orange, then grey, and finally (1880, Dec. 24d. 5h. 21.5m.) was seen as a fine pencil line fading towards the equatorial belts. *Jupiter's Satellites*.—From a series of 424 observations I find:—I brightest in inferior half of its orbit. II much brighter in the eastern half of its orbit. III brightest E superior, much darkest W inferior quadrants. IV brightest W superior, darkest W inferior quadrant, where it sometimes almost disappears.

Relative intrinsic reflective power, II, I; III; IV.
Relative brilliancy, III; I, II; IV.
Relative variability, IV; III; II, I.

FRANK C. DENNETT.

[45565].—**Photographs in Natural Colours.**—Sir John Herschel made several experiments, and he obtained photographs of the spectrum in natural colours; this was on paper, and took place about the year 1842. He himself did not think they would be available for ordinary photographic pictures. Professor Hunt obtained his best naturally-coloured pictures on the daguerreotype iodinated tablets. He (Hunt) wrote an account of his results in the *Philosophical Magazine* for April, 1840; it was entitled "Experiments and Observations on Light which has Permeated Coloured Media." In the same year he prepared some papers with the chromate of silver (which was at that time thought to be insensible to light), he placed this paper behind a frame which admitted respectively—1st, violet, indigo, and blue rays; 2nd, the blue, the green, and part of the yellow rays; 3rd, green, yellow, and orange rays; 4th, orange and red rays. The weather being at the time very foggy, the apparatus was left several days exposed to the light; upon examination, it had under the respective colours, become tinted of a blue, a green, and a red. The "barytic salts" have nearly all a peculiar calorific effect, the "muriate" giving a rich crimson. To produce a leaf in colour, take a silvered copper plate, place it in a shallow vessel, and lay upon the plate a delicate green leaf, put upon this a piece of glass to keep the leaf in position. Now pour (so as the plate beneath may be covered) a solution of the hydriodate of potash containing free iodine, then expose the whole to sunshine; in about half an hour the image will be formed on the silvered plate beneath. M. Edmond Becquerel copied coloured drawings by photography, reproducing the colours all right. But the writer thinks that these were most likely coloured for the purpose of being photographed. According to M. Niépce de St. Victor, "when a plate is plunged into a solution of sulphate of copper and chloride of sodium, at the same time that it is rendered electro-positive by means of the voltaic battery, the chloride formed becomes susceptible of colouration, when having been withdrawn from the bath it receives the influence of light." Briefly, strontian gave purple; sodium gave yellow; chloride of calcium, orange; all sorts of copper give green; sulphate of copper and chloride of strontian give violet; chloride of lead, white; liquid chlorine must always be present. If F. Yelwood will obtain the "Transactions of the Photographic Society of Great Britain," for November, 1881, or Hunt's book, he will find all that I have told him and a very great deal more. In conclusion, although most coloured photographs, or as they were then called, "heliocromes," were very fleeting, yet Becquerel took one, which he presented to Faraday, who left it to Warren de la Rue, and this is said to be in perfect condition.—WILLIAM PEEK, Hayward's Heath.

[45565].—**Coir Rope.**—I should consider that to use a coir rope would be decidedly a retrograde idea. Instead of that, why have you not tried a clip pulley? You would then abolish all chances of the wire rope slipping. With 5ft. pulleys, such a rope would, even if it stretched, hold firmly to the drum. As for a coir rope, that would stretch and tighten far worse.—SUNLIGHT.

[45571].—**Truing Grindstone.**—Drive at a moderate speed and true up with a rod of $\frac{1}{2}$ in. or $\frac{3}{4}$ in. iron, or even a piece of tube. To use it, keep turning the rod or tube, which should be held nearly at right angles, and turns as the edge grinds away. By thus turning it round a new edge is formed, all the time that the stone is turned off true. The stone should be dry, not wet. Do not attempt to perform such an operation close to a lathe or other machine without thoroughly covering them up, as the dust flies everywhere and will cause serious damage.—SUNLIGHT.

[45572].—**A Serious Question.**—One way to remove the incrustation would be to apply paraffin oil. This, as it soaks in, will cause the scale to split up and become detached, when it can be easily knocked off with an iron rod.—SUNLIGHT.

[45573].—**Cleaning Water-Pipes.**—A few years ago I took up a considerable length of tin

pipes, replacing them with others of larger bore. The old ones were coated internally for nearly an inch thick, with lime deposited from the water. A bonfire was made, and the pipes laid in the burning embers; whether the scale became loosened by the expansion of the metal, or whether the composition of the scale was affected by the heat, I cannot say. But the result was that the incrustation all came away, chiefly in dust, and the pipes were as good as ever.—ANTARES.

[45576].—**Steam-Launch.**—I am sorry to tell you that it is next to impossible to get 8 knots out of a hull 21ft. long and 5ft. beam; 6 to 7 at the best would be pretty good. You might have a pair of 3in. cylinders and 5in. stroke oscillators; but they will not do you as good service as the ordinary slide-valve ones. One of the simplest forms for oscillators is that I designed a few years since, in which the oscillations opened and closed the valve passages, whilst a single slide-valve stopped, started, or reversed the engines, one lever only being needed to do all. When we come to the boiler question, do you propose to use a horizontal return tube one, or a vertical? If I knew as to this, would quote sizes. As to the screw, that might be 20in. or so diam., and, say, 22in. to 24in. pitch. The draught of water aft would in great part determine the proportions of screw; but with so much beam, a fine pitch would give by far the best result. With a coarse pitch, nothing like speed would be got. Anything else you want to know I will tell you with pleasure.—SUNLIGHT.

[45577].—**Air Currents.**—You would only get irregular and intermittent currents under the conditions you name. Even supposing that you carried a pipe from the stove to the top of the flue, or carried an entire division the entire length, then the stove would rather draw air from the apartment than down the flue, where the waste products would partially heat the supposed descending air-current. By far the best plan would be to turn the products of combustion into the flue, and then bring air from the outside of building through a pipe with an adjustable valve.—SUNLIGHT.

[45583].—**Steam-Launch.**—Your craft would really be more of an auxiliary screw than a launch. If you are intending to apply sailing power such proportions as 19ft. by 7ft. by 4ft. deep would do fairly well; that is, for the conditions required for a sailing boat. But with these dimensions, when the launch is driven by steam power, the great breadth of beam would be decidedly adverse to speed. The only thoroughly successful application of this principle I have met with was in the case of a Liverpool pilot boat. For a moderate speed, a 5in. bore and 5in. stroke cylinder might be employed. For the vertical boiler I should specify it to be about 3ft. 6in. high, and 2ft. 9in. diam. This would give the very ample grate area of 4½ square feet, whilst a properly designed boiler could be made to yield as much as 40 square feet of heating surface. This would allow of using a quick-speed engine, and a fine pitch of screw, which is the only chance of getting any speed out of the boat. A smaller boiler could be made to do the work, say, 3ft. by 2ft. 6in., with 30 square feet of heating-surface. But I strongly prefer ample boiler power as being the cheapest in the long run.—SUNLIGHT.

[45584].—**Weights for Pressure Boards.**—It all depends on the aperture of the jets. But as a general rule, a couple of 56lb. weights will be found sufficient, as even then, with jets such as I use, 10ft. of each gas would be none too much to last two hours. Some jets, from the small aperture, require more weight on the bags; but it is a great mistake to work with apertures below a given size. Extra pressure is then required, which means wear and tear of bags, and increased chances of leakage in connections. Not only so, but the jet is apt to work noisily as well. A moderate aperture is by far the best, as the jets do not squeak, and the oxygen-tap can be placed full open. I am also a believer in the theory of the gases passing on to the lime cylinder at a moderate speed only; this means a fairly large aperture. With a lantern I have, which has a pair of the most perfect jets I possess, and using bags a little more than 10ft. capacity, if 100lb. be placed on them the jets squeak, and do not give their full power, except the pressure is a little reduced at the jets. As soon as they are quiet the best light is obtained, and one that well lights up a 20ft. picture. As regards weights, rubber bags, to hold water, have been tried, and are now advertised by one maker; but they must necessarily be somewhat awkward to handle. Bags of sand are also sometimes used with success, as they are handier, in my opinion, than water. The form of weight I prefer myself is that of flat bars of iron, the length of them being the width of the pressure-boards, so that there is no straining of them. These bars, if of a section to equal 25lb. each, give every chance to increase the pressure by ½wt.—SUNLIGHT.

[45585].—**Platinum Residues.**—Add a little NH_4Cl to precipitate any soluble PtCl_4 , filter, and

dry and ignite the residue; wash with hot H_2O , dissolve in three parts HCl to one of HNO_3 , pouring off the solution now and then adding fresh acid. When all is dissolved, evaporate nearly to dryness, add HCl to expel HNO_3 , and evaporate quite to dryness in a water-bath. Dissolve the residue in H_2O , or preserve dry in a bottle.—BRUTUS.

[45586].—**Feed for Small Boiler.**—(1) A small force-pump would be found best for the purpose, as the boiler is in a boat and it might be overworked by the engine, or a hand one with a little lever to take off and on. A pump worked by engine would not reduce the steam pressure so much, as the quantity of feed sent in would be but small, as a hand-pump, which, to be of any service, would have to throw a good quantity at each stroke to obviate the need of pumping for a long time. With a stationary engine a gravity feed arrangement can be applied, but not well to a marine boiler. (2) For a small boiler, such as the one you mention, methylated spirit is the best fuel, burned in a siphon lamp. The same boilers as a land one could be worked with a coal fire well enough, but it would be next to impossible to feed it with coal in a boat.—SUNLIGHT.

[45587].—**Horse-Clippers.**—If "Cutter" will get a piece of strong plate-glass, about $\frac{1}{2}$ in. thick, and mix upon it some No. 90 emery powder, which is to be had from his ironmonger, with some colza oil and a little petroleum; then take the horse clippers to pieces and rub them on the glass among the emery and oil till they are all bright alike over the inside of both the top and bottom plate, he will then have them up to cutting pitch. I have done hundreds as above; but I may say he will find it no easy job, and must not be disappointed if he has to spend one hour at each plate. I never heard of them being sharpened with a file.—JOE BLANE, Carlisle.

[45589].—**Noise in Engine.**—No doubt the brasses are badly fitted in the first place, or you have, by accident, changed the brass round so that it does not form with the bottom brass a complete circle. Hence the force of the engine lifts the shaft out of its bearing at one part of the stroke, whilst at the opposite point it falls back with a jerk, which causes the bump possibly. Are you also sure that the noise does not emanate from the connecting-rod end. It is a most difficult thing to locate exactly the source of any particular noise in an engine from mere description, although in a few minutes I could, no doubt, say where it proceeded from if I was standing by the engine. I expect that if you carefully examine the brass of the main shaft you will find it as I suggest, or that it and the wall-bearings are not square one with the other.—SUNLIGHT.

[45589].—**Noise in Engine.**—"Constant Subscriber" has just the same complaint with his engine as we had with ours; but we remedied ours in the following way:—Our engine is one of Jonathan Edge's patent engines. The slides are worked with eccentric wheels and cams; one of the cams had slipped back, causing the steam to be put on too late. The result was a thump on the crank-pin and crank-shaft; the above-mentioned places could not be kept cool. I think if "A Constant Subscriber" will look to his slides, he will find some mistake; when he has made that right he will be able to tighten the bearing down without heating. I should be glad if "Sunlight" will attend to query 45534, and also his opinion on query No. 45425, along with Mr. Lancaster, or any other correspondent.—R. T. B.

[45590].—**Power for Fan.**—You can apply a lever to a crank on the same shaft that carries the heavy flywheel, and from the rim of this wheel either carry a strap to the small pulley on the fan or to one on the second motion. But much depends on the size of fan and the pressure of air you require. If the flywheel is a heavy one, if you get it up to a good speed it would, no doubt, run for some seconds after you take your hand off the lever. But to keep up the motion without constantly working the lever, the only way would be to drive the fan with a falling weight. Perpetual motion has yet to be discovered, or that would just suit your requirement. With the few details before me given in query, it is not possible to say more with certainty.—SUNLIGHT.

[45596].—**Steam-Launch.**—For details of hull, &c., see my reply to query 45541. The I.H.P. would be dependent on the speed of engine, the nominal being less than 2 H.P., but such an engine driven up to a good speed would probably indicate 4 to 6 horse at least. It is surprising what a small cylinder will do. I have regularly got 25 I.H.P. from a 6in. cylinder and 6in. stroke. The speed of the boat would be as stated in previous reply; but if with bluff lines not more than about six miles an hour could be calculated on. I have not, as yet, seen the castings advertised, but shall have a set down before this is in print, and will then tell you my opinion. But I fancy they would be too slight for actual hard

work. A screw is far cheaper to fit up than paddles, as you would find if you had built both, as I have. The wheels, to be of much use, should be feathering ones, and these are very costly for their size, from the lot of small forgings and fitting they require to fit them up. A screw-engine also can be made cheaper than a paddle, as the cylinder-area for the same power would be much more. Paddles make a very showy boat, but it means more cost and weight. One I designed some four years since, was very light for its power. But the boiler was made to form a base to form part of the framing. Altogether, I should not advise you to try a paddle in preference to the screw.—SUNLIGHT.

[45598].—Lamp - Burners.—The burner in question is one quite beyond the skill of an amateur to make, as it requires special stamping machinery to turn them out. It is certainly a most ingenious designed and constructed burner, as a flat wick is used and so fed in at the bottom of the burner, whilst it comes out as a circular wick. If "Fyn-nart" likes to communicate with me through the "Address Column," I would do all I could to be of any assistance to him, or should be happy to show him one.—SUNLIGHT.

[45611].—Boiler Pressure.—To "SUNLIGHT."—As the ends are not riveted, but simply brazed—and, therefore, the weakest part—I should say that by my rule the pressure necessary to blow out the ends would be theoretically about 2,246lb. The shell itself should be good for 5,000lb., but as the ends are brazed only, I should not care to calculate on more than the tenacity of the spelter in the joint. In making a calculation of this kind it cannot be more than approximate, as unless one made a thorough examination to ascertain the extent of hold the brazed joint had, it can be only theoretically expressed. As to a working pressure, I should not advise more than from 40 to 50lb. I believe this to be well within the limit of safety—but it is always well to be on the safe side. At any rate, I should not myself mind working the boiler at 50lb. pressure.—SUNLIGHT.

[45615].—Piano-Tuning.—To Mr. W. H. DAVIES.—Your difficulty probably arises from a want of practice. In laying the bearings, you must try to forget that such things as flats and sharps exist; the twelve notes of the octave ought to be equally divided, and each major third or sixth should have precisely the same number of beats. I fancy you have also been misled by some fastidious directions—such as the old masters used to love giving—as to the sweetness or brilliancy of certain keys; if so, the sooner you discard poetry from tuning, the more likely you will be to succeed in laying an equally tempered scale. Tuning is simply a mechanical operation, and has nothing whatever to do with music; consequently, although practical tuners may speak of notes as being flat or sharp, it is not the flatness or sharpness that they think about in putting them right, but the roughness or smoothness of the intervals they tune by.—W. H. DAVIES.

[45616].—Boring.—If I was about to tackle such a job, I should try and get through it quicker than by taking three cuts through. I should first, either buy or make an inch twist-drill, and run this through with the ratchet and a lever, say, 3ft. long, which might be a piece of iron pipe slipped over the ordinary lever. When the line hole was through, I should next take an inch cutter-bar, with a cutter to take out the hole to the required size of 2½in. A lever a little longer than before on the brace. Patience, and plenty of soap-water would do the rest, and produce, if you know how to properly shape the cutter, a fairly good hole. If you drilled the hole through with three sizes of drills you would get a very bad hole, probably running all on one side. This you would entirely avoid by the plan I have suggested.—SUNLIGHT.

Speed of Roll-Mills.—At the last meeting of the South Staffordshire Mill and Forge Managers' Association, a paper on "Rolling-mill Speeds" was read by Mr. G. B. Wright, of Walsall. Experiments and calculations seemed to point to the best speed for forge rolls for billets being 315 per minute; by 20in. rolls running at 60 revolutions; bars up to 4in., 260ft. per minute, by 20in. rolls at 50 revolutions; bars up to 12in., 230ft. per minute, by 22in. rolls at 40 revolutions; bars up to 18in., 172ft., by 22in. rolls at 30 revolutions. All these speeds were for ordinary draughts. A discussion took place as to whether or not increased speed would not injure the quality of the famous Staffordshire bars, but the objection was met by a recommendation of the use of the light draught.

To break glass to any required form make a notch with a file on the edge of the glass; draw your figure, starting from the notch; make a small rod of iron red-hot and draw it along the lines; a crack will follow the iron, and the glass can then be easily broken.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

45049 Carmine Paste, p. 170.
45050 Papermaking, 170.
45052 Watch Finishing, 170.
45070 Soap Frame, 171.
45071 East Anglian Passenger Engines, 171.
45073 Guitar Construction, 171.
45075 Armstrong's Combination Lathe, 171.

45299. Tale of Man, p. 264.
45300. Shoeing Young Horses, 265.
45303. Numismatic, 265.
45306. Fuel Oil, 265.
45309. Chemistry of Alcohol, 265.
45313. Air-Gun, 265.
45318. Copper Wire, 265.
45320. Hosiery Finishing, 265.

QUERIES.

[45621].—Caledonian Engines.—Can "Carstairs" kindly give the wheel-base of the 45 class?—THE FLYING DUTCHMAN.

[45622].—Spring Balance Safety Valve.—Would "Sunlight" or others tell me how to make a spring balance safety valve for a model locomotive 2½in. long, with directions how to make spring, &c., with sketch, if possible, and oblige—AN ENGLISH BOY.

[45623].—Carbonised Bristol Cardboards.—How are these prepared? Are they brittle? Or, may they be freely bent to any shape?—SCREW.

[45624].—Gelatine Plates.—Can I successfully prepare my own plates from emulsions as sold? I only require to use them occasionally indoors for scientific purposes, and, if practicable, had thought of using them moist as saving time and trouble. A practical answer will be esteemed.—F. W.

[45625].—Angular Aperture.—I will thank some expert for a rough and ready way of judging of the angular aperture of microscopic objectives when great accuracy is not needed.—E.

[45626].—Micro. Objects.—How can I prepare duckweed and the rootlets of wheat so as to see the circulation of the sap? Both objects show it distinctly, I learn from my book, and I have a good microscope.—F.

[45627].—Winter's Ring.—To Mr. LANCASTER.—Many thanks for your kind reply to this query, and your kind offer. I have not any book numbers, so should be glad of your kind instruction. I have not yet fitted up the machine, but may tell you that the cylinder measures 1½in. by 7in. Any information as to fitting the ring on, or any hints as to making machine, &c., I should be very grateful for.—TAU SIGMA.

[45629].—Rheumatism.—A gentleman, age 41, living in a salt district, suffers much from sciatica and neuralgia, is anxious to find a suitable sea-side place (not large) that would be likely to improve him. Would someone kindly advise for a permanent residence in England or Wales? He sometimes suffers severely in hips and legs, losing all use in them for a time, especially after any worrying business or excessive walking, or by standing on cold floor. A small but increasing place preferred. Any advice will be much valued.—X. Y. Z.

[45629].—Ventilating Grates.—Has any one tried the modern ventilating grates so-called, with an aperture above for the hot air to enter the room, and do they answer, or is there inconvenience from damp on the walls, as I have seen stated?—E. T. S.

[45630].—Lathe.—I wish to turn some pieces of shafting, but in doing so I find it springs. How can I stop this? What kind of backstay should I use? And, how is it fixed to the lathe? A sketch would oblige. Also, what change-wheels should I use to take a clean cut guide screw? Four threads to the inch.—A NOVICE.

[45631].—Guardianship of Children by Marriage Settlement.—Would "Sperans" very kindly say if two parties are married, and a settlement is executed between them, is it usual to give the trustees (who have merely to protect the funds) the power of guardianship over unborn children? In fact, is it ever done?—the power of guardianship being usually vested in the father alone by will?—J. W.

[45632].—Oleographs.—I have a couple of the oleographs on canvas now so common, which have become sadly muddled and blackened by exposure to a London atmosphere. For certain associations connected with them, I am particularly anxious to revive them and make them look presentable. How can it be done without injury? A sponge and warm soft water are inadequate to the work.—H. C.

[45633].—One-Cylinder Locomotive.—I am going to make a model locomotive, but wish to propel it with one cylinder only. Now, would "Sunlight," or some other correspondent, kindly tell me whether it would work fairly with one inside slide-valve cylinder? I thought that large driving wheels would give it momentum enough to carry it over the dead points, just as a flywheel does when driving machinery.—AN ANXIOUS AMATEUR.

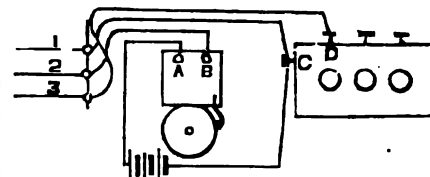
[45634].—Piano.—I wish some reader of the ENGLISH MECHANIC would kindly tell me the best way to put pedals to a piano? What kind of action to use? I have made the pedals two and a half octaves. Should be glad to

know the most suitable, as I have not the back numbers of the "E.M." to refer to. Should be glad if any of your kind readers could advise or give a drawing.—A NEW SUBSCRIBER.

[45635].—Magnetic Induction.—To Mr. LANCASTER.—If I wind a permanent magnet, say, having poles 8in. long and ½in. square, lifting (say) 50lb., with wire to the depth of ½in., what current should I get by removing and replacing keeper? Or, say what sized magnet, &c., should I require to obtain a current equal to four 7in. Bunsens at moment of pulling away keeper? Also, how best to make the magnet—in plates or otherwise? And, how wind the wire? I suppose on two bobbins separately, as in electro-magnets?—TAU SIGMA.

[45636].—Turning in Tin Edges.—I should esteem it a great favour if someone would explain how I could make a machine for turning in the edges of circular sheets of tin for small lamps?—W. H., Plymouth.

[45637].—Faulty Electric Bell.—Will Mr. Lancaster, or some of our electrical friends, kindly give me an explanation to the following?—I have a single-stroke bell on, and it acts all right and drops the indicator flag; but wanted a trembling bell instead. This I put on and connected as above, but could not get the flags to drop, although the bell would ring all right. I had the two bells there, and connected and disconnected them alternately, and the single-stroke bell in each case worked all right, ringing and dropping the flags from the different stations, but in no case can I get the flags to drop with the trembling bell on, all the connections in each case being alike. The reason for the three wires I have bells at each end of the station. 1 and 3, line wires; 2, copper wire. I also tried the following connections with the results appended:—Connect A D, drops the flag; connect



B D, drops the flag and rings bell; connect B C, rings the bell—this with the single-stroke bell. With the trembling bell it will ring the bell in each case, but will not drop the flag. If you will kindly point out to me the cause of the above curious results, and how to remedy same, you will oblige—A NOVICE.

[45638].—Object-Glasses.—Mr. R. Hind (19439, p. 392) states that he uses a crown glass o.g. Will he kindly inform me, in your pages, if this is better than plate-glass? I have recently constructed a simple refracting telescope with an o.g. of plate-glass ½in. thick (bought at a London optician's) 14ft. 9in. focus, 3in. diameter. I have also fitted it with a Huyghenian eyepiece of my own mounting, a 2in. and a 1in. lens 2in. apart. With the aperture reduced to 2in., I can see Saturn's ring well defined, one of his satellites, and I fancy on one occasion a second; it will not divide the ring. Jupiter's belts, but not any red spot, a good deal of the lunar details, the ridges on the interior of the walls of Copernicus, &c. It will also divide the double star Castor. The Moon and Castor will bear the full opening. Should I obtain better results with a crown glass o.g.? It is rather awkward on account of its length, but my object has been economy. Your scientific readers will, no doubt, smile at so antiquated and rude an instrument, but I have been simply repaid for my small outlay (only a few shillings) besides time and trouble.—E. T. J.

[45639].—Eyeglasses.—We are having such an explanation of making specula, that it encourages me to ask for the same on eyeglasses. I, and several others among my friends, have succeeded in making specula of various sizes, and we shall be glad to see the subject of eyeglasses taken up by someone who can give a good account of it, giving us descriptions of the best and latest out. I should like to ask a few questions, and trust some of our friends will kindly answer them; but first I may say that my speculum is 10in. diameter, and 74in. focal length. Will our friend G. W. H. Pigott, or Mr. Calver, please say the powers that would be supplied with such a size of speculum to make it complete for all kind of observing? And, say what the different powers would be used for? Very likely someone may say that my speculum will not bear the powers that would be supplied to one made by a good maker. Never mind that. Also, are they Huyghenian, or otherwise? And, which would be supplied with sun-caps, &c.? Now come other questions. What diameter is the field and eye-lens of each power (the focal length I could get when I knew the power I required), and the size and distance of the small eye-hole from eye-lens? Now, to make my telescope complete, what size shall my finder be, focal length and diameter of object-glass, and power of eye-lens? A formidable list of questions, but I trust someone able will take it up. Think what a boon it will be to many a good workman who, like myself, has never seen a big instrument, but who, for all that, is determined to have one.—E. P.

[45940].—Tidal Communication between Liverpool and Manchester.—A proposal of considerable interest to engineers and mechanicians generally is being discussed in this city for effecting a tidal communication between Liverpool and Manchester for ocean steamers by a channel of such depth and width as to allow of the passage of the very largest vessels. It is proposed to follow the existing course of the rivers Mersey and Irwell, on which latter river Manchester stands, about seven miles above the point of confluence of these streams. The distance from Manchester to the point where the tidal current intersects the ordinary current of the Mersey is about seventeen miles. Beyond this point, which lies between Runcoorn and Warrington, the channel would be trained in the Mersey estuary. As the crow flies the south-western extremity of Man-

chester, where it is intended to form the harbour, is some 28 miles from the South End Docks of Liverpool. As the present alignment of the river channels would be cut through, the navigation would be accomplished by a comparatively straight course of 35 miles—only one-fourth longer than the river's flight. I should be glad if some of your ever-willing correspondents would afford me any information on the following points connected with this matter:—(a) The present range of tides at the mouth of the Mersey. (b) The effect of the bar at the entrance of the Mersey on the ingress and egress of the tidal waters of the estuary. (c) The probable length of time it would take for the tides to ascend to Manchester. (d) The extent and effect of the resistance occasioned by the friction of the banks and bottom of the channel, which, between Runcorn and Manchester, would be about 200ft. wide at the high-water level, and about 80ft. to 100ft. across the bottom. (e) The probable range of tides in the harbour of Manchester after ascending a channel excavated sufficiently to allow the utmost possible development.—**MENEST, Manchester.**

[45641].—**Danish Butter-Casks.**—Can any reader inform me where the beech timber it grown out of which the Danes make their butter-casks, and out of which, also, cutlers in this country make ham and other knife handles?—**MALCOLM AND CO., Greenock.**

[45642].—**Green Mould on Brick Houses.**—My house (fire-brick) built only a few years, is being rapidly covered over with a green mould or fungus. What is the cause? And, would some of our practical readers prescribe a remedy?—**GARDNER.**

[45643].—**Stop Watches.**—Can any of our watch-making friends describe the mechanism of the better kind of stop watches? I have seen one with a centre seconds hand, which, normally, is directly over the XII. One pressure on the stem spindle starts the hand, a second stops it, and a third sends it flying back to the point whence it started. I am told that in the United States, where stop watches have been brought to a high degree of perfection, some have as many as three hands in order to take the time of passing of three competitors. Can anyone explain how it is managed?—**P. W. K.**

[45644].—**Dark Slide and Lenses for Camera.**—Will W. Lancaster, or some other reader, kindly give me instructions as plainly as possible on making a dark slide to hold plate 4½ by 3½. Also, how many lenses are there needed? And, what should they be, convex or concave?—**MANNING.**

[45645].—**Telephone Circuits, Induction of.**—I have two telephone wires running on same poles. The induction is great. Several plans have been tried, and nothing answers so well as a return wire. On economical grounds it is desirable to use earth. Will any of our electricians say if making the two circuits exactly uniform in resistance would be likely to answer the purpose?—**F. E. H.**

[45646].—**Berliner's Violin.**—Respecting "Glow-worm's" communication, giving his practical experience of Berliner's improvement, I should like to ask whether the wood of the pear tree is so much superior to other woods for violin bridges?—**CASW.**

[45647].—**Circular Cistern.**—I wish to erect a circular cistern 10ft. diameter which, with its contents, will weigh about 18 tons. It will be supported by a cast-iron beam resting upon two cast-iron pillars, 12ft. apart, and by two cast-iron or rolled iron joists crossing said beam at right angles, and each end fixed in the main walls, which are 21ft. apart. Will anyone tell me the section of said beam and joists? And, how this is to be arrived at? Breaking weight should be double actual weight to be carried, say, 30 or 32 tons. The pillars and beam are equidistant from each wall which supports the ends of the metal joists.—**H. G.**

[45648].—**Carbonic Gas.**—Will Mr. Allen or some other reader answer the following query:—I want a supply of carbonic gas at about 300lb. pressure, and do not want to use a pump—given, that I have a chamber sufficiently strong to resist that pressure with the means of putting in the acid and chalk, either all at once, or by successive small doses, will the gas generate up to the required pressure? or how am I to go about it—with-out the aid of pumps, and what quantity of chalk and acid (with strength of acid) will make 100 cubic feet of gas?—**(J. J. VALVE.**

[45649].—**Wave.**—What is held to be the utmost height of a channel-wave from base to crest? What the force of it per square foot, and how much greater its force in a storm than that of the water from two to six fathoms in depth under it? Whether is the direct action of a wave, or the upward or downward motions first at, and what are the relative differences?—**SUNSHINE.**

[45650].—**Corrosion of Wrought-Iron Plates.**—Will any of our chemical friends kindly inform the writer what to use to act as a preventative of corrosion of wrought iron plates under the following circumstances? I have charge of a mechanical apparatus, which works with a reciprocating motion in water, which water, through coming in contact with metallic surfaces, becomes acid, and attacks the iron very much. What I wish to know is, is there anything I could put in the water to prevent the action alluded to?—**S. G.**

[45651].—**Valve.** Can any of your readers give me a drawing or idea how to make a valve that will work in a small vessel about 1½ in. diameter? I admit liquid into this vessel, and I have a small hole to allow the air to escape. When the vessel gets full I want the valve to close the aperture; but all the different kinds of valves I have tried do not act properly on account of the pressure not being sufficient to force the valve tight up to its seat, and I cannot use a ball-and-lever valve on account of the confined space I have to work in—a 1½ in. radius down the middle of the vessel. What must I do?—**T. HOSKINS.**

[45652].—**Can I** thing to appreciate a I should be glad if you would kindly write to me, I would have to three gasometers, and an engine.

[45653].—**Caledonian, &c., Tank Engines.**—Will "Carstairs" kindly give the dates of original construction, and the builders of the following classes, as mentioned in his interesting letter in No. 869? Caledonian, Nos. 570, 524, four-coupled 491, by Dübs; 510 and 516, six coupled; Callendar and Oban, Nos. 152, 140, 167, and 540, four-coupled; and also if 540 has inside or outside bearings, and whether the first three mentioned have outside or inside cylinders? Also if Cal. 570 has saddle tank?—**R. N. H.**

[45654].—**Owen's Acme Incubator.**—Will some kind contributor be good enough to give a short description, with diagram, of Owen's Acme Incubator and Reamer, or of any other make of incubator to be kept heated by the aid of kero-oil lamps, as we have no gas here?—**WALTER CASE, Townsville, Queensland.**

[45655].—**Pump.**—Would some of "ours" kindly give drawings of feed-pump patterns and size for 1½ by 3 in. stroke engine? Please state it as plainly as possible, and what throw of eccentric I should have for same. I can manage the plunger and stuffing-box part. Is this size engine large enough for a sewing machine? Yes or no?—**INDEPENDANCE.**

[45656].—**Railway Plant.**—Will any friend kindly inform me, through your very valued and interesting paper, whether, by Act of Parliament, railway companies are bound to provide trucks or waggons to carry coal, mineral, stone, &c., over their lines for traders sending such materials? Or must merchants or traders provide their own trucks or waggons if the railway company so require them?—**A. TRAVER.**

[45657].—**Refraction.**—I have a small transit instrument used solely to give me the correct time, but which I have not been able to use satisfactorily. When right on an elevated star, it is wrong on one near the horizon, though I have taken great care in its adjustments. Now the question arises, should I make any allowance for refraction when a star is near the horizon? I read in Herschel's "Outlines" on refraction "since, however, the disposition of the strata is the same in all directions around A, the visual ray will not be made to deviate laterally, but will remain constantly in the same vertical plane passing through the eye, the object, and the earth's centre." p. 28. I also refer to "Chamber's "Practical Astronomy," on the transit instrument, and I cannot see that he makes any allowance for refraction. But on looking over a back volume of the "E. M." (Vol. XVI, p. 63), I find "F. R. A. S." says that refraction does affect the right ascension of a star—"refraction lifts it towards the west," and in a Orionis, which is more than 7° N. declination, as much as five or six seconds have to be reckoned. Will some one kindly explain, and if allowance has to be made for refraction, is it the same as the tables give for deviation of altitude? Also in the sun, should any allowance be made for refraction now it is so low in the heavens. I mean from the equation of time, as given in the *Nautical Almanack*?—**GIRRL.**

ANSWERS TO CORRESPONDENTS.

* * All communications should be addressed to the Editor of the ENGLISH MECHANIC, 81, Tavistock-street, Covent Garden, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

* * Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 28, and unacknowledged elsewhere:—

SERG. MAJ. CORRY.—M. H. Layton.—T. Williams.—U. Dini.—Capt. Dopping.—G. F. Clough.—Webb and Webb.—D. F. McCarthy.—J. H. Coyle.—Boag.—C. W.—M. H. L.—Prismatique.—Niobe.—Cab.—J. Hieop.—J. C. King.—Seconds' Practical Watchmaker.—T. J. Neut.

G. R. DERRANT. (Perhaps not so accurate as a gas-meter, but several fairly accurate and trustworthy. Try Bailey and Co. Albion Works, Salford.)—W. H. MAY. Has been answered many times. See p. 545, Vol. XXIX., and p. 189, Vol. XXX. The proportions are approximately one part glue to four parts glycerine.—**SHARPEN.** (When files are worn out for their special work, it is good economy to sell them to those who can find a use for them. The only economical process for resharpening is the sand-blast, which we described on p. 437, Vol. XXVII. There is no "easy method of recutting"; but you can try the effect of cleaning them in strong soda solution and dipping for a moment or so in a mixture of nitric acid 1 part, sulphuric acid 3 parts, water 7 parts.—**W. TUCKER.** (Mr. Riggsaid he hoped to complete the translation by the end of the year—not publish. We have not received a copy, and conclude that it is not yet in book form; but if you send a stamped envelope to the secretary of the Horological Institute, Northampton-square, E.C., he will be able to inform you, no doubt.)—**D. CHADWICK.** (See p. 95, Vol. XXIII., for a full description of an electric clock, and also p. 607, Vol. XXVII. Further

details in Vol. XXV., p. 641, and Vol. XXVI., p. 44. An electro-magnetic clock on p. 636, Vol. XXII.; and much information on the subject in the back volumes from XII. upwards.)—**W. P.** (You will see that you have been anticipated by "Sud. Inst. C.E.," p. 387.)—**ALBAIO.** (If you can supply the diameter of the planet and its mass, it might be possible to answer the question; but as it is of no practical use, why should you seek to occupy the time of another?)—**W. H. W.** (Glaire, that is, white of egg, well beaten and allowed to stand for some time.)—**MILLER.** (See the indices of recent back volumes. There are plenty of telephones in them. Full instructions were given for making a good one in No. 846.)—**A. NEW B-GHIER.** (What is it you want to know? It is apparently a list of stars, giving their magnitudes; but you do not say where you found it. "O. S." means "O. S. Struve"; stands for red, n. f. for north following.)—**A. CIVILIAN.** (You should procure the specifications from the Patent Office. 2. Where are such calls to be obtained? 3. By "composition," we presume you do not mean his electric fuse. We believe they are made by the Steam-market Explosives Company.)—**L. WARRER.** (For instructions on violin making, see p. 456, Vol. XXII., and 177, Vol. XXIII.; also recent indices under head of New Violin.)—**SCROGGINS.** (See recent numbers and the index of the last volume.)—**TAU SIGMA.** (A simple device was illustrated in No. 729, and a good machine in No. 731; the latter can still be had. There are several of them in back volumes, including diagrams of the patent automatic machine.)—**RICHARD JONSON.** (Your query is almost un decipherable, owing to the ink not having dried before folding up; but we can understand sufficient to say that you will find your questions answered in recent back volumes. The instrument referred to will do, but you had better have a return wire, and use larger gauge for both.)—**C. E.** (Kingszett's "Alkali Trade," Longmans, contains a notice of it, but the best information is in the specifications of the patents.)—**J. H. ALKX. OLLARD.** (These are several. Try the *Journal of Horticulture* office for a cheap one, and we believe Cassell's publish an elaborate book on the subject. 2. See the articles on the polariscope, &c., in the last two volumes.)—**AMATEUR.** (See p. 18, present volume, for information about the stereoscope, and as to the graphoscope, it is merely a lens of large diameter, and a focus of 10 to 20 in. mounted on a frame; that its distance from the picture can be adjusted.)—**CAVE CAN-EM.** (If the floor was stained, it has been partly bleached. The remedy is to restrain. Probably a little weak vinegar and water will bring it back. You do not say whether floor is dark and the stain light, or the reverse. We assume the former.)—**J. WALKER.** (Perhaps Whitaker's *Almanack* would serve your purpose, 2s. bound. If not, there is the *Nautical Almanack* for 2s. 6d.)—**WIM.** (Can be done in the lathe, or by appliances similar to those used for winding cotton reels. We know of no book on the subject.)—**G. W. KELLS.** ("Eldridge's Manual," published at 54, Murray-street, Hoxton, N.)—**H. A. L.** (See the indices of the last three or four volumes. Slides of all kinds have been described therein.)—**J. HARRIS.** (Thanks; we have seen the circular before. Sir D. Salomons invented a similar system some years ago.)—**CONSTANT.** (Impossible. You want a shocking coil. With a battery strong enough to induce the dropping of the handles, they would not be able to leave go. See the indices, under head Shocking Coil.)—**COVARIUS BERNARD.** (Assuming that you mean wood engraving, get Gilk's Manual, 1s., of any bookseller, or of Mr. Calvert, Great Jackson-street, Hulme, Manchester, whose catalogue of books you will find useful.)—**JOHN BATCLIFFE.** (1. The plaintiff cannot recover the expenses incurred in connection with the summons which was not served. 2. If the judge commits the debtor who has failed to comply with the order made on the judgment summons, you will be put to no expense in connection with his maintenance. It is very unlikely that the judge will commit if you have no better evidence of the debtor's means than your letter affords.)—**TAN FLYING DUTCHMAN.** (We thanked you at the time for the offer, and regretted that want of space prevented us from availing ourselves of your kindness.)

T. HOSKINS.—Vixen.—Your queries can only appear in the "Sixpenny Sale Column."

GEM.—(Illustrated and described on p. 387, Vol. XXVII.)

Sizing Photographs for Oil-Painting.—Mr. Gulliver, writing to the *Photographic News*, says:—"To make the solution, take (say) two ounces best white gum-arabic, put it in a small gallipot, and just cover it with clear cold water; let it stand a few hours, add a little more cold water, then (say next day) use warm water until sufficiently liquid to flow nicely from the brush; filter it through a piece of wet muslin, made so by dipping the muslin in water, and wringing it out; then add to the whole solution about a small teaspoonful of finely-powdered alum, let it stand until clear, and it is then fit for use. It spreads nicely over the photograph. Using two coats gives a good surface to colour upon; it is always ready for use, and is useful in spotting out, and for many other purposes. It keeps well; I have some that was made eighteen months ago, and is now as good as ever."

To prevent boiler incrustation use the purest water that can be obtained, rain-water if possible. Use the blow-off cock frequently. Never empty the boiler when there is fire enough to harden the deposit. Wash out frequently. Experiment with zinc, lime-water, carbonate of soda, carbonate of baryta, chloride of ammonium, some substance containing tannic acid, linseed-meal, and the electro-magnetic inductor. When the right thing is found continue to use it.

SOME French polish reviver is made of—pale linseed oil, 2 parts; strong distilled vinegar, 1 pint; spirit of turpentine, 1 pint; muriatic acid, 1 oz.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, JANUARY 6, 1882.

INVENTION AND THE PATENT LAWS.

THE criticism to which the Patent Law Amendment Bill drafted by a committee of the Society of Arts has been subjected, will help to clear the ground for the measure, which it is generally conceded must be brought into the Houses of Parliament and passed with as little delay as possible, whether introduced by the Government or by private members. The Bill put forward by the Society of Arts has much to recommend it, for, in the first place, it is drafted by a committee formed of men who really know something of the points at issue, and secondly, it contains many provisions which are steps in the right direction. At the same time it has other provisions which are believed by many to be antagonistic to the true purpose of a Patents Law—viz., the encouragement of invention for the benefit of the public. The preamble of the Bill is excellent; it sets forth clearly and succinctly the only reason the State has for granting any one a monopoly; but some of the provisions are as objectionable as those which have marred the last five Bills presented to Parliament. We have no intention of following the speakers who have taken part in the prolonged discussion of the subject held at the rooms of the Society of Arts; but we may point out that the weak parts of the Bill are the scale of fees and the clauses relating to examination. The proposed examination would be worse than useless, for while from one point of view it does not go far enough, from the other it places too much power in the hands of the examiner without providing any benefit whatever to the intending patentee. The examination which would be welcomed would be one that pointed out to the "inventor" the want of novelty in the invention, or which warned him against the possibility of infringing existing patents, but not to the extent of stopping the issue of a patent. The scale of stamp duties, though reduced to £12 10s. by the Bill (£2 10s. on application and £10 on grant of patent), is still too high; for assuming the object of a Patent Law to be, as is stated in the letters themselves, the encouragement of invention, the fees should be made as low as possible, but so as to leave a margin for the support in a proper condition of a museum and library. Here we may appropriately note the error that has been frequently made in connection with the cost of patents in the United States, where it is asserted that they really cost more than an English patent, because each feature has to be made the subject matter of a separate patent. It is true that all the parts of a machine, if novel, can be separately patented for application singly or collectively to other machines; but there is nothing to prevent the inventor including them all under one patent, and obtaining that for, so far as the Government is concerned, £7, which in practice has always been found sufficient to cover the heavy expenses of the United States Patent Office. If anyone doubts that an amended Patent Law, giving protection at a small cost would be of benefit to this country, he may be referred to the experience of Messrs. Denny, the well-known shipbuilders of Dumbarton

Rather more than a year ago that firm, believing their workmen possessed a large amount of the inventive faculty which remained latent for want of sufficient encouragement to bring it out, offered small money rewards for improvements in any of the machines or processes carried on in their yards and shops; and they intrusted the awarding of these to a committee, who have recently issued their second annual report. Practically, this report is the first since the scheme has been in working order, and from it we find that the committee have had under their consideration no fewer than thirty-four claims. The whole of these claims, we may take it, had some ground, though possibly in some cases those who made them, had a slightly exaggerated idea of their importance. Nevertheless, they all represented some inventive work—whether useful or not was left to the committee to decide; and out of the thirty-four only eight have been rejected as unworthy of reward, while four remain for further consideration. We thus find that during 1881, in one establishment, no fewer than twenty-two improvements have been made which are judged worthy of being rewarded by sums ranging from £2 to £5—sums which are practically acknowledged to be inadequate as rewards. The committee, in fact, are now, we learn, empowered to grant sums of money exceeding £10, and also to give larger amounts than those which have been hitherto granted for improvements of the same degree of merit. Further, some of the improvements made are of so important a character, that provisions have been made for giving assistance in procuring patent rights; so that we may fairly say the scheme has been so successful as to have exceeded the anticipations of the firm. A large proportion of the improvements made by the workmen are in connection with the wood-working machines, some of which have been so modified that they now do twice the quantity of work, while others have been so improved that they are now used for different kinds of work, besides the one for which they were designed. Other machines, again, have been so improved that they do the same kind of work with greater safety, while sundry new processes and new methods have received awards from the committee. The results obtained in the short time reported on by the committee are highly encouraging, proving as they do in the most unmistakable manner that there is plenty of inventive talent amongst our mechanics and artisans, and that it lies dormant in the majority of cases because there is so little inducement for its exercise. We have always held that a Patent Law which encouraged invention by putting protection within the reach of the poorest workman would be of public benefit to this country, as it has been to the United States, and the results of the experiment made by the Messrs. Denny are convincing proof that there is no lack of inventive skill in the rank and file of our workshops. Many of the improvements made by Messrs. Denny's workmen are in small details, not worth patenting, but still of importance in the workshop; it is clear, however, that the improvements which made machines capable of doing twice the amount of work are not only worth patenting, but under different circumstances would have been patented and published for the benefit of other inventors.

NEW STORAGE BATTERIES.

THE utility of the secondary battery or accumulator in any system of electric lighting appears to have been widely recognised, if we may judge from the number of inventions, patented and otherwise, which have come into existence within the past twelve months. Besides those already

described and illustrated in our columns, there are at least three whose experimental trial is looked forward to with some interest, viz., those of Edison, Swan, and Brush—the latter, it is stated, being on quite a novel principle. Until a demand was created for these secondary batteries, no one thought of improving Planté's simple device of two plates of sheet lead; but since the discovery of the value of red lead as a coating, which was made by M. Faure, many experimenters have been at work, and there will probably shortly be as many different accumulators as there are batteries proper—that is, batteries in actual use, for the varieties of Voltaic cell known and described are more numerous than is generally supposed. At a recent meeting of the Society of Telegraph Engineers and Electricians, Mr. Cromwell F. Varley, gave some curious instances of the manner in which inventions lie dormant or practically unutilised for want of a sphere of labour. It seems that so far back as 1854, in Patent No. 2555, he described forms of cells which have actually been re-patented three times—viz., by Sir C. Wheatstone, Minotti and Marie-Davy. The battery first described in the specification is a modification of the Daniell; but Mr. Varley also inserted a description of the sulphate of mercury cell, and in connection with the patent, claimed the use of induction surfaces for storing up electricity. These induction surfaces were then of well-known condensers composed of laminae of tinfoil separated by sheets of some non-conducting substances, and connected at alternate ends to the poles of the battery. It is not unlikely that in the forgotten documents at the Patent Office there may be some other inventions which more nearly resemble the electric accumulator as we know it to-day; but it is obvious that the "survival of the fittest" will be the natural result, and the fittest will, no doubt, be that one which is cheapest. From this point of view it might be supposed that the secondary battery devised by M. J. Roussee, in which he employs a sheet of palladium as the negative element, would be of little practical utility; but with a sheet of lead at the positive pole, the battery is very powerful, even when of small dimensions, and notwithstanding the cost of the metal, it is not impossible that other circumstances may combine to render the use of palladium commercially profitable. The palladium is said to absorb 900 times its volume of hydrogen; but as a sheet of thin iron, with ammonium sulphate as the solution, absorbs 200 volumes, it is possible that the latter may be found more advantageous. The positive pole is either a plate of plain lead, or lead covered with litharge, or pure oxide, but the solution must contain 50 per cent. of ammonium sulphate. In another device, M. Roussee employs a cylinder of ferro-manganese for the positive, and sheet iron as the negative element. Modifications of Planté's secondary battery appear to have more attraction for inventors, probably because they are efficient and are cheaply constructed. On p. 615, Vol. XXXIII., we gave a description of one of these modifications, made by M. de Pezzer, who, working with M. Carpentier, has lately made further improvements. He uses strips of lead about half an inch wide by half a metre (say, 20in.) long, and of any suitable thickness—which probably means as thin as can be handled and worked—which he passes between the rollers of a corrugating machine, so arranged as to make the corrugations in an oblique direction. Each of these strips he folds in two, with a porous separator between, and solders the ends together. The corrugations are obviously to afford a passage for the escape of gases, and they are so arranged as regards the alternate position of positive and negative plates that they all point upwards. The soldered ends of the plates are at the top,

where they are in metallic connection with projecting strips forming the electrodes. In some cells already constructed the negative elements are made of lead $\frac{1}{8}$ mm. thick by 10mm. wide, and the positive of lead $\frac{1}{8}$ mm. thick, and 15mm. wide. They are arranged in the flat or rectangular form of the Bunsen cell, with a porous pot, both divisions being filled with a weak solution of sulphuric acid. The porous pot may seem an unnecessary addition, but it is found that its use prevents the crystallised junctions between the plates which are found in secondary batteries constantly worked. The arrangement is said to have given good results, and its resistance, notwithstanding the porous jar, is not greater than is found in other forms. Further improvements of Faure's battery were also provisionally protected by patent No. 2,323 of 1881 (see p. 273, *ante*), in which a "porous vessel" is obtained by folding a sheet of felt or other material in a number of radiating folds, in each compartment of which is placed a sheet of metal to form a negative element. The positive elements are placed exterior to this "porous vessel," all plates of similar name being connected together. In another arrangement the positive plates are also placed in a "porous vessel," but as the patent was not proceeded with, we may assume that the device was not found of sufficient value to need a special protection. In this specification it is mentioned that the electrodes may be ropes of lead or zinc wire, the "porous vessel" being then a "gimp" of woollen thread. It is probable, however, that ultimately lead will be found not so economically useful in secondary batteries as has been supposed, for although it is low-priced it is also heavy, and it is doubtful whether it can be employed in sheets of such thinness as is possible with other metals.

The paper by Mr. Sutton, of Ballarat, read recently before the Royal Society, the contents of which we described briefly last week, would seem to show that we have not yet discovered the best form of secondary battery, or, in other words, the best means of storing electricity. From his paper we learn that he has made very many experiments with the commoner metals, such as lead, zinc, iron, and copper, and has also tried other solutions than diluted sulphuric acid. He also has tried the porous pot, placing in it the positive plate of lead with dilute sulphuric acid, and inserting the negative in the outer vessel containing a solution of acetate of lead. This combination stores electricity by peroxidising the positive electrode and depositing metallic lead from the acetate solution on the negative, the hydrogen combining to form acetic acid. When the cell is discharging the peroxide is reduced, and the oxide dissolving in the acetic acid forms the original solution of acetate of lead. By this arrangement the injurious effects of the hydrogen when charging are eliminated; but the results obtained were not apparently satisfactory to Mr. Sutton, who continued his researches. His first important discovery seems to have been that by simply amalgamating the lead plates with mercury, a marked increase is obtainable in polarisation effects, the plates becoming more uniformly and rapidly peroxidised when used as positives, while local action entirely ceases. The amalgamated positive electrodes were tried in various ways in order to discover the best negative to use with them, and Mr. Sutton found that with zinc, iron, or copper negatives, using a solution that in each case was a salt of the metal composing the negative electrode—the sulphates invariably—he obtained results far more powerful than with the lead plates, and more constant. The cell with zinc negative was discarded because it would be necessary to keep the amalgamated to prevent local action:

the iron negative was similarly treated because the iron-oxidised when the cell was not at work; and the battery finally adopted, which will be known henceforth as the Sutton, contains a plate of copper as the negative, a plate of amalgamated lead as the positive, and a solution of sulphate of copper as the medium of communication. The sheet of lead is prepared in the usual way by scouring, dipping in dilute sulphuric acid, and rubbing on mercury, so as to thoroughly amalgamate it; the copper is a thin sheet cut a little shorter than the lead. Both plates are perforated with a number of holes, and are rolled into a spiral, care being taken to keep them a sufficient distance apart to allow of free circulation of the solution. Mr. Sutton mentions rubber bands, but it is obvious that any substance may be used, provided it is unacted upon by the solution and is itself not injurious. The spiral form is obviously of no moment, and it is possible that in the case of large batteries the flat plates may be found more convenient. The combination is, however, immersed in a solution of sulphate of copper, and the lead plate is connected to the positive electrode of the electric generator. As the charging proceeds, the oxygen of the decomposed solution combines with the lead forming an even coating of insoluble peroxide, the hydrogen replaces the copper of the solution, which is deposited on the copper plate in the metallic state. The cell is known to be fully charged by the colour of the solution, which gradually loses its blueness until it is converted into sulphuric acid and water. A reversal of the action follows when the cell is brought into use; the peroxide is reduced, and the copper element is oxidised, and, as the latter dissolves in the solution, the blue colour returns, the solution thus forming, as Mr. Sutton says, a "veritable charging gauge." Such a cell can be made to last for hours, the time being dependent on the quantity of sulphate of copper decomposed. With a small cell measuring 4in. by 4in., holding about one pint of solution, Mr. Sutton has obtained over two hours' effective work in heating to a red heat an inch of No. 28 iron wire. Mr. Sutton has also constructed trough batteries by fixing a series of amalgamated lead plates in grooves in boxes, and filling the intervals with the sulphate of copper solution, "the positive sides of the plates being peroxidised and copper deposited on the negative sides," when a current is passed through. It is not quite clear whether he uses copper plates or only lead ones in this form; but sufficient has been said to guide the experimenter, who is free to make what use he pleases of his discoveries, as Mr. Sutton has not patented his form of secondary battery. Mr. J. W. Swan, of electric-lighting fame, has also made some improvements in electric storage batteries, and has taken out a patent for them. His object was to contrive surfaces more suitable for holding spongy lead, or lead in a finely divided form, than the simple plates of sheet lead, and he apparently believes he has accomplished that object by giving the lead plates a cellular, grooved, or corrugated surface, the interstices of which can be filled with the spongy lead, which is supported in position by the corrugations or cells, as the case may be. The main idea is to obtain as large an amount of acting-surface as possible in a small space, while preventing the spongy lead from falling away, as it does unless held up by some supporting material. We have thus briefly described some of the more noticeable of the secondary batteries which have sprung into existence since a demand was created for them, and it will, we think, be seen that the lines laid down by Mr. Sutton and M. J. Roussee are those which give most promise of reaching as near as possible to perfection.

THE WATCH, AND HOW TO REPAIR IT.

By "SECONDS' PRACTICAL WATCHMAKER."

(Continued from page 321.)

Dial when too large, Stop Watch.

A GAIN I introduce a defect of a lever watch which seldom comes before watch-repairs, though more than one instance of such has fallen to my lot, in connection with an old watch which had descended as an heirloom to its present owner, whom I knew.

The watch referred to was useless as a time-keeper. During the usual course of examining such things, it was found that an enamel dial had been introduced in lieu of the original one—gold or silver. The enamel dial being much thicker than the old metallic one, protruded considerably through the glass bezel, which resulted in the fact that difficulty was experienced in firmly closing it, in consequence of the glass pressing upon the edge of the dial, although it had been much reduced in size. The dial being pressed by the closing of the bezel, the "bar" and pillar-plate under such pressure reduced the end-shakes of the fourth and escape-wheels, which resulted in the watch frequently stopping, and occupying considerable time to detect the cause. It was remedied by reducing the thickness of the third-wheel bar, and giving a trifle extra end-shake to the escape-wheel and pallets-staff, the end-shakes of which were less than should have been. I may add that, the glass was somewhat at fault, inasmuch, instead of the concavity of it "rising direct" from its "seat" of the bezel, its "lunette" form was imperfect; hence, pressure from it upon the dial when the bezel was closed.

Vibrations of Levers "falling off."

Young hands will do well to attend to the following. It is no uncommon occurrence to find in ordinary low-priced lever-watches that, little thought and care are bestowed upon them at their final completion, termed by some of the craft "examining;" inasmuch, a movement may be put together and supposed to be ready to be put into its case so soon as the balance-cock is screwed on; but, when such has been accomplished, no "tick" can be produced. "Young hands" may be astonished to find, upon looking through the frame, that the "balance-bar" (or bars) are foul of the curpins or the pendulum spring-stud. Looking again through the frame, such workmen may observe that the potence, although screwed tightly down, is not close to the upper plate: hence the balance is lower in the frame than it should be. The watch is then taken to pieces, in order that the cause of such may be discovered and remedied. I have frequently pointed out to such as I am addressing that, more than one cause may be in operation to produce that which is the present topic; namely, the potence-screw when screwed down till the further advance of the screw-driver is arrested, frequently arises out of the fact that the end of the screw does not pass through the potence-hole and the upper-plate; thereby, although resisting further motion of the screw-driver, the potence is not secured, which generally results through the "tap" of the screw not being "free" in the passage-hole of the potence-foot; in which case, instead of the screw acting in the upper plate only, it has to act in the partly "tapped" hole of the "potence-flap" as well as in the "tapped" hole of the upper-plate. Should it happen that the screw of the potence did not pass through the upper-plate by reason of a "burr" on the end of the "tap," or that the passage-hole of the "potence-flap" was too small for the tapped portion of the screw, two defects, similar in results, would result—namely, in the first instance, the potence would be loose; in the next, it would not be secured close to the upper-plate.

Escape-Wheel Loose on its Pinion-Collet.

The defect here referred to is of frequent occurrence in watches of "low" quality, arising in most instances from the want of care in properly securing the wheel to its collet. Workmen of limited experience are apt to consider that, when a lever watch "loses," and that the balance does not "vibrate" its full extent, the mainspring power is insufficient. Instances are not few where workmen have exchanged the mainspring

of such a watch for another of stronger power, which resulted in producing no better result, hoping that, as time went on, improved action of the balance would result; but results proved to the contrary. In one instance I remember a workman was entrusted to correct a watch as referred to, which resulted in his discovery that the "escape-wheel" was loose on its collet, in consequence of which the mainspring power could not impart sufficient force to the propulsion of the lever and pallets. The wheel having been made secure, the defect was remedied.

To Tighten a Lever Escape-Wheel when Loose on its Collet.

Most watch-wheels are secured to their pinions by means of "riveting," but lever escape-wheels are managed in a different manner, inasmuch, a collet is fixed on the pinion-arbor, upon which the wheel is fitted.

In the present instance the details of placing the collet and arranging the wheel upon it are not intended; therefore, our subject is merely to instruct, as the "heading" of the subject purports.

The wheel being loose upon its collet, workmen should see that a trifling portion of the collet is slightly above the surface of the wheel; if so, and the collet fitted the hole of the wheel properly when originally made, little trouble will result in securing it, because, by fixing a ferrule upon the pinion, placing the same in "turns" with brass centres, so formed that the shoulders of the pinion act upon the face of such centres instead of the ends of the pivots in short holes of it. With the pinion secured in the turns with centres as referred to, placing the "rest" of the "turns" properly—i.e., to suit the height of tool to be described—when put in motion by means of a "hair-bar," by holding the point of a small "half-round" burnisher, when placed upon the "rest," against that portion of the collet which projects through the wheel; and, while the pinion partakes of motion with the "bar," pressure of the "burnisher" point should be made use of to somewhat press the projecting portion of the collet which passes through the wheel toward it, by which means the wheel becomes secure. At the same time (if a dampness of oil be upon the point of the burnisher, the "rubbed over" portion of the collet will be burnished; but don't let the burnisher pass from the "collet" to the surface of the wheel, else a "slovenly" job will be the result.

Lever Escape Wheel—Jewelled Holes too Large or Cracked

Among the varieties of watch-repairers, there are classes of the "craft" who possess qualities of extraordinary repugnance to patience being their guide; inasmuch examples occasionally come before "jobbers" where the jewel-hole is not only too large for the pivot, but the pivot of the brass setting of such hole is too small for the upper plate; at the same time such setting is not made secure by its end-piece when screwed down—resulting in this: that, as the escape-wheel advanced, the teeth of such wheel "dropped" at different depths upon its pallets; and when the "wheel depth" was shallow at its deepest depth, it might occasionally miss "locking," resulting in the watch stopping. The same result is frequently caused by the upper jewel-hole being chipped, whereby the pivot would be working in a hole approaching an oval form instead of a circular one. I have occasionally found that such a state of things has arisen out of misadventure in putting the watch together; inasmuch, should the upper plate not pass readily over the "pillars," pressure upon it would be necessary; then, in such case, the end of the pivot might fracture the jewel-hole unknown to the workman, who in his ignorance of the defect would necessarily complete "the job," resulting in the inexperienced "jobber" thinking that the cause of the watch "stopping" is the result of a defective fourth-wheel depth.

Geneve Horizontal Stop through the Barrel being "Out of Flat."

The following remarks refer to an instrument of early date; inasmuch, fusee and chain were a part of the arrangement, instead of the more modern "going-barrel." The watch referred to had the upper-plate secured by four pins, as is usual with watches of ordinary English construction, with the exception that the pillar of

the frame which is near to the barrel-hollow was so close to it that the hole of the upper plate had been made so large as to endanger its freedom with the barrel in its usual course of action; added to which, the pin of such pillar which secured the plate, had been left so long that it projected considerably beyond the barrel-hollow; so that, when the barrel—which was untrue as to flatness and circularity—in its action, presented its more extended portion (that is to say, its projecting "rim," toward the pin referred to, the watch stopped, by the "rim" of the barrel being foul of the end of the pillar-pin.

Lever Conversion—Stop by Chain-Hook.

A few years ago it was no uncommon event to transform a "verge" watch into a "lever" one by removing the old escapement and introducing the more modern arrangement—"the lever"; but in the days to which I make reference there had been little experience in such matters, resulting in this—that, after the owner of such old watch having been charged—say two pounds—for the alteration, his modernised watch could not be relied upon as indicating the time, arising out of its frequent stoppage, owing to the "calliper" of the original arrangement being unsuited to the alteration. A case in point is as follows. In the days of verge-watch manufacture, it was not uncommon to find the fusee chain had special attention paid to it as regards its sound structure, by having it broad, by which the pins of its links were sound, and of fair proportion; hence, in instances where such broad chain was retained, and the "lever" escapement introduced, its "roller" was too near such broad chain, and occasionally, when the "roller" was placed high toward the balance, it has been the means of the watch stopping by reason of the edge of the roller occasionally being foul of its barrel chain-hook, which in some instances projected beyond the chain. Remedy: reducing the breadth of the hook, or a narrower chain.

Stop-work Unsafe to Lever Watch.

Although this defect may have been pointed out previously, two other instances have to be recorded, the first of which frequently is occasioned by "young hands" being too much in a hurry to get rid of their work by striving to produce more than their fellows. I here take advantage of an opportunity to counsel such by stating that to excel in watch jobbing, success seldom, if ever, is attained by rapidly—which often means carelessly—cleaning and putting together watches. For instance, an upper-plate when cleaned with rapidity and placed on one side as ready, without looking to the "stop" to see whether the spring of it acts so as to force the "stop" to its proper position, is a dangerous proceeding; because, should the "spring" of it be altered in form by the act of brushing—which frequently occurs—when the watch has been put together and wound up without due care as to a defect existing, it is no uncommon occurrence to have the chain broken, or if not, the frame has to be taken asunder to alter the "stop-spring" so that the "stop" may "rise" to allow the fusee-cap to pass under it.

Again: another defect in "stop-work" often arises from "jobbers" putting the wrong screw in the "name-piece"; inasmuch, should one screw-tap be longer than the other, and the longer tapped one be so placed that its point is over the chain, such screw-end may prevent the chain rising sufficiently to allow it to press the "stop" to its proper place, by which "over-winding" of the fusee is prevented. So simple a matter as the length and positions of such screws—in fact all—is worthy of observation.

French Horizontal Watch Stop through the Minute-Wheel.

A horizontal watch of early date, and of French make, had been a source of trouble to jobbers a long time. It might go fairly well during a few weeks; at other times it would stop more than once a day. After repeated attempts to correct it, one jobber detected the cause of the troubles it had caused—namely, that the motion-work was defective, inasmuch that the minute-wheel, instead of acting upon a "stud" as is usual in modern work, a "pipe" projected beyond the back of the wheel, which pipe worked in a hole formed in the pillar-plate. The pipe referred to projected beyond the surface of the centre-wheel sink, hence the centre-wheel,

which had "bars" instead of a plain surface, occasionally caught against such "bars," and stopped the watch. The projecting pipe of the minute-wheel pinion was turned shorter, which remedied the defect.

Geneve Pendulum-spring Foul.

Many old-fashioned Geneve watches have little room for the freedom of the pendulum-spring, so that, should such spring get damaged, great difficulty is often experienced in freeing it. In some of the old models, the cylinder upper-end piece is secured by screws from the under-side, in many instances of which the screws have from time to time been improperly screwed in, resulting in the heads of them projecting above the surface of the balance-cock, so much so, that the upper surface of the spring is doubtfully free of them; at the same time, if the movement be reversed in position, the necessary end-shake of the cylinder may cause the spring to be foul of the projecting portions of the two screws referred to; therefore, no watch should be put into its case until the freedom of the end-piece screws and the pendulum-spring are insured. It may be asked how to free such spring. Firstly remove the screws, reduce the thickness of the heads so that they are level with the under-side of the balance-cock; then should the pendulum spring be foul of the "cock," the collet and spring should be removed from the balance, placed upon an arbor, and when secured in the turns without a "bow" upon the ferrule—the flatness of the spring may be much improved by the point of a rigid pointer. If the "pendulum-collet" be large (some old ones are so), the top edge of such should be chamfered off with a graver, the end of which should not be pointed, but flat.

Escape-Wheel Jewel-Holes to "Lever" Watch Deep.

When a lever escape-wheel has more than necessary end-shake, evils are introduced which otherwise would not exist. For instance, very few jewel-holes are perfectly straight through their entire length; that is to say, they are larger at the entrance portion of them than they are at the "end-piece" side. Therefore, such pinion, when in the frame with the pillar-plate downward, and the end-shake of it in excess, the end only of the upper-pivot being in the largest part of such hole, will soon convince anyone who may venture a trial that in such condition (the watch being "set going" with a light "locking" of the wheel on the pallets), the wheel will miss its "locking"; but the same conditions remaining, and the frame reversed in position, instead of the wheel missing the locking, it—in most instances—will "lock" safely; but, when the escape-wheel by its gravity "locks" safely, there will be danger of the fourth-wheel depth being shallow in the escape-wheel pinion, which, in any kind of quality, would be fatal to continuous "going."

(To be continued.)

CART AND WHEEL-MAKING.—XIII.

By J. CHARLES KING.

(Continued from page 344.)

THE Chart, Fig. 22, at p. 344, supplies every measure requisite for the cart-maker in planning his shafts, and framing together with one or two cross-bars, to make up what is technically termed the carriage of a gig, or dog-cart.

Of course it need hardly be pointed out that the level ground is the horizontal base from which the heights on the vertical line A, as well as those marked on the other four divergent lines of the chart are measured. The main one of these is D, the third from the vertical line, showing the rise, width, and distance of the tug-stop, from, and in relation to the height of horse, and to the corresponding measures on the vertical line A. E, the fourth line from the vertical, is the next structural line to notice, while B and C, the first and second lines from the vertical lines, relate to the proper fit of the harness used in stopping or retarding a dog-cart. The breechen-staple-line, E, is essential for the proper position of the breechen strap. B, the first line from the vertical line, is of less importance to the cart-maker, as it simply supplies the due position

of kicking-strap staples. These are now seldom used, except for show or for restive horses, to prevent kicking, which the kicking-strap prevents if in proper position;—in too many instances the kicking-strap staples are put too forward: this makes the kicking-strap useless, as the hips of the horse are behind the strap, and allow him to kick with impunity.

It is with the vertical and tug-lines the cartmaker has to do mainly in construction, as the front of the bar is framed into the shafts at the vertical line A, and the back-ends of the shafts have to be made to the length of body.

We will take the learner over some of the little difficulties which are sure to arise, and of insuring that his carriage shall be out-of-winding; that both shafts shall be duly level at the bar, tug, and back-ends—that is, when a straight edge is laid on their top flat surfaces; and, finally, that both shafts shall rise equally from the bar to the tug, and from the bar on the line, A, to the back-end of shafts. Unless this accuracy is insured, the shafts will be uneven in height, and press unequally on the tugs of the harness, or one of the front steps will be lower than the other, and strain the body on one side at its fixing near the bar, to which the steps are fixed.

Upon receiving your shafts from the shaft-benders, thoroughly examine them; reject them if there are any black, hard, cross-grained marks between the position of the bar and the tug on the lower edges of the shaft. These black marks do not so much matter if in a line along the centre of the back-end of the shafts. The best shafts are free from such defects. The next thing is to ascertain if the shafts have the same side-cant from the tug to the back-ends. This can only be done by first marking the exact position of the bar—(by the term "bar," the draft-bar to which the steps are fixed is always understood); then mark the position of the tug-stops on the highest part of the rise of the curve at the front-end of the shafts, line D. Have a flat-topped tressel, about 2ft. high, for testing the side-cant; by cramping down on this tressel the two shafts back to back, as represented by Fig. 20 (see page 344), with B for a tressel. A and C are the points of contact; these should be same as each other. Perhaps you may find one of the ends at A nearer the floor-line than the other, by, say, half an inch. Find out which is correct to your measure of side-cant, which is done by measuring the height of the tressel, 2ft., then the height of the tug part, say 20in., and the height of the back-end, say, 20in. one shaft, and 20in. the other (I purposely make the shafts to measure differently to help a learner); the mean between 24in. and 20in., being 22in., or two inches less than the height of tressel for each shaft, makes 4in. side-cant, or "throw-in" of both shafts from the bar to the tug—the measure wanted. But how about one of the shafts being 20in. from the floor? This must be corrected, which can mostly be done by cutting a strip off along one outside edge of one shaft 4in. at the end, out to nothing at the bar, and 4in. inside of other shaft from back-end to nothing at the bar. This gives 4in. less than the requisite side-cant wanted. By a critical measure of the width of the shafts at the bar they will invariably found 1 of an inch wider than ordered of the bender; this, planed off, gives the side-cant wanted.

Again, at the tug parts, the widths of the shafts are generally left from 1 to 4in. more than ordered. This mostly enables you to adjust the side-cant exactly. Turn-out of points is ascertained to be correct at the same time, and rectified if wrong from the extra width of wood left on them by the shaft-bender.

Before beginning to measure for the rise of the shafts from the bar, be sure any twist in the shaft is corrected by planing each true from bar to back-end, which is always reckoned to be horizontal. Now, cramp both shafts on the tressel at the bar part, and measure from the floor at the tug-part, say one shaft rises 6in. above the height of the tressel, the other rises 7in., 6in. being the correct measure, and 7in. one inch too much: this is rectified easily by cramping the tug-part, or a little behind it, on to a solidly-fixed bench, with the back-end and bar-part free to be bent back out of its extra throw; bend back the shaft by the force of your arms, sprung heavily down on the back-end; measure again, and it will doubtless be the same as the other shaft; if not

straight enough along the belly-part of the shaft, hang on a half-owt. all night, with fore-part cramped to the bench; this will do it by the morning.

Do not use any hot water unless carefully, and with a little aid from a coachmaker, or you will get your shafts out of shape, and perhaps twisted.

We will now suppose everything is to exact measure in your shafts; dress up square with smoothing, compass, and concave planes, beginning with the bottom of shaft, and gauging to the thickness at the bar, which is always the largest part of a shaft.

The insides of the shafts are next squared from the bottom, and the outsides to the due widths, and the tops last, to the thickness required. If you have to leave your shafts for a few days, it is best to brace them together to their correct rise—the side-cant will not alter, but may be altered after framed, if wanted, by struts or ties. The bent points of the shafts have to be dressed up to true sweeps, and gradually tapering to the tip, 1in. wide, 3in. thick.

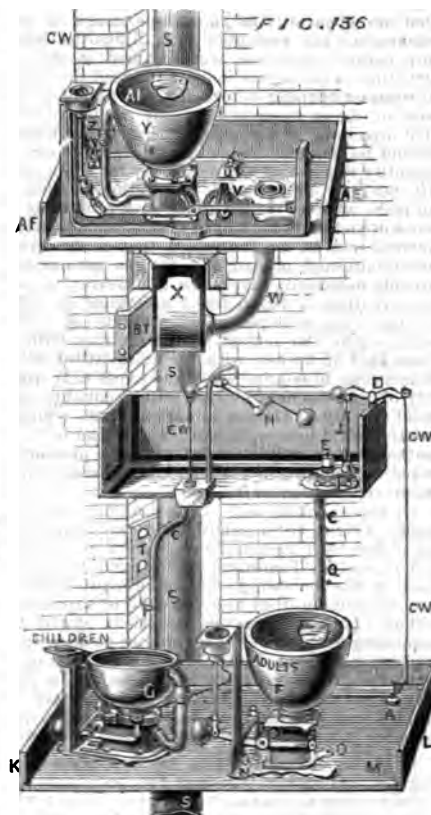
(To be continued.)

PRACTICAL NOTES ON PLUMBING.—XXIII.*

By P. J. DAVIES, H.M.A.S.P., & Co.

Inside Work, or Sanitary Plumbing—Twin Closets—Fixing and Wiring Closets.

A REFERENCE to Fig. 126, chapter XX., of this article will show the necessary traps and pipes to be fixed to twin closets, and Fig. 136 illustrates the two closets as fixed. Both



these closets are supplied with water through service boxes and submerged valves, from the cistern above. When such valves are used they are generally actuated by means of a strong copper wire, CW, 1/2 in. in diameter, and by the use of the cranks BA; also the ball lever D, which answers, as its name implies, as a lever, to change the direction of the wire, and as a weight to bring up the wire. When fixing these closets it must not be overlooked that it is essential in all cases, without exception, to fix them over a proper lead safe, M, fitted with a good overflow pipe.

Though to some experienced hands in the trade it may appear superfluous, it is necessary

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sary to remind the younger ones that it is very requisite to use great care when bedding down, or as it is better known in the trade, when setting the closet, so that, when screwing it to the floor, the bottoms of the lugs and lead-work are well painted before the putty is applied; also that the closet must be properly bedded on good putty before the screws are put in. In the upper part of this diagram is shown a Bramah closet fixed over a U-trap, and there is also shown the old method of fixing the overflow of the safe into the side or cheek of the trap. There are plumbers even to this day who adopt this style, and I think that they are in this point decidedly in error.

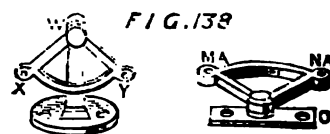
Fig. 137 is a diagram of a pan-closet as fixed



over a U-trap. This kind of closet I have long since condemned, but as there are thousands of plumbers who think otherwise, and will insist on fixing the old pan-closet, I deem it almost a matter of duty to apprentices in the trade to describe the proper method of fixing them. Some of my readers will probably more easily recognise this diagram under the title of "wired closet," which means that the valve in the cistern is actuated by the use of a wire CW (closet-wire). The cistern should be lined with 6lb., or, better still, 7lb. lead, and the valves fixed over a service-box properly wired.

Wiring and Cranking Closets.

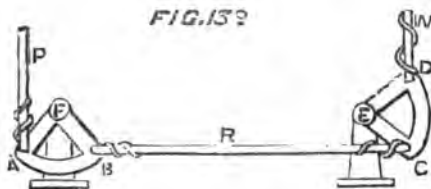
The best method of doing this is to fix the cranks so that they may pull in a line one with each other. Use side cranks, MA, Fig. 138, for changing horizontal directions, as also at B, Fig. 137, and upright cranks WX, Fig. 138, for



changing the pull-line from a horizontal to a perpendicular, as shown at A, Fig. 136.

Fig. 139 shows the method of fixing cranks to a pan-closet without the use of a side crank, and which gives undisturbed motion. P is where the power is applied from the lever of the cistern, and W the end working the weight. It will very readily be seen that if you pull up the first crank at A, that this power will be communicated to that corresponding point of the second crank C, and affect whatever is at the end of the wire W. Now suppose you cannot go in a straight line with the wire W, but have a wall to pass through, as at E, Fig. 140, you must, under these circumstances, connect the

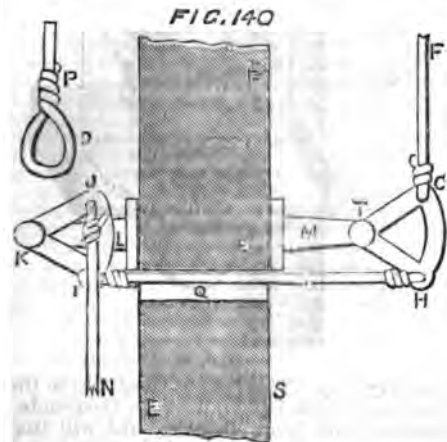
wire W, Fig. 139, to N, Fig. 40. In this case the crank is shown to work back or with crossed wires, which allows the wire N to work close up against the wall E. Here notice the difference



with the crank H. MG, as it is now fixed, throws the wire F at least 6 in. away from the wall, and is a clear indication that the person who fixed it did not know his business.

The proper way to fix the foot of this crank is lower down at about S, so that the wire may pull from above the rivet line or about T, which would throw the crank to work backwards as K J I, and thus allow the wire to come near the wall.

By turning Fig. 140 upside down, and joining F on to P, Fig. 139, the whole of the work may be reversed. That is, pull at N, and you actuate W, Fig. 139, and by turning Fig. 139 upside down, you at once get an overhead motion, or in other words, pull the wire, and you actuate W. The above is the method of fixing cranks to the bottom of joists or ceilings, and will answer



in situations where ball levers cannot be employed. Of course, in instances as here described, a weight must be fixed on the wire W to draw the wire back, or a check-spring may be employed.

In the selection of cranks it is always necessary to see that they are not put together with an iron rivet; they must be brass and work loosely.

If by any chance they have become clogged up and stiff through the use of oil, place them over a moderate fire and so burn out the oil; but remember that if you put them over too hot a fire you will most probably melt the rivet.

GAS-BURNERS.*

WITH an ordinary gas-flame, as used for lighting, on the gas issuing from the burner, the hydrogen is consumed at the lowest part of the flame with its characteristic colour, while the particles of carbon are liberated in a solid state and by the heat become incandescent; and according to the temperature the carbon attains, so is the degree of light evolved. That the carbon is rendered solid is proved by passing the blade of a table-knife, or a card through the upper or brighter part of the flame, when on the knife or card will be deposited a coat of soot or lamp-black, or solid carbon. If, however, the gas be mixed with a quantity of air previous to ignition, then the carbon is not separated, and the mixture is consumed in the gaseous state without giving any practical amount of light, but yielding heat in proportion to the quantity of carbon and hydrogen consumed.

It is almost needless to state that a proper admixture or supply of air is indispensable to the perfect combustion of the gas, and that in the event

of an insufficiency of this, the carbon is liberated as smoke; while an excess of air, particularly when cold, will materially affect the intensity of the light of a gas-burner. Already we have familiarly explained this cooling influence on flame, and its effect of diminishing the intensity of light, which fact was first discovered at the commencement of the present century by Sir Humphrey Davy, and described by him in his "Researches on Flame." Moreover, it is now well known that in order to obtain the best results, or the maximum amount of light from gas, the air supplying the burners should be heated. Thus for the proper combustion of gas for lighting purposes, a sufficiency without any excess of air is necessary, and where practicable the air should be heated or all provisions made to prevent a quantity of cold air to come in contact with the flame. The effect of the atmospheric burner may be produced by causing gas to issue under the comparatively heavy pressure of 4 in. or 5 in., and from a very fine aperture, when only a blue light entirely devoid of light will be observed. This is undoubtedly due to the cooling influence of the air, but according to the opinion of some engineers the gas is too much oxidised,—however, whichever of the two assertions may be correct, the effect is the same, an excess of atmospheric air, or too thin a stream of gas. But if we now increase the size of the orifice and diminish the pressure then the gas will yield light in the form of a single jet, which, as is well known, is the most extravagant of all burners, arising from the fact of the smallness of the flame and cooling action of the atmosphere. If, however, a number of these jets are placed side by side as in the argand burner, then the gas is applied advantageously as each jet combines with that next it, and the cooling influence is to a great extent prevented. But should the jets be detached, as was often the case in the early years of gas-lighting, when argands were made with three and six holes, then all the defects of the single jets are retained, with none of the advantages of the argand.

During many years the argand burner was exclusively used for shops, where the employment of gas only had extended, and we may observe that no apparatus in the whole range of gas-engineering has presented such difficulties before any degree of success was attained in its construction as the argand burner. Indeed the system of contract burning before the adoption of meters was in direct opposition to any improvement in that direction, as companies insisted that burners should be employed which could only deliver the quantity of gas contracted for, say for a burner of 5 ft. per hour, at a pressure of 5-10ths or 6-10ths of an inch, when of course under such conditions the gas will yield only one-half of the available light to be derived from it, for the reason that as the orifices are diminished in size, so is the gas influenced as already described. To make this clearer, we may observe that, if the holes of an argand be drilled of such a size as to permit 5 ft. to issue at 1-10th, and to give the light of 16 candles, then with the same kind of burner, with the holes drilled of the dimensions to require 6-10ths to expel that quantity of gas, the light evolved will be equal to eight candles only. This is a curious fact, which is easily proved by experiment; and if the holes are of that size to require about 35-10ths pressure to expel the quantity of gas mentioned there, no light whatever is given by the gas.

By some writers, and of the number was Alexander Wright, the argand burner as a light-giving agent has been described as the most economical; others, such as Tomlinson, have given the preference to the bat-wing, and again many engineers are of opinion that the fish-tail is superior to either. It may, however, be briefly stated that supposing each burner of its kind to be made in the best manner, that is, to give the full amount of light under favourable circumstances for the quantity of gas consumed, then only under certain conditions can one kind of burner be pronounced superior to another, as we will hereafter explain.

Confining our remarks in the first place to the argand, this burner possesses the peculiarity that it only gives the maximum degree of light when consuming the full quantity of gas for which it is made, and when burning more than that quantity the flame smokes and the gas is wasted. This, however, may in one sense be claimed as an advantage, inasmuch as the act of smoking calls the attention of the consumer to the evil, and thus the waste is prevented.

When, however, less than the quantity for which the argand is made is consumed, then the light evolved per cubic foot diminishes in a remarkable manner, with the reduced quantity of gas. Thus, if a burner consuming five feet per hour gives the light of 15 candles, with a flame of about three inches high, we would naturally suppose that when burning 2 ft., with a flame of about two inches, the light would be equal to the half of the other, or 7½ candles. This, however, is not the case, as it will be but 3½ candles; consequently by reducing the flame from five feet to 2 ft. per hour, one half of the illuminating power

of the gas is lost. But on further diminishing the supply of gas, a much greater difference will be observed, as, with the same argand consuming 2 ft. per hour, instead of giving the light of six candles—the proportion to the maximum consumption—barely the light of one candle is obtained. Thus we find that, when consuming the full quantity of gas for which the burner is made, each foot yields the light of three candles; when burning half that quantity only the light of a candle and a half is evolved, and on reducing it still further barely half a candle per foot is given, and if we again diminish it to one foot per hour, then no practical degree is obtained.

This remarkable reduction in the illuminating power of the argand, which exists in all kinds, is a serious and inherent defect, and should be known by every consumer who employs the kind of burner in question, as it is evident that, by reducing the flames in a shop with the view of economising, directly the opposite result is produced, and the premises are put into comparative obscurity; if, however, some of the burners were left full on and the others extinguished, then a real economy would be effected.

The argand is influenced in various other ways: for instance, if when consuming but one and a half feet per hour, and the chimney be removed, the light is immediately increased to about four candles, a similar effect is produced by raising the chimney about an inch above its seat; even the position of the bottom of the chimney in relation to the top of the burner will influence the amount of light.

All these defects of the argand arose from the same cause, for the burner and chimney being constructed to supply the quantity of air necessary for the maximum consumption, it follows that on reducing the quantity of gas, an excessive supply of air must naturally take place, and this, in passing and impinging on the flame, carries off a portion of heat, and thus reduces the light to be derived from the gas. That this is beyond dispute is made evident by checking the current either by removing the chimney entirely or partially as described, when the light is augmented fourfold. The diminished light occasioned by lengthening the chimney is due to the increased current or draught, consequently causing more air to pass through the chimney, and so deteriorate the light of the gas.

The question of heating the air for the alimentation of gas-burners now being practically applied, has long engaged the attention of engineers and others; for as long ago as 1835, Chaussonnet obtained a patent for an argand burner provided with two chimneys, the one concentric to the other, and so arranged that all the air necessary for the burner should descend between the two chimneys, and, being heated in its passage, it would pass to the burner. By this system an economy of 35 per cent. was effected. Dr. Bowditch reproduced the system many years afterwards. We believe that the cause of failure was the high temperature to which the inner chimney was exposed, which caused it to melt.

Another instance of the application of hot air is in the experiment mentioned by the Metropolitan Gas Referees, with an argand burner consuming about two feet per hour, and yielding little more than the light of a candle. On the top of the chimney they placed a disc, when the light of the gas was immediately increased ninefold; as the referees observed "an amount of light proportionately greater than is obtained from good argands when burning at the usually higher rates, and of course under the most favourable conditions." This effect is entirely due to the supply of air being limited to the actual requirements and heated before combining with the flame.

Among the various requirements for a good argand, are that its orifices shall be of such dimensions as to allow the full quantity of gas for which it is made to pass with a pressure not exceeding one-tenth. The other details, such as the number of the holes, the inner and outer diameter of the burner, the height and diameter of the chimney, can only be obtained by experiment. The Gas Referees have, however, given their attention to this subject, and have issued instructions as to the mode of making the burners to be employed when testing the gas supplied by the Metropolitan Companies, which we would recommend to all manufacturers of argand burners, with the conviction that a burner recommended by those gentlemen must be superior to others.

ENLARGEMENTS ON GELATINO-BROMIDE PAPER.*

AN old friend of ours, an artist, who never loses an opportunity of visiting the Photographic Exhibition, described to us some platino-type pictures recently exhibited, as beautiful imitations of steel engravings, and we venture to

* From The Review of Gas and Water Engineering.

* From the Photographic News.

think that a good enlargement on gelatino-bromide paper approaches them as closely.

The ease and simplicity of the process, and the beauty of the results, can only be thoroughly appreciated by those who have worked at it; and, although the process is rapidly finding favour with professional photographers, we hardly think that amateurs are giving as much attention to its study as it deserves.

We had the privilege, some little time ago, of visiting Messrs. Morgan and Co.'s establishment at Greenwich, to whom is due at least the credit of bringing the process into commercial use. The possibility of coating paper successfully with a gelatino-bromide emulsion has, of course, been familiar for a long time; but, although it has been discussed at various times, it had never passed much beyond the experimental stage until introduced by the above firm. Mr. Morgan uses artificial as well as daylight for his enlargements, and it will be within the recollection of our readers that this gentleman demonstrated, at a meeting of the South London Photographic Society, a method of enlarging by means of a paraffin-lamp contained in an ordinary biscuit-tin, a 4½ or 5 condenser being used to concentrate the light on to the negative.

At the meeting of the Liverpool Association in September, the Rev. H. J. Palmer (see p. 225, ante,) described the method that he employed, which appeared to be identical with that shown by Mr. Morgan. The practice of enlarging by daylight is necessary when negatives of a larger than quarter-plate size are being employed, as the cost of condensers to cover a half-plate is a very serious item.

Any convenient room can be used for the purpose of enlarging, by covering the window and cutting a hole in the covering large enough to admit the negative. A camera is set up in the rear of the negative, and the picture focussed on to a sheet of cardboard, set up parallel to the negative. The space between the negative and the lens must be rendered light-tight by means of a sleeve of black twill or other opaque substance. The camera should have a rising front, so that the picture can be adjusted accurately in position on the screen. The paper can be simply pinned to a board and substituted for the focussing screen; but in our own practice we always prefer to soak the paper, film-side downwards, in a dish of water for a couple of minutes, and then lay it on a sheet of glass of the same size as the focussing screen. The paper lies much flatter, and the required exposure is not affected, although care must be taken to drain the paper well before exposure. The latter is an item about which instructions are misleading; but to those who attempt the process for the first time, we may state that on a fine morning at this time of the year, and with an eastern aspect, such as our dark-room possesses, we give about three minutes' exposure in enlarging a negative to double its dimensions with a rapid rectilinear lens of a focal aperture $f/12$. A small amount of practice is better than many pages of instructions, and a few failures will be of more assistance than the same number of successes. The picture should be developed with plain saturated solutions of potassium oxalate and ferrous sulphate. The use of various other ingredients has been proposed, as well as the ordinary alkaline development; but in our opinion they add to the difficulty, without in any way improving the results. Saturated solutions of ferrous sulphate and potassium oxalate in the proportions of one to four, restrained with potassium bromide, constitute an extremely rapid developer, giving the purest blacks in the shadows, and white paper in the light, a result which does not invariably obtain when alkaline pyrogallol development is employed. The more contrast and density in the negative, the less restraint is required, and *vice versa*. The development of the print should always be stopped slightly before the desired density is attained, as the shadows darken in fixing. After thorough washing, the prints should be soaked in water containing about three per cent. of sulphuric acid. This quantity of acid will usually be found sufficient to dissolve away any slight discolouration due to development. The prints may, if desired, be still further improved by enamelling or use of encaustic paste.

IS THE MEDITERRANEAN OF RECENT ORIGIN?

THE degree of likeness, or unlikeness, of the fauna and flora in regions more or less apart may be found to throw light on changes that have occurred in the configuration of land and sea. This line of thought has lately engaged the attention of M. Blanchard. In an interesting paper to the Paris Academy he shows by numerous examples how the fauna and flora on the extensive coasts of the Mediterranean present the same general character, which disappears at a short distance from the coast, where the ground rises. If the

Mediterranean coasts, he says, where brought together, the most attentive investigator might pass from Europe to Africa, or to Asia, without any trait of living nature making him aware of it. Now, as very moderate obstacles prevent the dissemination of a large number of animals and plants, it seems certain that the Mediterranean would be absolutely impassable for most species. M. Blanchard infers that the sea has been formed at a recent epoch, in the midst of a region already inhabited by the animals and plants now found on its coast. Recent data as to the marine fauna he regards as confirming this view; for the fauna of the depths appear to be entirely from the Atlantic. M. Milne Edwards suggested that the uniformity of natural production in the Mediterranean region (which had struck several naturalists) was rather to be explained by easy communication between the northern and southern sides of the basin or basins, by two broad isthmuses, now submerged, one between Sicily and Tunis, the other between Spain and Morocco. The inland sea must at one time have extended much further eastwards, and may have communicated with Arctic waters and with the Indian Ocean; it appears not to have been in junction with the latter since the miocene epoch. From the geological point of view, M. Daubré was also unable to think the Mediterranean of quite recent formation; for there are Cretaceous, Eocene, and Miocene deposits in the space it covers. More recently, in Pliocene times, the sea exceeded its present shores, and Pliocene deposits are found throughout the extent of the present basin in the numerous islands which rose from the sea at the end of the tertiary epoch.

PUTTING UP LINE SHAFTS—SETTING ENGINES AND TOOLS.*

HOW to put up a line shaft with the least labour, and so as to know that it is all right when done, is a question that bothers a good many machinists. In putting up line shafting, in many cases the trouble is in not making haste more slowly. For if the shaft is not put up true, of what avail is the speed with which the job is done? I have adopted a plan that suits me well and gives good results, and I offer it for the consideration of others. If, for instance, I am to put up all the shafting, together with engine, etc., I commence by making a ground-plan, showing the location of the tools to be run, and study so to place them, that the work may progress from one to another, or from the beginning to the conclusion, with as little handling as possible. Then, knowing the speed that the tools should run, I note what size pulleys are wanted on the line, and on what section they are wanted. I then take the longest shaft and lay out where I wish to place hangers, and I am then ready for business. If there are to be any extra timbers put in, I show the carpenter just where they are wanted, and proceed to locate permanent points, from which all measurements are taken, by measuring from one of the corners to whatever distance the line is to be from the side of the room, and driving a copper or brass nail and marking with pick-punch, to show the exact centre—and the same at the opposite end of the room. Then from one point to the other snap a fine chalk line, being careful to have it thumbed at frequent intervals, if the line is long, so that it may show only one mark. I then drop a plumb line from the ceiling to the centre marks on the witness nails, and snap a line across the timbers, taking the same care as on the floor. I then have as many wooden blocks—3 or 4 in. longer than the box, 3 or 4 in. wide, and 1 in. thick—as there are hangers, and tack them on the floor, over the chalk line, and under where the hangers are to be located, and level them very carefully, taking pains to change ends with the level and staff, so as to neutralise any error there may be in the staff or level. I then cut a measure to go from one of the blocks to timber above, on which the feet of the hanger rest, and from each of the blocks lay off, on these timbers, how much is to be taken off or added to, to make all of the seats for hangers level. Then from the chalk line already made, measure either way and mark for the bolt holes.

Now, while the carpenter is doing his work, I measure on each block, from centre mark for hangers, half the length of the box either way, and make a mark across the block, and on that mark I lay off half the diameter of the shaft and make a cross mark or dot, to line the shaft by.

Everything is now ready to bolt up the hangers, put the pulleys on the shaft, as required by the ground-plan, and hoist the shaft into place, and proceed to level and straighten, which I do as follows:

To level, I make a tram, by taking a pole and driving a piece of wire or a nail in the end, and tilting it off until it will just pass under the shaft when the end is resting on one of the blocks, and

by placing one end on the mark showing the length of box and the wired end against the shaft close by the box, I know that it is plumb, and have only to raise or lower the shaft by means of the adjusting screws, until the pole will just pass under.

To straighten the shaft, I drop the plumb line over the shaft close to the hanger, and if straight, the point of the plumb will be just at the mark laid off on the block, as described before, this being done at each of the hangers, and the job as far as the line shaft is concerned, is completed.

Now, to locate the counter-shaft, I measure from the witness nails driven in the floor, as far as it is to be from the main shaft, and snap a line as before described, and proceed in every way as on the main line. If desirable to set the tools as the work goes along, I do it all by the floor lines. For instance, to set a lathe, move the tail centre to the farther end of the ways, and drop a line from the centre to the floor, then move the lathe until the plumb point is the same distance from the floor line at both centres. For an iron planer, lay a straight edge across the bed and against the uprights, and drop lines from that, and so on with all of the tools.

To set the engine, go back to the witness nails, and measure distance to the centre of engine shaft; or, if not convenient to measure from the nails, measure from any convenient point on the floor line between those nails, and locate the ground line, from which to lay out engine foundation is the usual way. If there is to be shafting on the floor above, bore a small hole as near over the witness nails as possible, through which drop a plumb, and measure from the point to the nail, and then from the line above the floor measure off the same distance and drive witness nails for that floor, and so on from floor to floor, repeating the operation as described on the first floor. Experts may criticise my way of doing the job, but they are not the ones I am talking to, but to the men who have never had occasion to put up a line shaft. The problem is, how to put up a line shaft with the least labour, and know that it is all right when done.

HEALTHY HOMES.

SOME good hints on the methods of rendering homes healthy were given at the Brighton Health Congress in a paper by Mr. H. H. Collins. If you desire health, said the lecturer, you must work for and deserve it; constant supervision to insure great and continual cleanliness is essential. You cannot "nag" your domestics too much on this score; you cannot be too watchful, whether the house be large or small, whether it belongs to peer or peasant, if you wish to preserve it as a pure wholesome dwelling in which to live, instead of to die, in. This is a duty you owe to society quite as much as to yourself, bearing in mind that public sanitation is mainly, if not entirely, dependent upon private hygiene, and that the declares in unflinching accents "Sic utere ut alienum non laedas." (That people make use of their own property in a proper manner as not to injure that of others.) There are other hints equally necessary, a glance at—such, for example, as food. Be afraid, as a rule, it is exceptional for the household to pay that attention to the department as was the honoured custom of the last century. In aristocratic families the devoirs on the housekeeper, who relegate to her assistant, who hands it on to some under-servant. In middle-class life, the cook, whether skilled or unskilled, reigns supreme. In the elevated classes, an utter ignorance seems to prevail of dietary necessities. Goldsmith tells us "Heaven sends us good meat, but the devil sends us good cooks"; and if this latter gentleman exists, I am sure a large proportion of the audience will be of the same opinion. "Good digestion wait on appetite, and appetite on both," when the elements of chemistry of food and cooking are so lately unknown to the housewife. A hint here is to practically make yourself acquainted with "what to eat, drink, and avoid. How much thrift may be engendered; how much household saving effected; how much good humour secured; and how much health preserved by a little knowledge and some care given to this subject! First, as in all chemical operations, absolute cleanliness is required in pots, kettles, and utensils. Due weight—this will not suit the butcher! Purity of concomitants—a wail from the grocer! Economy in their use—warning from the cook! The meat weighed and washed; the vegetables cleaned, salted, and soaked; the fish carefully examined and well cleaned; the cloths free from impurities; the knives, spoons, &c., &c., clean and fit for use. Lastly, the result: a delicious meal, effected at half cost, productive of comfort and replete with health-giving properties. Sanitation is so wide a subject, and embraces so much

essential for the welfare and comfort of man; but I cannot conclude without calling attention to one other matter of every day: of equal importance with the other sub-jects which I have directed your attention to, "clothing." Dr. Max von Pettenkofer, of Hygiene at the University of Munich, says: "One of man's principal defensive as in his struggle for existence is his clothing; it takes in the history of civilisation and its relation with physiology are not often thought of; taken from a moral and aesthetic point of its main purpose is a purely hygienic one." Is that "the forgetfulness of this is to be a great misfortune, inasmuch as small rivulous considerations have subjected us to many ills, and have often acquired an any over better and fitter hygienic clothing." eds of grave disorders and chronic illness are very frequently promulgated by the of well-known principles with regard to g. This is a large subject, and I would on to Pettenkofer's work, wherein you will find instructive and interesting matter; but I mention that he calls attention to the fact: generally consider clothing as an apparatus ping air from us, whilst in truth we could rany garments which did not allow of a con-ventilation of our surface. It is therefore ry that we should make ourselves acquainted hose textures which being most permeable, us the warmest clothing. It is not the , thickest, or heaviest material which is best or our purpose. My "hint" on this head as our health is so intimately associated e economy of our dress, you should begin to r yourselves with regard to it; emancipate ves from the tyrannical dominion of fashion, dy to obtain a deeper insight into those clothing which will inevitably tend to in-crease the longevity of the community and to e its comfort and enjoyment. There are, re said, a host of other subjects connected mestic sanitation, such as those relating to re, &c. On this head I would "hint" at irability of taking care that it should be of rm and character as to prevent the lodg-! dirt and dust; all hollows should be filled l all unnecessary ornamental projections ad with; under any and all circumstances a al application of elbow-grease is very le. Too much caution cannot be exercised gard to various matters external to the house, en productive of serious consequences in- r, such as the selection of the laundress, man, seamstress, tailor, &c. It is a "hint" attention if the lady of the house would r at least ascertain the character and idings of, the homes and workshops belong- these people before availing herself of their ; good in countless ways would result from owledge. As my pen writes these conclu- sions, I seem to hear a murmur that I ife lost sight of the remark with which I iced this paper, and the question inevitably "That since life can do little more supply than ook around us and to die," is it worth the of practically adopting the many hints laid r our guidance? Cui bono? Has ever a o lived, and if so, with what results? My is, Yes, and with the happiest and best of- results which were intended for all, and all may attain. Without entering into emical disquisition as to whether the hich I am about to refer were of rigin or not, or whether they have been on by religious or superstitious motives; ey were wise and beneficent, if we judge ts, there can exist no doubt. The Laws d every matter upon which I have lightly ousehold, dietary, personal, sumptuary, ry conceivable sanitary question affecting piness and life of mankind. Explained and d by the servants of the Jewish race, they ted as their guiding star for over 5,000 ad have preserved them in health under pled difficulties up to the present day. hardson thus writes:—"Facts show that, me cause or causes, this race presents an ice against disease that does not belong to rtions of the civilised communities. The ce to those influences which tend to shorten al cycle of life is singularly instructive." es statistics which show that amongst 10 per cent. die amongst Jews, and t other denominations 14 per cent. That age duration of the life of the Jew is 48, a only 36. That a quarter of the Jews nd 71 years, and of others 59 years and bs. That the extracts from the civil pers of Prussia show a mortality of the l per cent., as against the mortality of le kingdom of 2.62. That the annual of the Jews is as 1.73 to 1.36 amongst enominations. He adds the Jews escape idemics more readily than other races. ortality of cholera, for instance, was so at the fact of its existence was even dis-

puted. He attributes the main causes to what he calls "sobriety of life," thus interpreted by him—sobriety, better food, carefulness in the rearing of children, thoughtfulness for their aged and infirm, general care of their poor and also of themselves. Whilst in no way disputing the conclusions which Dr. Richardson has arrived at, I venture to assert that most of these beneficial effects have been the results of continuous and unremitting attention to the sanitary and hygienic laws laid down by Moses and amplified by his disciples—Laws which, for the first time in the history of the world, proclaimed that "Prevention was better than cure"; that the real science of medicine lay in the direction of prophylactic rather than therapeutic measures: That by the laws he laid down—not as a monopoly for Jews alone, but open to all who desired to live by them, admittedly onerous but undeniably efficient—he not only prevented disease, but if, unhappily it arose, he took all those measures which modern science has revived to stamp it out.

SHOP WRINKLES.

AMONG the many simple shop wrinkles which it is possible a few mechanics have not tried, says a correspondent of the *American Machinist*, may I relate to your readers a little incident in my shop experience "before the war?"

I found myself brought to the necessity of devising means whereby the two edges of a sheet-metal plate could be bevelled parallel with each other, to fit accurately in an under-cut seat made by a bevel cutter, and at the same time the half-circle end needed to be bevelled so as to fit the seat at the bottom of the cutting.

This, of course, involved the half-circle end being exactly central with the edges. After canvassing the ordinary methods of finding the centre, I hit upon the following plan for doing it with a cutter of suitable bevel, running on a mandril projecting from the live spindle of a lathe. On the cross slide, which was worked by a lever, I pivoted near one end a parallel piece of the same width of the plates, requiring to be bevelled upon the top of the slide.

The slide had already been prepared for the operation, by having an upward projecting rib or shoulder running its entire length. The parallel piece, on which the plates were to rest, having had a hole of suitable dimensions made through it vertically, at such a distance from the end as permitted finishing the end from the hole as a centre, to the same arc to which the end of the plate was to be milled on the full side of the bevel, and the edges being made precisely equidistant from the hole, the parallel piece being left wider than required in its finished state, until after the hole was made, and brought to the proper width from the hole to insure this.

I then clamped it upon the top of the slide, with one edge parallel with, and resting firmly against, the upwardly projecting rib or shoulder on the slide, and with a short-tipped drill, the body of which exactly fitted the hole in the parallel piece, I drilled into the slide, a short distance, a hole of such size as permitted me to use for continuation a sufficiently smaller drill to allow tapping without disturbing the walls of the upper part of the hole.

Now, it will be obvious that with the hole in the slide, enough smaller than that in the parallel piece to admit of a good shoulder on the screw which formed the pivot, and with the holes concentric and screw well fitted, I had an arrangement which could be taken apart any number of times, with no chance for growing because it "did not come twice alike."

Having the pivot-screw fitted, I next put a pin in the right-hand edge of the slide, and in the bed on which the slide worked, I drilled an upright hole at such a point that with a pin standing in it, when the pin in the slide came in contact as the slide was carried forward, the centre of the pivot-screw would be precisely opposite the centre of the milling cutter.

Now, having reconstructed the old arrangement of 185- "on paper," let us mill a plate. With the cutter running backwards, and the plate to be bevelled firmly secured to the top of the parallel piece, with a screw and clamp holding the parallel piece against the rib, with the circular or pivoted end towards us, it will be seen that by pushing the slide from us the cutter will commence cutting at what would be the front right-hand corner, if we were to hold the plate in position to push into its seat.

The cutting will, of course, continue in a right line until the pins coming in contact prevent further motion of the slide, then, holding the slide firmly up, by taking hold of the long end of the pivoted parallel piece, and bringing it around gradually towards us, it will be seen that the half-circle end will be bevelled, and when the parallel piece has made a half revolution on the axial

screw stud, its other edge will be resting against the rib.

If we now remove the pin and push the slide forward until the other edge of the plate is bevelled, will any argument be necessary to prove that the desired end was gained?

AMATEUR MECHANICS.*

FOR amusement, exercise, and profit we commend, to those who are mechanically inclined, the practice of working with tools of the smaller sort, either in wood or other of the softer materials, or in metals, glass, or stone. This practice renders the hands dexterous, the muscles strong, and the head clear, with the further advantage of producing something for either ornament or use. Of course, a bench with a vice and a few wood-working and iron-working tools will be required; but the most expensive as well as the most essential tool is a lathe. With this tool, not only turning in wood, metal, ivory, rubber, &c., &c., can be accomplished; but it may also be used for screw-thread cutting, gear cutting, drilling metals, boring wood, spinning metals, milling, sawing metal and wood, grinding, polishing, moulding, shaping, and other purposes. A first-class plain lathe of small size cannot be purchased for less than 50dols., or 60dols., and one of inferior quality will cost 20dols. to 30dols.

How to Make a Useful Lathe at a Small Cost.

While the purchase of a lathe is recommended, there may be many who would prefer to make one. A lathe that will do admirably and which may be easily made is shown in the accompanying engravings, Fig. 1 representing in perspective the lathe complete; Fig. 2 is a perspective view of the lathe without the table; Fig. 3 is a vertical longitudinal section of the lathe, showing the manner of securing the head and tail stocks to the bars which form the bed or shears.

In making this lathe one pattern only will be required for the two standards of the head-stock, and the support of the ends of the bars. The lower part of the tail-stock is made in two parts, so that they may be clamped tightly together on the shears by means of the bolt that passes through both parts, and is provided with a nut having a lever handle. The rest support is also made in two parts, clamped together on the ways in a similar way.

The patterns may be easily sawn from 1½ in. pine. The holes that receive the round bars should be chambered to receive Babbitt metal, used in making the fit round the bars forming the shears, around the head and tail spindles, and around the shank of the tool-rest. The smallest diameter of the holes that receive the round bars should be a little less than that of the bars, so that the several pieces that are placed on the bars may be fitted to hold them in place while the Babbitt metal is poured in.

The dimensions of the lathe are as follows:—Length of round bars forming shears, 24 in.; diameter of bars, 1 in.; distance from the upper side of upper bar to centre of spindle, 3 in.; between bars, 3 in.; between standards that support the live spindle, 3½ in.; size of standard above shears, ½ by 1½ in.; diameter of head and tail spindles, 3 in.; diameter of pulleys, 5 in., 3½ in., and 2 in.; width of base of standards, 5 in.; height of standards, 7 in.

The live spindle should be enlarged at the face-plate end, and tapered at both ends, as indicated in the engraving.

The pulleys, which are of hard wood, are made of three pieces glued together, bored, and driven on the spindle, secured by a pin passing through both it and the spindle, and turned off. The bars forming the shears may be either cold rolled iron or round machinery steel; they will require no labour, except, perhaps, squaring up at the ends. The castings having been fitted to the bars, and provided with set screws for clamping them, the two standards that support the live spindle and the support for the opposite end of the bars are put in position, when the bars are made truly parallel, and a little clay or putty is placed around each bar and over the annular cavity that surrounds it, and is formed into a spout or lip at the upper side to facilitate the pouring of Babbitt metal. The metal must be quite hot when poured, so that it will run sharp and fill the cavity. To guard against a possible difficulty in removing the castings from the bars it might be well to cover the side of the bar next the screw with a thin piece of paper. The pieces of the tail-stock and tool-rest support are fitted to the bars by means of Babbitt metal, the metal being poured first in one half and then in the other. The bolts which clamp the two parts of the rest-support and tail-stock together are provided with lever handles. After fitting the parts to the two bars by means of Babbitt metal, the tail spindle,

* From the Scientific American Supplement.

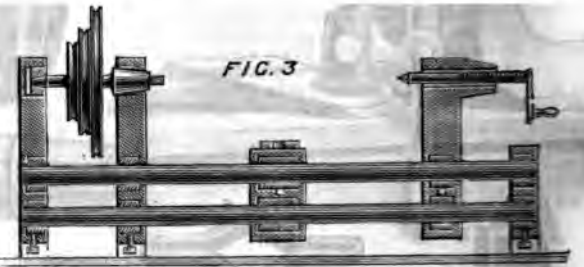
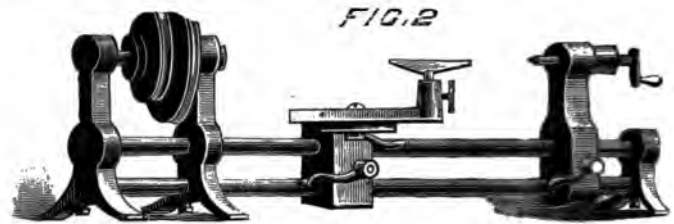
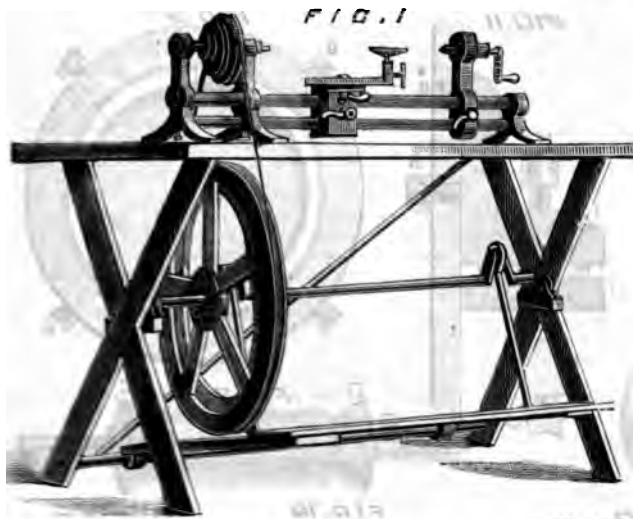
which is threaded for half its length, is placed in the tail-stock parallel with the bars and Babbitted. A binding-screw is provided for clamping the tail-spindle, and the spindle is drilled at one end to receive the centre, and has at the other end a crank for operating it. A steel or bronze button is placed in the hole in the standard that supports the smaller end of the live spindle, and the spindle is supported in its working position and Babbitted.

brace is secured to the top near one end, and is fastened to the lower end of the rear leg at the other end of the table.

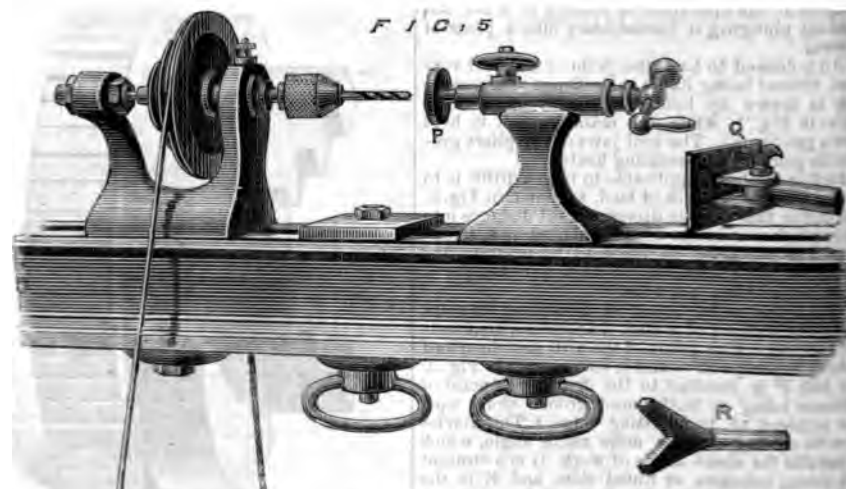
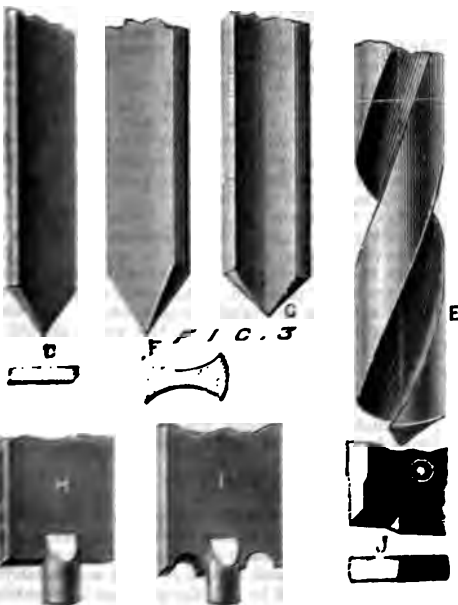
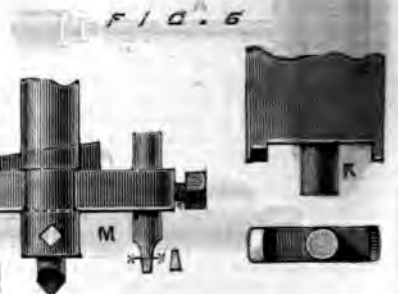
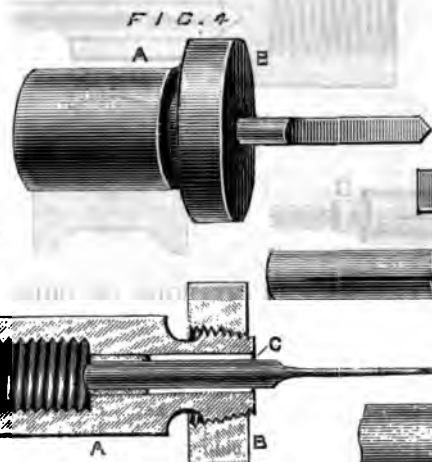
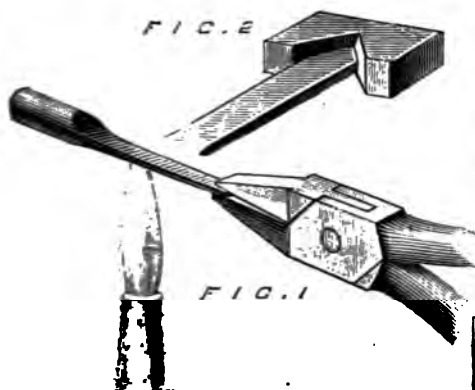
A block is secured to each pair of legs for supporting a pair of ordinary grindstone rollers, which form a bearing for the balance-wheel shaft. This shaft has formed in it two cranks, and it carries an ordinary balance-wheel, to the side of which is secured by means of hook bolts a grooved wooden rim for receiving the driving belt. The cranks are

proper size is reached. The wooden rim may be turned off in position by using a pointed tool.

The lathe above described, although very easily made and inexpensive, will be found to serve an excellent purpose for hand-work, and if the holes, instead of being Babbitted, are bored, and if the bars forming the shears are turned, the lathe may be converted into a kind of engine lathe by placing a feeding-screw between the bars, and putting a small tool-post in the rest support.



AN AMATEUR'S LATHE.



DRILLS AND DRILLING.

The thread on the spindle should be rather coarse, so that wooden or type-metal face-plates and chucks may be used. The table shown in Fig. 1 is simple and inexpensive. It consists of two pairs of crossed legs joined together and secured to a plank top. A small rod passes through the rear legs near their lower ends, and also through a piece of gas-pipe placed between the legs. A diagonal

connected, by means of hooks of ordinary round iron, with a treadle that is pivoted on the gas-pipe at the rear of the table. The shaft will work tolerably well, even if it is not turned. The cranks must have half-round grooves filed in them to receive the treadle hooks. The size of the different diameters of the drive-wheel may be found by turning the larger one first and the smaller ones afterward, using the belt to determine when the

Instructions about Drills and Drilling.

An ordinary flat drill for most purposes will answer nearly, if not quite, as well as a twist drill. It is not a difficult matter to make them, since we have such reliable material as Stubbs' steel wire of every size. The best form of flat drill for general purposes is shown in Figs. 1, 3, and 4. It is made by milling or filing the opposite sides of the wire so as to form a bit or blade having a thickness equal

to about one-fourth of the diameter of the wire. The angle of the point should be 90° , and the angle of its cutting edge about 45° , for most uses. For a drill for very hard substances these angles may be more obtuse.

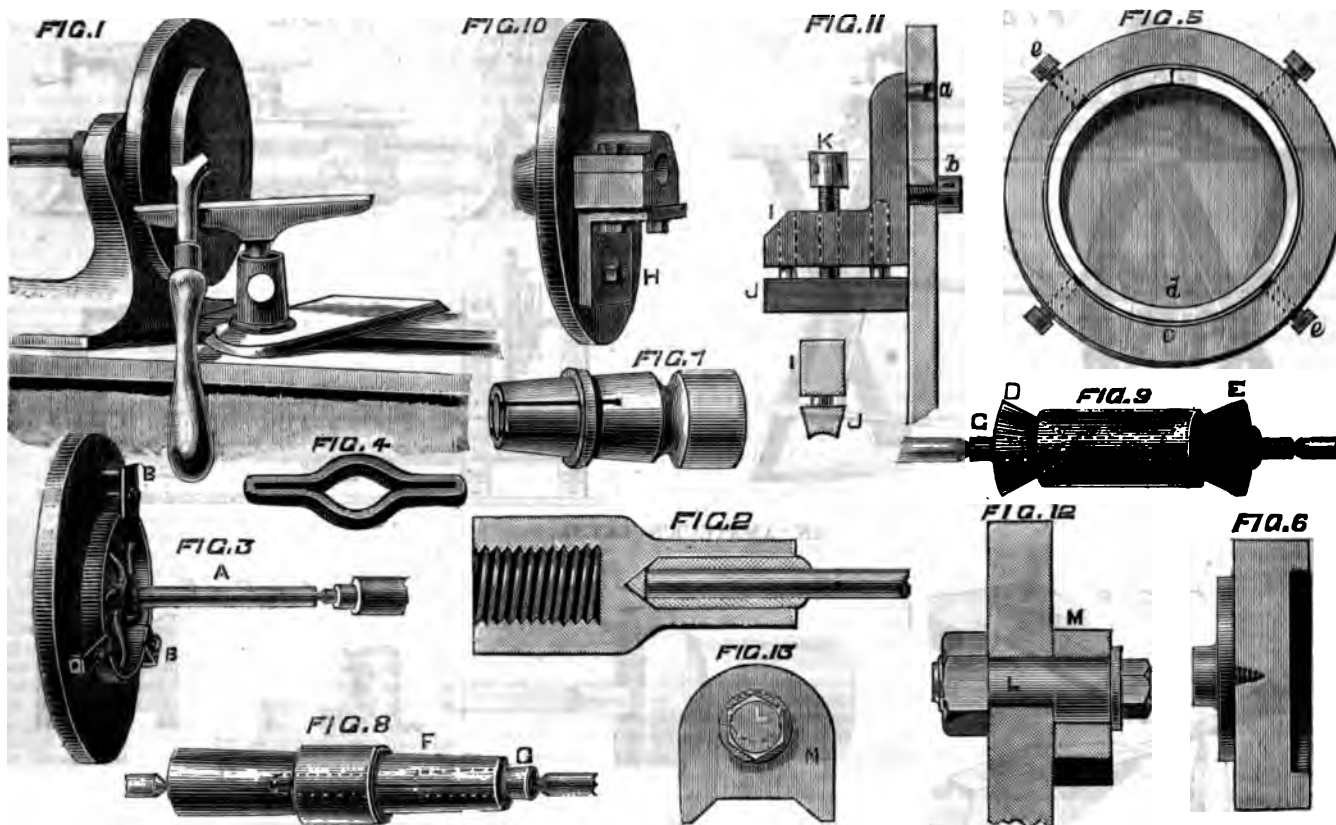
Having formed the drill, it should be hardened by heating it to a low red and plunging it straight down into cool (not cold) water. In case of a very small drill, it may be held in the flame of a gas-burner or lamp in a pair of spring nippers over a

central transverse one connecting the other two. This drill, as its name indicates, is designed to make a flat bottom in a drill hole.

The pin-drill, K, which is shown in side and end views in Fig. 6, is first carefully turned and afterwards milled with the rose bit, L, producing the cutting points or lips, which are afterwards beveled with a file. This drill is used for boring large holes in sheet-metal, a small hole being drilled first to receive the pin. M is an expansion drill for the

pare this chuck for holding drills, the pieces C are inserted in the chuck, centred with a pointed tool, and are drilled with the drill with which they are intended to be used. They are then split longitudinally with a saw for about three-fourths their length. The pieces C, when once prepared, will always answer for the same-sized drill; they may also be used with an ordinary chuck having a set-screw.

The fluted countersink, O, may be classed among



CHUCKS AND METHODS OF CHUCKING.

vessel of water. When it attains the required degree of heat it may be dropped into the water.

To temper for most cases, the drill, after being brightened on an emery wheel or piece of emery paper, is heated; if it is a small one, in an alcohol or gas-flame, until its colour at the point runs down to a brownish yellow verging on a purple. If the drill is very large it may be heated over a forge-fire, or over a heavy piece of red-hot iron. If the drill is a very small one, it may be hardened and tempered at one operation by heating to a low red heat and plunging it immediately into a piece of beeswax.

If it is desired to have the point of the drill very hard, without being liable to breakage; its temper may be drawn by holding its point in pliers, as shown in Fig. 1, while the main portion is held over a gas-flame. The cool jaws of the pliers prevent the point from becoming heated.

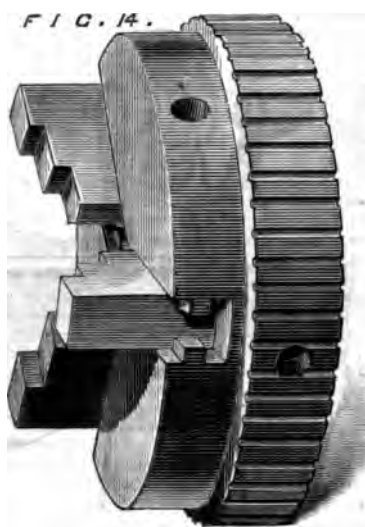
Another method, applicable to larger drills, is to employ a notched block of lead, as shown in Fig. 2. The drill in this case is driven a short distance into the lead before it is hardened; then, as it is tempered, it is replaced in the lead to preserve the hardness of the cutting edges while the temper is drawn in the other portions.

When a drill is hardened by immersing its point in mercury instead of water, it acquires a diamond-like hardness. The point of the drill just described is shown in perspective and in section at D in Fig. 3. The drill F is similar to the drill D, the point of difference being a half-round groove along each face adjacent to the cutting edge. This device gives the cutting edge a more acute angle, which is desirable for some kinds of work. G is a straight drill having concave or fluted sides, and E is the well-known twist drill. The drills, G E, are shown in cross section in the central figure. Twist drills of recent manufacture have a central longitudinal line, which locates the point in grinding.

The best rule for grinding twist-drills is to preserve, as nearly as possible, the original form. The ordinary pin-drill, H, is used for counterboring, a hole being first drilled to receive the pin. The drill I is employed to give an ornamental appearance to plates in which pivots or small shafts are journaled, as in clock-work. The bottoming drill, J, has three cutting edges, one upon each side, and

same purpose; its construction will be readily understood from the engraving. The spindle is mortised to receive the tool-carrying arm, which is secured in the mortise by a key. The lower end of the spindle is bored to receive the drill, which also forms the pin for guiding the cutter.

While universal chucks are recommended for



holding drills, another form of chuck, shown in Fig. 4, may be used with equal advantage. It consists of a main portion, A, which screws on the lathe-spindle, and has a tapering threaded end for receiving the milled nut, B. The threaded end is split to admit of its contraction as the nut B is screwed on. The part A is bored longitudinally to receive sections, C, of iron or steel rod. To pre-

pare this chuck for holding drills, the pieces C are inserted in the chuck, centred with a pointed tool, and are drilled with the drill with which they are intended to be used. They are then split longitudinally with a saw for about three-fourths their length. The pieces C, when once prepared, will always answer for the same-sized drill; they may also be used with an ordinary chuck having a set-screw.

Every lathe should be provided with a plate, or drill-rest, P, fitted to the tail spindle, for supporting plain work while drilling it. The lathe should also have a hinged or pivoted rest, Q, which may be clamped at any desired angle for drilling irregular work. This plate should have several perforations for receiving pins, for preventing the work from slipping. For supporting cylindrical objects to be drilled transversely, a fork, R, is inserted in the tail spindle.

As to the matter of drilling, little need be said, as nearly everything must be learned by experience; however, a few points may be mentioned. The work should be carried forward with a regular and not too heavy pressure. The speed of the drill will vary with the material being worked. For steel, wrought iron, and copper, the speed should be slow; for brass and cast iron, it may be quite rapid. In drilling steel or wrought iron, oil is the best lubricant for the drill; in drilling glass, the drill should be wet with turpentine, to which gum camphor has been added; the drill may be used dry in drilling brass and cast iron.

Chucking.

In spite of all possible appliances to be used in a general way for chucking work in the lathe, a degree of inventive skill is often required to accomplish it quickly and securely. The accompanying cuts are designed to aid the amateur in chucking; but after all is said, there is a world of knowledge that can be gained by experience only.

The arrangement of a metal disc in the lathe so that it can be turned on its face, and upon its edge, cannot well be accomplished by means of chucks; for this purpose reverse is frequently had to cement. A good cement for this purpose consists of Burgundy pitch, 2lb.; resin, 2lb.; yellow wax, 2oz.; dried whiting, 2lb.; melt together the pitch, resin, and wax, and stir in the whiting.

To chuck work with this cement, apply a small portion of it to a face-plate devoted especially to

this purpose; heat the plate so that the cement will cover the greater portion of its surface. The plate may be allowed to cool. Whenever it is desirable to chuck a metallic disc, it is heated and placed against the cement on the face-plate, and allowed to remain until the cement begins to stiffen, when a tool having a right-angled notch is applied to the edge of the disc, as shown in the cut, the lathe being rotated until, by the compound action of the tool pressure and the rotary motion, the disc becomes perfectly true.

To chuck a spindle or any similar object, a cement chuck like that shown in section in Fig. 2 is sometimes used. The larger portion is screwed on the lathe-mandril, and the inner end of the hole in the outer portion terminates conically. The hole is filled with cement, and the article to be chucked is warmed and introduced. It may sometimes be necessary to heat the chuck with an alcohol or gas flame. The lathe is rotated, and the spindle is held lightly until it becomes true, and the cement begins to harden.

To remove the work from a cement chuck, it must be warmed by means of a lamp or otherwise. Most of the cement adhering to the work may be wiped off after heating it; whatever remains, may be removed with a little turpentine.

A common method of chucking work on the face-plate is shown in Fig. 3; the wheel is temporarily retained in place by a pointed rod, A, which is forced against the wheel by the tail spindle. A little rapping one way or the other readily centres the wheel. A piece of crayon held in a crayon holder supported by the tool-rest may be used to discover which side of the wheel is "out." After the wheel is trued, it is fastened by the short bars, B, whose outer ends rest upon any convenient blocking while they are drawn by the bolts, so as to clamp the wheel firmly to the face-plate.

It is sometimes preferable to use the yoke shown in Fig. 4 instead of the bars shown in Fig. 3; it is placed diametrically across the wheel and secured by two bolts.

Fig. 5 represents a chuck, consisting of a wooden disk, c, bored to receive the wooden hoop, d, which may be forced inward by the common wood screws, e, which bear upon it. This chuck is useful where a considerable number of similar pieces are to be turned or bored.

Fig. 6 represents a simple and well-known chuck. It is simply a block of wood secured to a face plate by a screw centre and turned out to fit the work.

Fig. 7 represents an easily made chuck, which is useful for holding plugs of wood to be turned or bored. It consists of a piece of hard wood fitted to the mandril, turned, bored, and split longitudinally, as shown in the engraving. Its outer end is tapered, and to it is fitted a metallic ring that serves to contract the chuck when it is forced on.

Fig. 8 represents a tapered and split mandril, which may be either of metal or wood according to the purpose to which it is to be applied. The part F is bored conically at the smaller end before splitting, and to this hole is fitted the conical plug, G, which being forced in, expands the mandril.

In Fig. 9 the mandril, C, has permanently attached to it the cone, D, and upon it is placed the movable cone, E, which is forced against the work held between the two cones by a nut which turns on the threaded end of the mandril.

In Fig. 10 the manner of chucking work on the angle plate, H, is shown so clearly as to require no explanation. It may be well, however, to state that when the work is rotated rapidly a counter-balance should be attached to the face-plate on the side diametrically opposite the angle plate.

Fig. 11 shows a jaw for attachment to the face-plate, which consists of a right-angled piece, I, a jaw, J, which has two guide-pins, entering holes in the piece I and the screw, K, which passes through a tapped hole in the piece I, and bears against the jaw J. The piece I has a dowel, a, that keeps it from turning, and a screw, b, by which it is secured to the face-plate.

In Figs. 12 and 13 the pin, L, is fitted to the face-plate, and has formed on its projecting end an eccentric which fits the jaw M. It has also an hexagonal head for receiving the wrench by which it is turned. Three pins, L, are fitted to the face-plate, which is quite thick. Two of the pins need not be turned after being adjusted for a certain kind of work; the third is loosened and turned when work is put in and taken out of the lathe. After the work is clamped tightly by turning the eccentric the nut on the back of the face-plate is tightened.

In Fig. 14 is shown a type of the most convenient and most universally useful chuck in existence. Its construction and use are so well known as to need no description.

THE DANGERS OF OXYGEN MAKING.*

IN oxygen-making and lime-light-exhibiting the gross carelessness in some cases and the utter absence of any knowledge of danger in others is most remarkable, and still more surprising is it that so few accidents, nevertheless, occur. We once formed part of a gathering of gentlemen of science and scientific tastes, when, discussing the making of oxygen gas, a member of the gathering—a chemist of great skill and experience—pointed out a great wen on his hand, the lifelong witness of an accidental explosion that once happened when he was making a store of this gas. The cause was inexplicable, but he supposed some impurity must have gained admission to the retort. One of the other guests—a country rector—was perfectly horrified. He had made, he said, oxygen gas many times during the last twenty years for exhibiting the lantern to his parishioners, and had never any idea there was the slightest possibility of danger involved in its manufacture. No doubt there are very many more in the same happy ignorance of the risks they incur, unless certain precautions be taken, every time they heat their oxygen retorts. In fact, judging from the frequency with which such accidents occur to practical chemists, it would seem as though even they, as a body, were ignorant of the risk so frequently accompanying the operation. Rarely, even in important works on practical or theoretical chemistry, is any hint given of the possible danger arising from the making of this, the commonest, experimental operation of the student or demonstrator. A most painful prominence was given to this danger some sixteen years ago by the death of two persons from an explosion, caused by the use of impure oxide of manganese in making a quantity of the gas.

Many of our readers are aware of the cause of danger we allude to, but it will bear repeating. It consists in the contamination, by accident or design, of the oxide of manganese with some carbonaceous body, such as coal-dust, &c., &c., the result being that when heat is applied to the mixture with chlorate of potash, it fires with the rapidity of gunpowder, rupturing the most powerful cast-iron retorts, and scattering the pieces like an exploding bombshell.

Whenever fresh materials are purchased they should be carefully tested by a tentative experiment with a small quantity in an open vessel, such as an iron spoon. If the action then proceed gently the material is safe. A very slight amount of foreign matter would quickly show its presence by the explosive or, at any rate, greatly increased rapidity of action. This precaution taken, and the materials kept where they would be beyond the reach of contamination, not the slightest danger need be apprehended, although we know of an instance where a gentleman—a member of a firm of manufacturing chemists, and who had once been nearly killed by an oxygen explosion—never made oxygen without first putting before the fire a screen of some sort (often a door lifted off its hinges), so greatly had he been affected by the shock; indeed, his death, we believe, was indirectly owing in later years to the effects of the accident.

Quite recently, a Continental chemist has had a narrow escape from such an occurrence, a violent explosion having taken place in the gas-holder itself. He attributes the accident to the india-rubber tubing evolving some hydrocarbons, which, mixing with the oxygen as it was formed, finally gave rise to an explosive mixture. It could not have been owing to the manganese, as the gas was made from chlorate of potash alone.

These are what might be strictly called chemical dangers; and in the same category may be included the risk, now thoroughly authenticated, from explosion of the peculiar dust formed in the oxygen gas-bag after long-continued use. If, however, all oxygen gas were carefully passed through a wash-bottle containing caustic soda solution, instead of plain water, a great improvement would be made in it in many respects. Its illuminating quality would be improved by the removal of the carbonic acid, and the interception of the sulphur by the same means would greatly prolong the existence of the bags.

The list of dangers is, however, far from being complete if only chemical risks are included. Thus, a by no means uncommon occurrence has been the frothing up of the "oxygen mixture" into the neck of the retort, and its consequent plugging up, the end being, of course, explosion, the pressure produced during the decomposition of the chlorate of potash being exceedingly great. Similar consequences have ensued from the use of tubes of too small a bore for conveying the gas as it is evolved. When great heat has been applied it has come off at so rapid a rate as to exceed the delivery power of the exit-tube, partially choked up, as it may have been, with the dust and accumulations of many previous charges. The class of acci-

dents may be provided against in an efficient and easy manner by making the delivery-tube of full width. An inch bore is not too much, and greater than that would do no harm.

A further excellent precaution recommended is the introduction of an india-rubber tube connection at the nearest possible point to the retort. This acts as a safety-valve upon occasions of extreme pressure, the tube being blown away, and the only damage resulting being the loss of the oxygen. We ourselves once witnessed what would in all probability have been a serious accident but for the adoption of this plan. The tube to the wash-bottle was blown away, and the gas came out of the rubber tube with alarming violence. The tube itself caught fire and burnt with the utmost vehemence, being fed by the oxygen gas. Copper as a material for retorts is preferable to iron, on account of the slighter risk of pieces being thrown off if an accident should happen. The last dangers we shall notice are those connected with the accidental admixture of the oxygen and hydrogen gases. In one way or another this seems to happen most frequently, though at first sight it would appear unlikely to occur; but what is very remarkable in this matter is that a fatal result has rarely to be set down. Perhaps the most fruitful source of this danger is the sudden removal or diminution of pressure from one bag, which causes the gas from the companion bag to be sucked or forced in, an explosive mixture being at once produced. We cannot too strongly or too frequently caution our readers against the sudden removal of pressure from one bag, as a corollary to which advice we would say—Never obtain pressure by getting some boy from the audience to sit upon the bag; very frequently has such a proceeding led to disaster.

The most careful people are liable to fits of abstraction, and on such occasions may have the misfortune to convey oxygen into the hydrogen bag which may not have been entirely emptied from a previous exhibition. This is an accident which has so often happened that we take pleasure in recalling to the notice of our readers a method of preventing such an occurrence which has been before described in our pages. It consists simply in making all the hydrogen and the oxygen connections of different sizes, so that one cannot possibly be used for the other, even if it were so wished. We will conclude by giving a word of advice to exhibitors:—Never let any person touch your jets or gas-bags unless you know him to be thoroughly conversant with the use and application of such apparatus.

USEFUL AND SCIENTIFIC NOTES.

Rye and Rye-Flour.—Rye is the staple food of three European countries—Russia, Germany, and Austria-Hungary. A yield equal to two quarters for every seven inhabitants is grown by France; in spite of which that country is reckoned by many persons as consuming one quarter of wheat per head of population, and may certainly be taken as using seven bushels per head of wheat, or one and a-half bushels more than the average personal consumption within this realm. The fact that each Frenchman consumes on an average over seven bushels of wheat, and rather over two bushels of rye yearly, while the average Englishman eats only five and a-half bushels of wheat and no rye, witnesses very strongly, the *Miller* thinks, to the high average prosperity of the French nation. Of course the consumption of meat is less in France than in England; but then, again, the consumption of vegetables and fruits is much greater across the Channel than with us. The population of Russia for the present year is estimated at 80,000,000, for whom 75,000,000 quarters of rye, in addition to the large wheat crop, more than suffices as a home supply. Thus Russia is a large exporter of rye as well as wheat. Germany used, till very recently, to consume a great quantity of rye, and still does so, but there is nowadays a growing disinclination to eat the black and grey bread, and it may safely be asserted that the wheat consumption per head in the new Empire is steadily on the increase, while less and less rye is used. The present production, however, gives close upon one quarter of rye to each inhabitant. Germany is still a poor country, and it will take a long time for the movement referred to to dethrone the bearded corn from its predominant position. England does not appear at all in the table of rye-producing countries, and the substitution of wheat for rye as the leading corn staple marks not inaccurately the material progress of the mass of the people. In the Middle Ages Englishmen ate as large a proportion of rye as Russians and Germans now do.

A SATURATED solution of sulphate of copper in water is recommended as the cheapest and best thing for writing on zinc labels. The writing should be done either with a hard wood stile, or with a blunt quill pen.

* From the *English Journal of Photography*.

SCIENTIFIC NEWS.

THE discovery of small planets having apparently ceased for a time, the discoverers have had time to think of suitable names. Dr. J. Palisa has named 211, found on Dec. 10, 1879, "Isolda"; and 214, found on March 1, 1880, "Aschera."

Mr. J. Rand Capron has issued in a pamphlet form his paper entitled "A Plea for the Rain-band," which was published in *Symons' Monthly Meteorological Magazine*. The rainband is seen with a spectroscope, preferably one giving a large spectrum. Mr. Capron uses one of McClean's star spectroscopes. Having obtained the instrument, he says, close the slit and adjust the focus till the lines in the spectrum are sharp and clear. That should be done on a bright part of the sky. Then point the instrument to the quarter of the heavens which it is desired to examine, and note the appearance of lines D and their neighbourhood. Care must be taken not to observe too near the horizon, or a false band, due to earth-moisture, will always appear. Some little practice will be required before accurate comparisons can be made; but when the rainband is detected—it lies on the C side of D, and sometimes extends half-way across the interval—rain may be expected, especially if the band is strong. Faint bands indicate an amount of moisture which will remain suspended for some time. The subject is one that deserves the attention of meteorologists.

At a recent meeting of the Royal Society, a paper by Mr. S. A. Hill, meteorological reporter for the N.W. provinces and Oudh, was read "On the Constituent of the Atmosphere which absorbs Radiant Heat." An examination of many observations leads to the conclusion that the constituent in question is water vapour. A series of observations are to be made this year at Leh, 11,500ft. above the sea, which taken in conjunction with those made by Prof. Langley at Mount Whitney (see p. 226) will, probably, yield data of considerable value.

The Royal Commissioners on Mines have commenced a series of experiments with the so-called safety lamps by testing them in currents of explosive gases. When the velocity of current was 600ft. per minute, the gas passed through the gauze and ignited within the lamp. In the case of an ordinary Davy it burnt through the gauze in little more than half a minute, and at the instant the gauze was burnt through the gas exploded. The experiment shows the advantage of using lamps that go out when the atmosphere becomes explosive.

The pressure of gas in the solid coal has been found by Mr. L. Wood to range from 100lb. to as much as 461lb. per sq. inch. His experiments were made by boring into the seams, and fitting pipes connected with pressure gauges in the holes. He has reprinted his paper, which was read before the Newcastle Institute of Mining Engineers.

Mr. Haweis's church in Westmoreland-street, Marylebone, was illuminated by the electric light last Sunday. Maxim and Edison lamps were used, supplied by a Faure battery.

The electric railway at the Collieries of the Donnersmarckhütte Co., in Silesia, is about to be opened. It was constructed by Siemens and Halske, on the same plan as they adopted in Paris. The maximum speed of the locomotive is eight miles an hour. The same firm have also contracted with another colliery company to construct an electric line for doing the underground haulage.

The busiest line of railway in the world during certain portions of the day is the Elevated Railway in New York, which during one hour in the morning runs no fewer than forty-four trains on one line of metals.

The phenomenon of diffusion of solids in solids occurs, e.g., when one heats, in a reducing atmosphere, an iron plate in lampblack. Not only does carbon pass into the iron, changing it successively into steel, then cast iron, but notable quantities of iron are diffused in the carbon. M. Colson, who has lately studied this class of phenomena, states that at a low temperature, apparently, the iron is more easily diffused in the carbon, while the opposite occurs at a high temperature. Platinum, treated similarly, shows no diffusion, whatever the temperature. Just

as, for diffusion to occur between liquids they must be capable of dissolving each other, so for diffusion of solids in solids, there must be a mutual affinity, or they must be capable of reaction on each other. Other examples of the latter diffusion are: Chloride of silver, or silver, and pure dry chloride of sodium; polished sulphide of iron and copper (heated in a current of carbonic acid). To find the law of diffusion of iron in carbon, M. Colson placed in a cylinder of retort carbon a series of similar discs of iron alternating with lampblack and heated this in a crucible. The law is represented by $h/p = \text{const.}$; p being the weight of iron contained in unit volume at the distance h .

The German Imperial Board of Health has lately published an account of experiments by Herren Koch and Wölffhügel, with reference to the question of disinfection with hot air. The following results were obtained:—1. In hot-air sporeless bacteria do not survive a temperature of a little over 100° C., acting 1½ hours. 2. Spores of moulds require about 1½ hours' temperature of 110°-115° C. to kill them. 3. Spores of bacilli require at least three hours in air heated to 140° C. 4. In hot air, the temperature penetrates so slowly into the objects to be disinfected, that after three to four hours' heating to 140° C., objects of moderate size, such as a small bundle of clothes, or a pillow, are still not disinfected. 5. Three hours heating at 140° C., as required for disinfection of an object, does more or less injury to most stuffs.

The polishing gold used in painting on porcelain, and obtained by precipitating chloride of gold solution with nitrate of mercury, is found by a German chemist to explode, in many cases, when moistened with oil of turpentine. The conditions, and the means of prevention, are not yet sufficiently determined.

An instructive account of a pontoon bridge that was to have been thrown across the Danube by the Russian army in 1877-8, but the materials of which, finished too late, were sent instead to New-Georgievsk for experiment, appears in the *Revue d'Artillerie* for December. The middle part of the bridge was supported on 38 pontoons, composed each of four iron cylinders; but 23 fixed supports were used near the banks. It was concluded in general that such a bridge might be constructed by 200 workmen (or, in specially favourable circumstances, and with well-trained and energetic troops, by 150 workmen) in 30 days. The transport to the river, formation, and launching of the pontoons, would have required 19 days more. The bridge, it appears, proved unable to withstand the pressure of an ice-barrier which formed against it.

The idea has been entertained in France, it is known, of opposing phylloxera by a cultivation of small organisms that are parasitic on that insect. M. Gayon has lately made experiments in this direction, which, though not yet complete, may here be noticed. In a small proportion (2 to 3 per cent.) of phylloxeras examined with the microscope, he found unmistakably the small rods characteristic of vibrions; the insects in which they were found were somewhat old and inactive. Taking precautions against foreign germs, he put such a phylloxera, or some liquid from its body, into a vessel holding chicken-broth, neutralised with potash, and soon got in each case multitudes of active rods of bacteria and vibrions. The constancy of this result made him doubt whether there was not some source of error. A curious green product was produced by these small organisms; it deposited ere long green groups of crystalline needles. Again, it has been proposed lately by M. Bidault to counteract phylloxera by turling the ground between the vine-stocks, for the reason that turling ground has been proved (by M. Becquerel) to have a much lower temperature in summer than bare ground; and the heating of the ground in the latter case is very favourable to the hatching of the wingless, and still more of the winged insect.

A recently-published portion of Zetzsch's *Handbuch der Telegraphie* supplies a series of statistical tables of data as to the state, cost of construction, and maintenance, &c., of the electric arrangements of 72 railways of central Europe. (An abstract appears in *Dingler's Polytechnisches Journal*, Dec.)

A new sub-class of infusoria is proposed by M. Geddes (*Comptes Rendus*) for certain cells he

has observed in a planarian (*Convoluta*). He proposes to call them *Pu'storians*. They are shaped like a bent pear, and in one side of their central cavity, or *vacuole*, which is filled with water, are a row of fibrille of muscular nature, which, if the cell is in water, cause it to contract or pulsate rhythmically at a surprising rate (sometimes 100 to 180 times a minute). This action seems to be stimulated by the water, in which, however, it slackens ere long, and the cell dies. When the cell is in the animal, it contracts but slightly. M. Geddes regards these remarkable cells as parasitic.

A considerable portion of Berlin is now supplied with water from the dirty and sluggish Spree, after very thorough filtration in beds constructed on the English model (fine sand at the top and coarser material below). The daily supply is about 10½ million gallons of filtered water; in summer often more. There are 11 filter beds, three covered and eight uncovered, having a total area of about 400,000 square feet. With this large area the filtration can be carried on at a very slow rate; the maximum being not over about 4in. downward per hour. A very slight head, too, is used; seldom more than 20in. Even under these conditions, it is found desirable to let a thin coating form on the surface of a freshly-cleaned filter for removal of the finest particles ere the water is used. Of course, as the coating thickens, the filtration becomes more difficult till it partly stops, and the filter is "dead." In summer, curiously, the gaseous products of decay of the algae (which then cause much trouble by clogging), sometimes break through the slimy coating, so that a "dead" filter is thus brought into activity again. Clear Spree water, let stand for eight or ten days, develops green algae; but this is of no practical consequence, as the water is consumed soon after filtration. In some other waters supplying Berlin, an alga develops so rapidly that filtration would not be of much use.

The use of cyanides in coppering of steel or iron is both prejudicial to the workmen's health and expensive. M. Weil substitutes for them organic acids or glycerine, which are cheap and are not decomposed, so that the baths do not require renewal of these matters, but merely a supply of oxide of copper. The coppering is done in three different ways, according to circumstances. (1) The pieces are immersed in the bath in contact with zinc wires. (2) Porous vessels containing soda-lye are placed in the bath liquid containing the objects to be coppered, and zinc plates in the lye are connected with those objects by means of thick copper wire. The soda-lye serves continually, for when it is nearly saturated with zinc oxide it is treated with sulphide of sodium, which regenerates the caustic soda, precipitating zinc-white, which may be sold. This method is very suitable for candlesticks. (3) A dynamo-electric machine is used under the same conditions. M. Weil's copper-plated articles have fully approved themselves as regards durability, &c.

A pretty and interesting room-ornament may be made with a sponge as a basis of vegetation. As the experiment may be new to many of our readers, we give the following directions, from *La Nature*:—Get a clean sponge, the bigger the better,—and having dipped it in warm water, squeeze out half the water. Put into the holes seeds of millet, barley, purslane, red clover, grasses, &c., and in general any seeds germinating easily, and that will give a considerable variety of colours. Place the sponge thus prepared on a vase, or hang it in a window facing the sun. Sprinkle it with water every morning during a week. The sponge will soon be covered with vegetation.

To Deodorise Rubber.—Cover the articles of rubber with charcoal dust; place them in an enclosed vessel and raise the temperature to 94° F.; let it remain thus for several hours; remove and clean the articles from the charcoal dust and they will be found free from all odour.

Flexible Paint for Canvas.—Yellow soap 2½lb., boiling water 1½ gallons; dissolve; grind the solution while hot with 12½lb. good oil paint.

ORDINARY American railway cars weigh as follows: a sleeping car of the usual pattern, about 66,990 lb.; a drawing-room car, 63,900 lb.; a passenger car, 55ft. long, 42in. wheels, and four-wheel trucks, weighs 45,300 lb.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 21, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made Payable to J. FARMER EDWARDS.

. In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page in which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physics: a view from whence great inconveniences derive their origin."—Montaigne's Essays.

CLEOMEDES—ALPHA CASSIOPEIÆ—MARE SERENITATIS.

[19580].—A RECENT observation of Cleomedes, made on Dec. 24, 1881, is somewhat remarkable. $1G^{\alpha 4}$ appeared as a very lofty hill (the S.W. wall), casting a large shadow. The pass on the north was visible, but with all attention I could not be certain that $1G^{\alpha 3}$ was visible. There was a very slightly brighter spot on the north of the hill before-mentioned, but there was not the slightest suspicion of its being a crater, no shadow being visible, nor was the very slightly brighter spot of any definite form. $1G^{\alpha 20}$, $1G^{\beta 25}$, and $1G^{\beta 24}$ were all visible as craters containing shadow. Definition was fair, but very misty. The 2.75in. achromatic, power 102, was employed.

It seems remarkable that the crater $1G^{\alpha 3}$ was not visible, as it is usually a very conspicuous object even under a higher illumination. On May 4, 1881, age 6.5 days, it was seen very plainly as a crater.

In answer to Mr. Bone (letter 19499, p. 326), the distant companion to α Cassiopeiæ was measured by Burnham in 1878. From one night's measure he obtained—

$$P = 279.8^{\circ}, D = 62.51'', 1878.6.$$

He also measured another much fainter comet, 13—14 mag., at 106.7° and $40.20''$. The magnitude of the distant star has been variously rated. H called it 14; Smyth, 10; Piazzi, 9m. The actual magnitude would seem to be about 9.

Mr. Bone also mentions a dark streak crossing the inlet to the Mare Serenitatis a little west of Hadley and Autolycus: perhaps he, or someone else, could give some further particulars of this streak, as it appears to be similar to the dark border on the west of the Mare, and I can find no mention of such a streak in the elaborate monogram of the Mare Serenitatis by the late Mr. W. R. Birt, in connection with whose death "F.R.A.S.," on p. 339, exactly expresses my sentiments. A. Stanley Williams.

Brighton, Dec. 31, 1881.

ENCKE'S DIVISION—SHAPE AND POSITION OF FLAT—POSITION OF EYEPIECE.

[19581].—In answer to Mr. Westlake (19534), there was a ground fog on the night of Nov. 28th, the air very steady. I first saw Encke's division about 11h. 30m., power 160; about six smaller lines were visible on the ring exterior to Ball's division; these were visible whenever Encke's division was seen.

It appears to me that Ball's division is broader than it was, and the outer ring narrower; this may be the result of better definition. When observing, the telescope is always in the open air.

The shape of the flat must be an ellipse, because it is the section of a cone of rays. At first sight it is incredible that an oblique section of a cone should form the same elliptic curve as an oblique section of a cylinder.

The image of the large mirror is always seen as a perfect circle in the flat, when viewing it from the eyepiece. The centre of this image does not coincide with the minor axis of the flat, because the minor axis of an elliptical conic section does not pass through the axis of the cone from which it is cut. This is not of the least consequence.

The definition of my reflector is dependent upon a certain angle being maintained between the axis of the eyepiece and that of the speculum: I suspect this to be a right angle. Has the eyepiece of a Newtonian ever been placed in any other position?

Mimas.

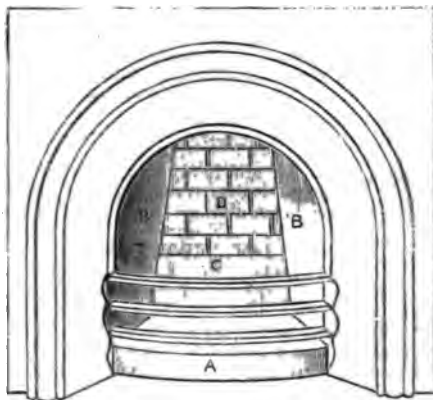
DAYLIGHT METEOR.

[19582].—THIS morning, at half-past eight o'clock, a brilliant meteor was seen by a friend who was coming into Leicester from the south. It appeared nearly in the zenith, and descended in a vertical direction towards the N. Its colour was intense white, and it left a luminous train for about 10 seconds. Was it seen by any other of your correspondents? W. S. Franks.

January 1st.

IMPROVING ORDINARY FIRE-GRATES.

[19583].—HAVING read your account of Mr. Fletcher's lecture at the Smoke and Fog Prevention Exhibition, and having had a stove, such as he describes, altered from an ordinary register stove which has now been in use for nearly two years:



perhaps a sketch and description may be of some use to your readers.

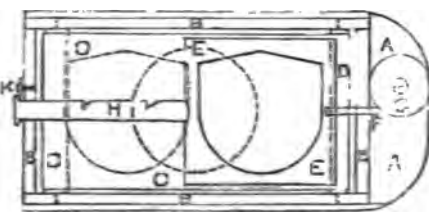
The stove was an ordinary register stove. All the metal behind the front bars was broken out. A fire square was then cut for the bottom, the front being made the same shape as the front bars. This was set with a little slope towards the front, and a space of an inch left between the bottom of the front bars and top of bottom. The sides B, and back C were also fire squares cut and fitted as shown in the sketch. The upper part of back D was built of firebricks, because there you require a greater slope.

It has been a very successful alteration, the cost being only about 10s., and this soon paid for out of the coals saved. The fire now give out a greater quantity of heat, and makes very little ash. I may mention that we cut the ash-pan to the shape of bottom, and this hides the bottom from being seen. Cab.

INSTANTANEOUS SHUTTER.

[19584].—THE following description of an instantaneous photographic shutter may be of interest to some of the readers of "ours."

A is the back of the shutter, which fits into the groove used for the sliding front of the camera; B, four sides $\frac{1}{2}$ in. deep; C, an endless band of leather, with holes cut in opposite sides of it, which revolves on two rollers, D D; E is a piece of tin, with an aperture corresponding to the hole in the leather, and is stuck to the leather with cement, and is to prevent the spring F pulling the leather



out of shape. The spring is attached to the tin by a small hook, and has its other end fastened to a drum, G. This drum revolves very stiffly on its axis, and is used to tighten the spring, and so increase the rapidity of the shutter. H is a strip of tin $\frac{1}{2}$ in. wide, with two notches in it. The notch in the centre is to set the shutter while focussing, the other to set it ready for exposure. K is a small catch to fall into the notches.

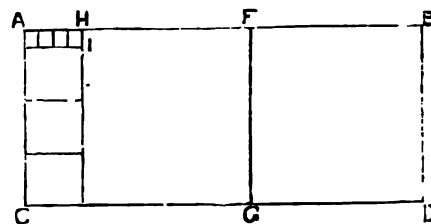
The action of the shutter will, I think, be clear to everyone. The front to which the lens flange is screwed is removed to show the interior. The drawing is to scale, and half the size of one I use for an S by 5 lens of the rectilinear type. The peculiar shape of the openings is to give more ex-

posure to the foreground than the sky. I have made some score of shutters on different plans, and this is the smallest, lightest, and most free from vibration of any, besides being very effective. Ingatstone. H. G. M. Conybeare.

GEOMETRICAL ARITHMETIC.

[19585].—THE rule for finding the greatest common measure of two numbers is a great stumbling-block to many learners; the process, unless carefully explained, usually seems incomprehensible at first sight.

The following geometrical illustration may help some:—If we have a rectangle A B C D, and desire



to know what are the largest squares into which it can be exactly divided, we begin by taking off a square F D, by laying off B F equal to B D. If a piece of paper be used as the illustration, it may be folded cornerwise, so that F comes where the corner D lies on the line B A. Then, similarly, another square, H G, may be taken off, leaving a remainder H C, which must be divided into squares, each the length of its shorter side A H. These, again, leave a remainder A I, which can be divided into four small squares exactly. It is obvious that the small squares last formed are the greatest squares capable of exactly filling up the rectangle A D, the side A C of which will contain 13 of these, and the side A B 30.

On going through the ordinary process for finding the g.c.m. of 13 and 30, we have as our first quotient 2, and remainder 4. The quotient is the number of large squares H G, F D, and the remainder the length of A H. Dividing 13 by 4, we have 3, the number of squares in C I, and remainder 1. Dividing 4 by 1, we have quotient 4, the number of small squares in A I, and so remainder, showing that they exactly fill the space. Ploni Almoni.

EXPLOSION ON HEATING IMPURE OXIDE OF MANGANESE.

[19586].—IN reference to the letter from A. H. Soward, in your issue of yesterday, re the above, I am sorry to say I have not observed the report in the London papers, of the inquest on the body of a gentleman who was killed by the explosion of a retort whilst preparing oxygen gas. I notice he states the cause of the explosion, and goes on to warn your readers who are students of chemistry, that black oxide of manganese is sometimes adulterated with charcoal. Now I have been connected with the manganese trade for upwards of a quarter of a century, and, at the present time, am the largest importer, dealer, and grinder of this mineral, and in no case have I ever come across a sample adulterated with charcoal or anything else. If adulteration does take place, it takes place with second hands, and I should like to see a sample, that I might examine it and prove this adulteration. For the information of your readers, I supply the trade very largely, and the trade for oxygen-making in particular; but in many cases, no doubt it goes through indirect parties; but from the mill I am perfectly satisfied of its genuineness, and capability of producing oxygen without the least danger. Further, for the information of your readers, they may get the quality they want, guaranteed from me, in any quantity, from £7 per ton upwards. Of course I have heard of accidents from sulphide of antimony; but that arises from small quantities purchased from chemists, who dispensed it in error. The adulteration matter, however, to me, is a perfectly new thing.

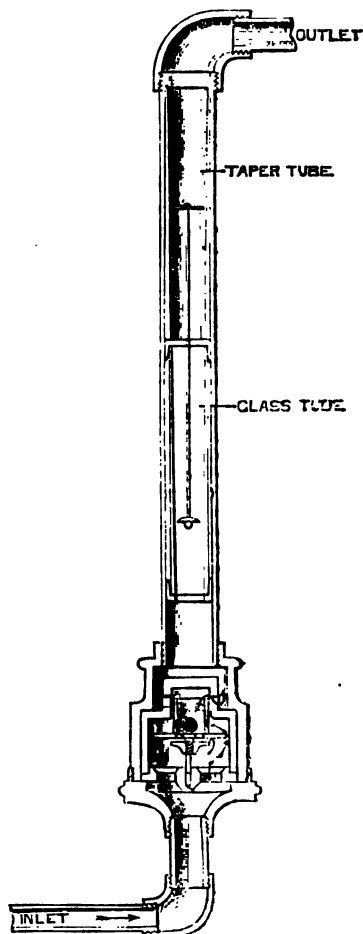
Geo. G. Blackwell,
Manganese Merchant,

25, Chapel-street, Liverpool. Dec. 31.

APPARATUS FOR CONTROLLING THE FLOW OF LIQUIDS.

[19587].—A FEW weeks ago one of your correspondents asked for the various means of regulating the flow of liquids from a cistern with varying level, and as no answer has appeared giving the required information, we beg to inclose sketch of a valve that will perfectly fulfil the required conditions, being, in fact, a modification of our patented regulators for controlling the flow of gas. We have also shown attached an instrument for

determining the exact quantity passing, by means of which the valve may easily be arranged to pass any desired quantity; of course, the size must be made to correspond to the amounts to be passed.



This instrument is likewise a modification of our "Aerometer."

Should the sp.gr. of the various liquids differ, then an allowance will have to be made—for gas we find it to vary as the density, but the disc will maintain exactly the same position, whatever the density, under constant pressure. Should further details be required, we shall be happy to give them.

By the bye, in your last week's issue, Messrs. Stott and Co. are stated to have received a medal for gas-regulators at the Glasgow Exhibition—these regulators were ours, and were simply exhibited by Messrs. Stott and Co.

Thorp and Tasker.

L. AND Y. ENGINES.

[19588.]—SEEING in your last issue a sketch of the L. and Y. express engines, I give a few dimensions:—

	ft.	in.
Diameter of cylinders	1	5½
Stroke of cylinders	2	2
Diameter of driving-wheels	6	0
Diameter of bogie	3	6
198 tubes { diameter	0	1½
{ length	10	9½
Diameter of boiler	4	0
Bogie wheels, centre to centre	5	6
Driving-wheels, centre to centre	8	6½
Total wheel base	21	0½
Length of fire-box	5	0½
Height of fire-box by tube-plate	5	1
Height of fire-box by foot-plate	3	11
Diameter of blastpipe	0	4½

WEIGHT.

	Tons.	Cwt.
On leading bogie-wheels	6	11
On trailing bogie-wheels	6	10
On driving-wheels	14	19
On trailing-wheels	13	18

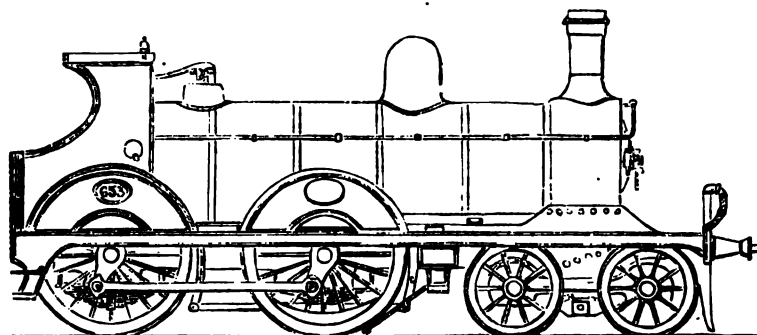
Total

In 1880, eight of these engines were built and fitted with Smith's vacuum, having four-wheeled tenders. In 1881 16 more have been built with six-wheeled tenders; eight of these have the Westinghouse and the other eight Smith's vacuum, all built by Sharp, Stewart, and Co. Nos. are 629, 630, 643—646, 649, 653 (1880). In 1881 627, 658,

664, 667, 668, 681, and two more have Westinghouse; 152, 675, 678, and five others vacuum. Meteor.

L.Y.B. BOGIE EXPRESS-ENGINES.

[19589.]—ALTHOUGH it has often been asked for, no one has yet sent a sketch of the above. I have, therefore, made a sketch, which I hope will be



acceptable. I regret to say that I have nothing to add to the particulars, meagre as they are, which have already been given. Centaur.

LOCOMOTIVES.

[19590.]—If "Iron Horse" will read my letter again, he will find that I made no such assertion, to the effect that drawings of "Cornwall," "Bloomer," and other types of L. & N. W. R. engines, had appeared in the "E. M." I simply asked if any correspondent would kindly supply them.

The chief types of engines used on the Highland Railway may be briefly described as follows:—1st, 6ft. 3½in. coupled, cylinders 18in. by 24in.; 2nd, 5ft. coupled, cylinders 17in. by 24in.; 3rd, 5ft. coupled, cylinders 18in. by 24in. (all these are driving and trailing coupled, first two having leading bogie); 4th, 6ft. single, cylinders about 16in. by 22in.

In answer to his other queries, I append chief dimensions of two of Mr. Stirling's goods engines:—1st—Cylinders, 19in. by 28in.; six coupled wheels, 5ft. 1in.; boiler, 11ft. 4in. by 4ft. 4in.; contains 232 tubes, 1½in. diam., and having superficial area of 1,240 square feet; grate area, 18·7 square feet; heating surface, 112 square feet; total H.S., 1,352 square feet. Weight:—

	Tons.	Cwt.
On Leading-wheels	14	0
" Driving "	14	15
" Trailing "	11	5
Total weight	40	0

Other class—Cylinders, 17in. by 24in.; leading, driving, and trailing-wheels, 5ft. 1in.; boiler, 10ft. long, and 4ft. 0½in. inside diam.; 206 tubes, 1½in. outside diam.; heating surface-tubes, 985·5 square feet; firebox, 94·5. Total, 1,080 square feet; weight, 32 tons 10 cwt.

The dimensions of 474 and 475, eight coupled engines, are:—Cylinders, 18½in. by 24in.; wheels, 4ft. 6in.; boiler, 4ft. 4in. diam.; 13ft. 9½in. long; 184 tubes, 2½in. diam. (outside); H.S. tubes, 1450·1; firebox, 100 square feet; weight, 56 tons. Carstairs.

SCREW-CUTTING.

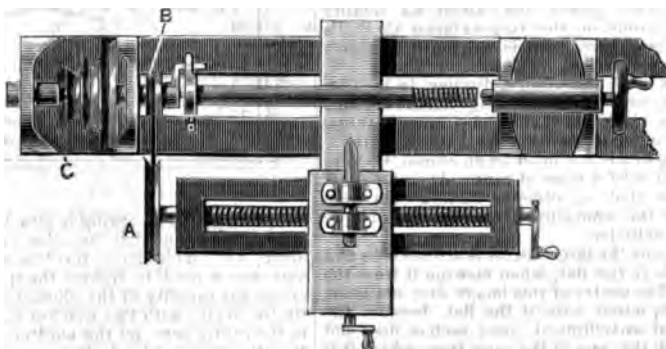
[19591.]—HAVING frequently seen inquiries in the "E. M." as to how to cut screws in an ordinary

lathe; but where hairbreadth accuracy is not required, a very good thread can be made by its help, and it certainly has the great merit of costing almost nothing. Of course a slide-rest will be necessary; in fact, it is simply a dodge to gear the mandril with leading-screw of rest in a simple manner. The sketch will almost explain itself; but still it might help some to tell them how to rig it up. Get a bit of hard wood (board)

about ½in. thick; cut it as round as you can, about 6in. diam., or a little more; take out the leading screw of rest, and screw (or clamp) the pulley (or board) on the end of it, as at A; then mount screw between centres, turn the pulley A until it is quite true, and run a groove in it for band. Next, the size of pulley B depends upon what number of threads to the inch you desire to cut; say, 12; then if the leading screw of rest contains 6 threads to the inch (as mine does), and if the diam. of A be 6in., then the diam. of B will be something less than 2½in. (but this had better be found out by actual experiment), and so on, larger for coarser, and smaller for finer threads.

The most convenient form of carrier in this case would be one carrying centre and arm, and screwed into mandril-nose. This would leave the outside thread free for pulley; but as the pulley need not occupy more than half the length of mandril-nose, a carrier with a short boss may be used to screw up against pulley. It will be seen at once that with this contrivance the length of bar to be screwed is limited, on the one hand, to the length of the slide of rest, and, on the other, to the distance between centres when the back poppet is brought up to slide-rest foot (in my lathe about 7in.) To remedy the latter, I keep a set of pulleys to fit on end of mandril C, and fastened by a couple of screws to mandril pulley; these are exactly the same size as the ones to fit on the mandril-nose, and of course, by shifting slide-rest closer to fixed head, so as to bring A in proper position opposite pulley on C, a screw can be cut on any short piece of metal. With regard to bars which are too long to cut screws on them with the slide-rest in position, as per sketch, the pulley A (or one of a similar size) could be hung upon a short axle, and run in a conveniently-shaped frame, with a foot which could be clamped to lathe-bed in proper position, and then a rod with two universal joints would communicate motion from pulley to leading screw.

The chief drawback to this plan is that the cuts, of course, must be very light: try ½th rev. of advancing slide handle for each cut; when the thread is very coarse, I generally finish with a chaser to save time. I use a round leather band, about ½in. diam. to connect the pulleys; keep it rather tight, and your lathe-cord only moderately so, and there will be no danger of slipping. I don't suppose that I am the first person who has



thought of this idea for screw-cutting; but then it may be useful to many who have not.

R. Hendley.
P.S.—Perhaps the above might suit "An Amateur Joiner" (45593). I could show him a good form of cutter for wood-screw making.

MAJOR ARMSTRONG'S COMBINATION LATHE.

[19592].—I HAVE been much surprised that amongst all those interested in lathe-work and construction, there has been no one to take any notice of this lathe, which seemed to me to be one having so many features of novelty that it could not fail to attract the attention even of our great authorities on lathe construction. Yet, with the exception of one query, there does not seem to have been any to show the least interest in it. And this, I think, should not be, for as a combination it seems well arranged—most ingeniously arranged for effecting the different works intended.

I was myself so much interested in it that I wrote on the appearance of the first letter, in October last, to Major Armstrong, asking some further particulars, and whether the lathe was yet in the market. He had then started for India, but I have since heard from him that he had deposited patterns for, I think, a 4in. or 4½in. lathe, with his improvements and arrangements, with the Britannia Co. So that I suppose anyone wishing to have a new lathe on this plan could have it at once. The only thing now being to get up a little discussion on the merits or demerits of the arrangements; as, of course, one is naturally a little cautious before venturing on new or little-tried ways.

My own, and my only fear about the very ingenious arrangement for drilling and shaping, was that the number of gear wheels—three—would greatly add to the labour of working it, and that it would be found rather heavy work for foot power. The method of fixing poppit-head so as to allow of taper turning is very simple, and seems to be all that could be desired. Also, is it not a good plan to have the right-hand standard placed as in this lathe, instead of at the extreme end of bed? There surely ought to be less vibration—bed would be stiffer—and there being a shorter crank-axle, there need be no second crank to add to the friction of driving.

I do not understand how the fret-saw is to be worked, as there seems to be something omitted either in the description or in the woodcut.

I wish we could induce some of those who are qualified to give a practical opinion, to take some notice of the capabilities of this lathe; for if it can be fitted up, as I believe it can, at a cost little above an ordinary screw-cutting lathe, it has, for the amateur mechanic who cannot have a separate tool for each class of work, a great deal to recommend it.

We have had Gilray's lathe discussed and written about, as it seemed to me, *ad nauseam*, for who would ever choose such a lathe? Apparently no one, for it was so long advertised. We have had now a good spell at bicycles and tricycles; and now I see "D. H. G.," whose least word is worth reading, has joined them; when he is done with that subject would it be too much to ask him to notice this combination lathe, and say what he thinks of it. Could we induce "J. K. P." to give us his ideas?—as he used to do so much purpose some ten years ago; we could not fail to be benefited and interested. Failing either of these veterans in lathe construction—who may decline to be "drawn"—I can think of none of our modern writers except "Sunlight," and everybody keeps him so busy, it seems hardly fair to spur the willing horse, yet I do ask him to leave his tricycle for a moment, and take a look at lathe matters.

Dec. 31.

Fredk. Carre.

TRICYCLES.

[19593].—It seems to me rather funny that, during all the phases of the interesting discussion which, for some time has been going on in "Ours," that we have heard nothing respecting machines embodying what I consider to be the only correct principle for a single driver—viz., machines with open fronts, and the single driver directly in the centre behind. Now, to my mind, the veriest tyro in mechanics could not but admit that this principle must be far more mechanical than any arrangement of a single wheel at the side; indeed, I do not see for a single machine, why it should not be at most equal to the best of the double-driving class, and yet machines on this principle seem to be in comparatively rare general use, to judge from the way in which their existence has been ignored in these columns.

Personally, my sympathies, as before stated, are entirely with the front-steerer, of which I consider the "Salvo" far and away the best; so much so that, after carefully following all the discussions in our columns, I come to the conclusion that nothing at present can beat it. I have an intimate acquaintance with the action of the much-abused differential gear on my own two traction-engines, and consequently know that the objections urged by one or two of our most talented contributors against it are perfectly groundless; and sure that anyone will agree with me *it be so, under the often difficult*

circumstances of traction work, how very much more must it be so on any pedo-motive vehicle; therefore, however our much-esteemed correspondent "Sunlight" can still argue that on turning a curve the outer wheel on any machine fitted with this gear is *not driving*, is a mystery to me, as any one must see that on the steering-wheel being turned, and so causing a retarding or backing tendency of the inner driver; so of course this inner driver (through its bevel-wheel rigidly connected) sets in motion the balance pinion (or crown-wheel, as Messrs. Starley style it), and this pinion, turning on its own centre in the chain-wheel, accelerates the action of the outer driver (rigidly connected to its bevel-wheel), exactly in the proportion as the inner driver is retarded. Now I can say from experience that the action of this gear is perfect, and that only under very exceptional circumstances (never likely to occur in tricycle practice) is there any necessity for locking the gear, as alluded to by "Sunlight" in one of his first notices of this point. The action of this and the driving gear of the Phoenix would, to all intents and purposes, be the same, and the latter may be quite equal, although not so simple as, what I have been describing.

At all hazards, I think so well of its action, that after a little experience gained on a "No. 1 Salvo," a year or two since, I have now decided to purchase one of the "Specials," and will quickly own I am wrong (with your permission, Mr. Editor, in these columns) if I find any of the "subtle loss of power" so ably foretold by some of "Ours."

Thomas J. Scutt.

[19594].—"FIFTY-SIX INCH" appears to be still "at sea" in his conceptions of the action of balance-gear tricycles. He still reiterates the old fallacies with all the authority of proved facts. I thought my letters had made the true double-driving character of these machines perfectly clear to any person of unbiased mind.

Surely it is plain enough that if you work a really single-driving machine, à la Otto, it will turn in a path more or less circular, with the free wheel for the centre. Not so the balance-gear machine. In this case, as both wheels are driven, the machine goes ahead in a path straight when the resistances on the two sides of the machine are equal, but more or less wavy and erratic as the resistances vary with the state of the road. No matter how the resistances vary, the moment the steering-wheel touches the road, it equalises those resistances, and the wheel where they are greatest is thereby enabled to overcome them, and the machine is driven over the obstacle by the rider, not carried over it by mere momentum. Of course, as the speed increases the momentum assists the rider's efforts, but that is all.

My contention is that balance-gear machines are the only true double-drivers made, as they drive both wheels, whether the road is curved or straight; whereas all other machines have to liberate one wheel, and drive with the other when going round a curve. It is true that double-chain and other machines will satisfy my definition of last week, as I purposely cut that down to a minimum, so as to enable them to do so. No. 170.

DYNAMO-MACHINES.

[19595].—WITH all due respect to "Sigma," I do not think dynamos are beyond amateurs. I have made one which has been running every night for the last two months, but it is now temporarily stopped for an experiment. I am also just starting the construction of a larger one, on a different plan. My first gives a light of about 3,000 candles, and the new one is intended to give three of the same power.

As the design of these is new and not patented at present, I am unable to give details, but will do so, if desired, at some future time. In the meanwhile many may be anxious to try their hands, but cannot get particulars of size and weight of wire, best type of machine, &c.

The first question is, What current is required, and what electro-motive force? For a single-arc lamp the smallest current that is any practical good is about 8 to 10 Amperes, and the electro-motive force of a single arc may be taken at about 35 to 40 Volts. Supposing, then, it is required to make a machine of this size, viz., to give a current of 10 Amperes and E.M.F. outside machine of 40 Volts, the size of wire required depends on the current. 10 Amperes will require No. 12 wire for the magnets. About 50lb. to 60lb. will be enough. Now there is the same current in the armature as in the rest of the circuit, and it might be considered that the same sized wire would be required; but as the armature revolves very fast and is cooled by the air, it may be allowed to have a little more resistance in a given length of wire, and half the area will do, or, say, No. 14. As, however, it is probable that a Gramme or Siemens armature will be used, it must be remembered that the wire in these is, so to speak, doubled—i.e., the current

goes two ways, so that 16 will be the right size. From 18lb. to 24lb. will be required, depending on the form of armature and arrangement of wires.

With regard to the type of machine, there are the Bürgin, Gramme, Siemens, and Brush. For an armature I think the first-named the easiest and best in every way. The commutator is really the only difficulty.

The Gramme is firesome to wind, and requires care to prevent the wire flying off; the Siemens is worse.

The Brush has a much simpler commutator, but makes a clumsy machine in such a small size. Any particulars I can give I shall be pleased to supply at any time if required; but the real secret in making a dynamo is *care and insulation*.

R. P.

[19596].—I AGREE with "Anglo-Dane" that "Sigma's" letter (No. 19523) contains very little encouragement to would-be constructors of dynamo-machines, of which class I happen to be a member. For the last two years or more I have been thinking of trying to construct a dynamo, and have been getting all the information I can on the subject, but have been greatly puzzled as to what form to adopt of the very many now extant, having regard to simplicity and efficiency. I, and I think it is the case with most, could manage the mechanical part pretty well, but am rather foggy about electrical details; notably, sizes and lengths of wire. I think, with "Anglo-Dane," that experimenting is the best method of getting at the required point; yet when this deals with few of wire or more, failures rather seriously affect the financial department. My idea was to construct one to absorb, say ½ or 1 h.p., and the Bürgin type seems to me to be the best, as I believe it gives very good results, and is fairly simple in its arrangement. I remember seeing one at the Cantor lectures, delivered last March by Professor W. G. Adams, and have also a drawing in the published report of the above papers. I should think an armature about 6in. in dia., having six soft-iron cores, each being a square frame of wires, would be about the size, and if I could not get better advice, should wind each core with No. 14 B.W.G.

I do not for a moment wish it to be understood that I doubt "Sigma's" "electrical capacity," but on the contrary should esteem it a great favour if he would say what he thinks of my ideas; and, noting the last six lines of second paragraph of letter 19575, shall probably purchase his book before setting to work. Volt.

[19597].—WITH respect to the discussion on dynamo-machines, I quite agree with "Anglo-Dane" in what he says with respect to the resources of amateurs, and their skill to produce such a difficult piece of mechanism as a dynamo, and living away from all electrical manufacturing centres, I would like very much to see the matter of dynamos taken up in your paper.

If some kind contributor could see his way to give us a few hints on dynamos and lamps (the Bürgin, for instance), with resistance of armature, field-magnets, and lamps, I am sure it would be conferring a great boon on many amateurs, myself included. I would much like to see this branch of science occupying a more prominent part in this journal.

Belfast.

W. J.

THE PATENT OFFICE LIBRARY.

[19598].—ONE of the most useful features of our Patent Office is the free library, located on the uppermost floor of the building near Chancery-lane. Here one can see not only the specifications of the patents that have been granted in this country, but can also consult the records of the American Patent Office. Beyond that, however, and perhaps of far more value, is the library of scientific works and the files of the different serials, the current numbers of which are to be found on the table. The library is open from ten until four, and all that is asked of the visitor is that he should enter his name and address, and the object of his visit, in a book provided for the purpose. The advantages thus afforded are appreciated by a large number of students, and are of immense value to inventors and patentees—so much, indeed, that they are inclined to resent any curtailment, and to urge that, if anything, the establishment should be extended, and the opportunities for study and research increased. Some few years ago the sale office was removed to Currier-street, and tons of old specifications were sold as waste; but it appears that the room thus gained in the Patent Office is inadequate, and with the advent of a new librarian, some of the most useful files have been turned out and sent to the waste. I am not singular in the opinion that this step is both unnecessary and impolitic. I think it is also scarcely fair to patentees, whether *in esse or in posse*. It is no doubt true that the files can be seen at the British Museum, but, in the first place, it is very difficult to get at them there, and in the second, the British Museum is not

altogether a free library. Looking at the matter simply from the inventor's point of view, the labour of a search as to the originality of an invention is not a light or easy task, and considering the enormous profits made by the Patent Office, it is not too much to ask that every facility should be afforded by the Government. It must be remembered that in this country a patent costs £25 in stamps alone in the first, or three-year, stage, and the office renders no assistance whatever to the patentee. It takes his money and receives his specification, although the same thing has been left only a week before. It is, in fact, no part of the duty of the officials to point out that the invention is old, or to warn the intending patentee that he is about to waste his money. If the indices and abridgments were made up to date, there would, perhaps, be not much to complain of in this arrangement; but at least, considering the large sums received, every facility should be afforded for searching, and the plea of want of room should not be urged as a reason for destroying files which practically cannot be examined elsewhere in London.

It may be acknowledged that the present Patent Office building is scarcely adequate to its purpose, but I have reason to know that with a comparatively small expenditure of the large accumulated funds an extension could be made sufficient to accommodate the valuable files which have been recently turned out, and I put the matter on a high ground when I venture to say that the Commissioners ought to sanction the requisite outlay. The accumulated "savings" of the Patent Office are considerably more than a million, I believe; and, looking to the importance of a complete library, so far as the records and history of invention are concerned, I think it no more than ample justice that the inventor and patent agent should have every facility afforded for making all necessary searches. Of the staff it may be said that they are distinguished for their courtesy, and for the pains they take in helping searchers to find what is wanted. The librarian has, no doubt, done the best he could under the circumstances, but nevertheless, the library has been denuded of some of its most valuable treasures, and I have a hope that this appeal, made through your columns, will help to induce the authorities to restore them, and to make such arrangements for the future as will prevent any diminution of the usefulness of the Patent Office Library. Saml. Ray.

COAL-GAS, AND HOW TO USE IT.—III.

[19599].—THE meter should be placed close to where the service-pipe enters the house, and in a place as little exposed to frost as possible, and where it will be easily accessible to put water in and let it out (if a wet meter), and to take the state; but not so as to be meddled with easily by mischievous fingers. In building a new house, if a cupboard or other woodwork is provided to contain the meter, attention should be paid, not only to the possibility of the meter standing in it, but to convenience in making the necessary joints. Many houses are built now which make one wonder what sort of a thing the conventional meter in the mind of the builder may be.

Care must be taken that the pipes in the house fall towards the meter, and that they are laid so that there is no chance of their falling hollow in places where water may lodge. If a pipe has to be taken downhill, and then up again, a siphon-pipe to let the water out should, in all cases, be attached at the lowest point. The pipes inside the building may be of wrought iron, lead, or composition. The latter material is lighter for the same length than lead, and, therefore, rather cheaper. If a governor is to be used at the meter, the pipe should be of ample size, as one square eighth of an inch of area should be given to each light, at the least. Thus, a

1/4 in. pipe will supply	3 lights.
1/2 in. " "	12 "
3/4 in. " "	28 "
1 in. " "	50 "

In some towns no pipes are allowed to be put up except by an authorised gasfitter, who has to work according to instructions furnished by the gas manager. This is adopted as a measure of safety for the gas consumer to protect his pocket against scamped work. Also the meter-fixer tests the fittings for soundness before fixing the meter. This is usually done by blowing into or drawing out of the open end of the pipe with the mouth and noticing whether it holds the air in the one case or keeps it out in the other. All taps and pipe-ends being of course closed. Mains are tested by putting a few inches pressure on, and noticing by a gauge whether it holds the pressure or not. There is nearly always a considerable amount of leakage from mains, especially old ones; and this is one reason why it is of importance to keep the pressure in the mains as low as possible. The importance to the consumer of not having too high a pressure is very great. With a high pressure, any leak in the pipes pours forth far more gas than at a low pressure; the

burners roar, and gas is literally blown through the flames, and makes a smell in the room.

The make, size, and suitability of the burners used has a great deal to do with the satisfactory lighting of any room or house. Many of the burners in use at the present day are very old ones, which never were economical, and which were put on because they were almost dirt cheap in first cost. When it is remembered that an ordinary burner of the best class (Bray's special patent) only costs 3d., and that three pennyworth of gas may be wasted by a bad burner in a week, the utter foolishness of grudging an expense so trifling will be manifest.

The old-fashioned burner was merely a refractory tip (often iron) for the pipe, with holes or a slit in it for the gas to come out. The old burners let a deal of gas come through, and burnt it without any reference to whether the combustion went to produce heat or light; consequently the non-luminous or blue part of the flame was often greater than the white luminous part.

I will mention two experiments which show how to improve this. If we take an old burner in one of the smaller sizes, light it, and gauge the illuminating power roughly by the eye, then put it out, and slip on over it an india-rubber tube furnished with a larger burner (the tube may be about 2 in. or 3 in. long), and light the gas at the larger burner; it is plain that the same amount of gas will be burnt as before, because the gas still has to pass through the smaller burner. But on lighting it at the larger burner (i.e., a burner with a larger hole or slit), it is found that the same amount of gas gives more light. Why is this? Because the gas issues more slowly through the larger aperture. This is the principle on which Bray's burners are made: a piece of enamel perforated with a hole of proper size is placed in the lower part of the burner; the holes in the tip are made larger than they would have to be if the perforated piece were not there, and so the gas, checked by the first hole, issues slowly from the holes in the tip, and burns to advantage.

The blue part of the flame is made much smaller, and assumes more of a dusky brown colour, while the illuminating portion is much larger, and very brilliant. It does not spread out into a broad fan-shape, owing to the checking and pressure; a fan-shaped flame may be very pretty, but it shows too great pressure, and consequent waste of gas.

The other experiment is one which some readers may have seen mechanically performed in a shop-window in the Strand. Two not very economical burners, when brought together so that the flames coalesce, give a brighter light than the two did when separate, as may be shown by making the burners approach and recede. One burner may be held in the hand and supplied with gas by an india-rubber tube for the purpose. But note that two of the Bray's burners will not give more, but less light, when treated thus. There are also very excellent but somewhat expensive argand burners, and also governor burners, each of which has a governor of its own, made by Mr. Sugg and others. A very important matter in connection with burners is the globe or moon. This should have large openings (4 in.), as now made for the Christiansa and other burners. The narrow opening at the bottom of the old globes causes a quick rush of air, which prevents the quiet and full combustion of the gas. Many chandeliers have a very large "ornament" just under the burner, which appears to serve no possible purpose but to throw a shadow directly under the burner, where in many cases the light is most wanted. This unfortunately is a great defect in the governor burners, which are otherwise excellent. There is one system of gas-lighting which appears very commendable, and that is one in which a large pipe takes away the burnt gases, thus ventilating instead of fouling the room. This was, I believe, advertised and illustrated in the *Journal of Gas-Lighting* by Mr. Sugg some little time since.

Ploni-Almoni.

GRINDING AND POLISHING GLASS SPECULA.

[19600].—It may perhaps seem an unnecessary proceeding to remove the wooden holder, and replace it with the iron "runner" described in my last (19475). Experience teaches that the wooden ring is apt to get wetted in the processes of "roughing out" and "truing." This fact, added to the natural tendency of wood to warp and alter in shape, makes it unfit to use for the smoothing process; and, as in smoothing, we wish to get a very close approach to an absolutely-spherical curve. The "runner" prepared with the tissue-paper strips, as described, answers the purposes of giving an equalised support to the mirror, the paper reducing the actual adhesion. For, supposing the mirror 12 in., the back or runner, if the whole surface of pitch was in adhesive contact, would be difficult to remove. In fact, the probability would be, the mirror would be broken in the attempt. There is, however, another method of reducing the adhesive surfaces—viz., by cutting out broad

rings in the pitch on the lathe. As the "runner" is chucked in the simplest way, and turning rings in pitch is simple, too, this may be used. There is the disadvantage of getting powdered with the pitch turnings, which stick as close as wax (or even pitch). This is a consideration that will commend itself to all who, like myself, have experienced the irritation caused by particles sticking to clothes or flesh.

There have been many modes of polishing optical surfaces adopted, some of them rough and ready, others requiring considerable skill in the manipulation. These modes are now, in most shops, used for the special class of lens to which they are most adapted. I will enumerate a few of the materials that I have used myself: Mixtures of white wax and putty-powder; ditto with rouge; beeswax with Burgundy pitch and rouge; ditto ditto, with crocus; cloths, silk, alpaca, with rouge; oxide of iron (precipitated), and putty-powder—these materials all successful with various classes of work; and last, paper. There are two sorts of this material that are useful for polishing purposes. The first, and that which I recommend, is the sort of paper usually used for the albumenised paper for photographic printing. This paper is unglazed, white, hard, and contains very little grit.

The other sort is a soft, unglazed paper, the filtering-paper of the chemist. I have successfully used extremely thin blotting-paper. I will suppose that our operator chooses the first, having provided a wine-glass or other hollow cone of glass or glazed ware, having a rounded and smooth edge, also a small quantity of starch made into a stiff jelly with boiling water, and allowed to get cold. The tool used in grinding the surface is wiped perfectly clean, left wet; a little starch is spread over the tool. The papers, cut into strips of 1 in. wide, are laid across the tool with 1/4 in. between them. The glass cone is now gently drawn from end to end of each strip, forcing the starch out, and causing the paper to adhere close to the tool. When all the strips are laid evenly, the sponge, very cleanly rinsed and slightly wet, must be used to wipe off all the starch that has oozed from under the strips; the surface of the strips, too, must be lightly wiped over with the sponge. Now it is required to dry the polisher: this must be done by holding a Bunsen gas-tube or spirit-lamp under the tool. When perfectly dry, a careful search must be made over the surfaces of the strips, and every black speck or blemish picked out with a penknife. A little of the material, known as "tripoli de Venise," is rubbed on each strip and rubbed down with the bruiser, the bruiser first chemically cleansed with the solution of spirits of salts or sulphuric acid before mentioned. This will show the position of grit, if any remains in the paper: this must be picked out. When the bruiser passes over every strip without scratching or catching, the polisher is fit for the mirror. Now, with a brush (a nail or tooth-brush will do) brush off all the tripoli that the bruiser has liberated, and have the mirror perfectly clean and dry, the tool slightly warm; then with straight strokes, and regularly rotating the mirror, work it over the polisher perfectly dry; blow off, from time to time, the tripoli that will gather round the edge of the mirror. This can be done by hand or "Rosse" machine, or any modification of Rosse machine that gives straight strokes or very narrow ellipses.

After polishing half an hour, look at the surface, and if the polisher "takes" the middle, shorten the stroke, or vice versa. It has happened that a splendid surface has been obtained by this method without further manipulation; but this must not be looked for. If the polisher goes well, a 6 in. speculum should polish nicely in from four to five hours. This, however, does not always follow. Even professionals cannot give the time to an hour or so. I will, in my next, describe more fully the pitch-polishers, &c., required for figuring; and I think then that the machine-working and testing promised us by H. A. Wassell will have placed in the hands of the amateur all the information he will need concerning the speculum. I will then, with the Editor's permission, describe how to make flat and eye-pieces—Huyghenian, achromatised, positive, &c.

Prismatique.

ELEMENTARY MATHEMATICAL OPTICS.—XII.

[19601].—It was shown in the last section, that when two lenses are free from spherical error, we must have $A_1 \cdot y^2 \cdot f^2 = A_2 \cdot Y^2 \cdot F^2$; in which A_1 and A_2 represent the tabular coefficients of aberration. Or we may put it in the following form:— $A_1 = A_2 \cdot Y^2 \cdot f^2 \cdot F^2$. But since the diameters of the lenses are equal, $y = Y$, which makes the second factor unity; and if f be the focus of the crown, and F that of the flint the quotient of the former divided by the latter is equal to the dispersive ratio, or δ . Hence the third factor equals δ^2 , and the equation reduces to $A_1 = A_2 \cdot \delta^2$.

Therefore, to find two pairs of curves which shall be free from aberration:—

a. Take out the tabular coefficient of the first lens for parallel rays, and of the second lens for vergent rays, corresponding to the given refractive indices.

b. Find the value of a , which is a function of the conjugate foci, and substitute it in the equation to the second lens; we thus obtain two numerical equations.

c. Assume a value for x in one of the equations, then, the value of δ being known, there remains a quadratic equation, from which the ratio of the other pair of curves may be determined.

We can also introduce the condition, that the two interior curves shall be equal, in which case, instead of assuming a value for x , we express it in terms of the ratio of the second pair of curves. An example of this kind is given below.

Coddington gives the following questions, illustrating the use of his rules. The first does not relate to an achromatic combination, but it serves as an easy introduction to his method of computing aberration.

Ex. 1. Two convexo-plane lenses, each of 4in. focus, are placed in contact (that is the curved side of the second touches the plane side of the first): compare the aberration for parallel rays with that of the equi-convex, formed by placing their plane surfaces in contact, the index of refraction being 1.5.

Here our equations are:—

$$\text{For parallel rays } \left\{ x^2 - \frac{10}{7}x + \frac{10}{7} \right\} \frac{y^2}{\phi^2} \dots (a)$$

$$\text{For vergent rays } \left\{ x^2 + \frac{10}{7}ax + \frac{13}{28}a^2 + \frac{27}{28} \right\} \frac{y^2}{\phi^2} \dots (b)$$

We omit the numerical factor at the head of the equation, because the lenses are all of the same medium.

For the equi-convex, whose focus will be 2 and $x = 0$, the equation gives $10/56 y^2$, consequently the aberration is found by multiplying this by the square of the focus; the result is $5/7 y^2$.

For the first convexo-plane lens, $x = 1$ and the focus 4; we have $1/64 y^2$, or the aberration is $4 \times 1/64 y^2 = y^2/16$. (The multiplier 4 is the square of 2, the compound focus).

For the second convexo-plane lens, the first conjugate focal length d , is equal to the focus of the first lens taken negatively, or -4 .

Hence $1/d = (1 + a)/2\phi$, becomes $-1/4 = (1 + a)/8$, or $a + 1 = -2$, $\therefore a = -3$. Substituting this in eqn. (b) and x , as before, being unity, we get $13/7 + y^2/64$, or multiplying by 4, $13/12 y^2$.

Therefore the whole aberration of the two lenses is $(y^2/16 + 13/12 y^2) = 5/28 y^2$.

But that of the equi-convex is $5/7 y^2$ which is four times that of the combined lenses.

Ex. 2. A plate-glass convex lens, whose focal length is 3, and refractive index 1.5, is united with a concave of flint glass, whose index is 1.6 and focus = 5. Find the radii of curvature which shall make the compound lens free from aberration for parallel rays. Here our equations are:—

For the first lens—

$$1.166 (x^2 - 1.428x + 1.428) \dots \dots \dots = A_1$$

For the second lens—

$$.78 (x^2 + 1.733ax + .68a^2 + 1.136) \dots \dots \dots = A_2$$

$$\text{And } \delta = (3 \div 5) = .6, \therefore \delta^2 = .216.$$

In this case $d = -3$, so that the equation for a is $-1/3 = -1 + a/10$, $\therefore a = 7/3$.

Hence we have $A_1 = (x^2 - 1.428x + 1.428) 1.166$.
 $A_2 \delta^2 = (x^2 + 4.01x + 4.84) .1635$.

So that the equation $A_1 = A_2 \delta^2$, becomes $6.33 (x^2 - 1.428x + 1.428) = (x^2 + 4.04x + 4.84)$.

First—we will assume that the plate-lens is equi-convex; then $x = 0$, and the first side of the eqn. becomes $6.33 \times 1.428 = 9.039$.

Therefore our final quadratic is $x^2 + 4.04x = 9.039 - 4.84 = 4.199$, from which $x = 0.85$. For the first lens each of the radii = $2\phi = 6$; for the second lens, the interior radius $r = 2\phi (\mu - 1)/1 + \mu = 6/1.85 = 3.24$ outer radius = $6/1.5 = 4$.

Secondly, let the convex be a crossed lens, the value of x being $5/7$. The first side of the eqn. gives $5.81 = x^2 + 4.04x + 4.84$, or $x^2 + 4.04x = 0.97$, from which $x = .22$. For the first lens, the curves are: 1st side $3 \times 7/12 = 1.75$; 2nd side $1.75 \times 6 = 10.5$. For the 2nd lens, the curves are 1st side $6/1.22 = 4.92$; 2nd side $6/1.78 = 7.7$.

Thirdly, let the flint lens be plano-concave, in which case x on the second side of the eqn. = 1. This gives $x^2 - 1.428x + 1.428 = 9.88 \div 6.33$, from which $x = .087$. Hence the curves of the 1st lens are $3/1.087 = 2.76$ and $3/1.913 = 3.28$. For the second lens, the interior curve is $6/2 = 3$.

Fourthly, to introduce the condition of coincidence of the two interior curves: let r_1 and s_1 be the convex; r_2 and s_2 those of the concave; r_1 and s_1 those of the first part of the equation, second. We must first express y

in terms of x . Since the interior radii are equal $s_1 = r_2$; but $1/s_1 = 1 - x/3$ and $1/r_2 = 1 + y/5.6/6$. Equating these values we find that $y = (1 - 2x)$. Substituting this for y in the second side of the equation, it gives:—

$$4x^2 - 12.08x + 9.88.$$

And multiplying the

$$\text{first side by the coefficient } 6.33 \dots 6.33x^2 - 9.04x + 9.01.$$

Subtracting the top line

$$\text{from the lower } \dots 2.33x^2 + 3.04x - 0.84 = 0, \text{ or } x_1 + 1.3x = .36.$$

$$\text{This gives } x = .028. \text{ Therefore } y = (1 - .056) = .944.$$

Hence the curves of the convex-lens are—

$$r_1 = \frac{3}{1+x} = \frac{3}{1.028} = 2.91$$

$$s_1 = \frac{3}{1-x} = \frac{3}{.972} = 3.09$$

The curves of the second, or concave, are—

$$r_2 = \frac{6}{1+y} = \frac{6}{1.944} = 3.09$$

$$s_2 = \frac{6}{1-y} = \frac{6}{.056} = 107.$$

For practical purposes, the flint-lens may be plano-concave.

We may express y in general terms of x by the following method:—

$$\frac{1}{s_1} = \frac{1-x}{2(\mu-1)f_1}; \frac{1}{r_2} = \frac{1+y}{2(\mu_1-1)f_2} \therefore$$

$$\frac{1-x}{1+y} = \frac{(\mu-1)}{(\mu_1-1)} \delta$$

The following remarks will show what kind of lens is denoted by the value and sign of x (or y).

Plano-convex $\dots \dots \dots x = -1$.

Equi-convex $\dots \dots \dots x = 0$.

Convexo-plane $\dots \dots \dots x = +1$.

Hence, if x has a value greater than -1 , the lens is a concavo-convex; for values between -1 and 0 , it is a double convex with longer radius in front. If x be greater than $+1$, the lens is a meniscus; and for values between $+1$ and 0 , it is a double convex with shorter radius in front.

For the second lens:—

Plano-concave $\dots \dots \dots x \text{ (or } y) = -1$.

Equi-concave $\dots \dots \dots x = 0$.

Concavo-plane $\dots \dots \dots x = +1$.

If x is greater than -1 , the lens is convexo-concave; for values between -1 and 0 , it is a double concave with longer radius in front. When x is greater than $+1$, the lens is concavo-convex; and for values between $+1$ and 0 , it is double concave with shorter radius in front.

This letter is the concluding one of my series on Elementary Mathematical Optics. In endeavouring to fulfil my promise made to "Nova Scotian," I have touched upon subjects not immediately connected with aberration; because it seemed very evident that many would wish to know the rules for finding simple foci, without going further into more difficult matters. I have not found it an easy task to compress sufficient explanations into the limits of a letter suited to these correspondence pages; but I trust those who read these articles will not have much difficulty in filling in such intermediate steps as may be necessary. I need not say that a fair knowledge of algebraical processes is essential to the study of matters treated of in these articles.

The mathematical principles involved in object-glass construction have received a fair share of space in these columns; both Barlow's and Coddington's rules have now been given, which should be sufficient to supply the wants of all inquirers. The practical part, however, is far from being exhausted; but it is not very likely that any hints will be given by professional workmen. The letters of skilful amateurs, such as Mr. Godfrey, "Nova Scotian," and others, who can follow up theory by practice, contain information invaluable to those whose inclinations lie in the same direction. It is with the hope of encouraging others to imitate their example, that I have imposed upon myself the task—and no light one either—of giving some account of the rules of Barlow and Coddington. Having discharged it, to the best of my humble ability, I hope to see practical matters, both in "brass and glass," occupy a place in the columns of the ENGLISH MECHANIC.

Orderio Vital.

ON THE USE OF THE SLIDE-RULE IN ELECTRICAL CALCULATIONS AND MEASUREMENTS.

[19602.]—UNTIL recently it was almost impossible to procure a slide-rule sufficiently well made to be of any real use in scientific calculations, and, therefore, it was generally discarded as an instrument only fit for very rough computations, such as builders and carpenters require to make; but as

now our best instrument makers can produce rules on which the fourth term of any proportion can easily be obtained to within an $\frac{1}{4}$ per cent. of the actual truth, even in the most crowded part—namely, between the 8 and 9, it seems a great pity that this valuable time and trouble saved should not be more generally used and known.

It is with the object of bringing it to the notice of those readers who have not yet given it a fair trial that I write this letter, in which I shall attempt to show how useful the slide-rule may be in electrical calculations.

There are a great number of measurements in the practical applications of electricity in which the errors of observation always exceed $\frac{1}{4}$ per cent.; to give two instances, the reading of the deflections on galvanometer scales, nearly all the measurements connected with the electric light, besides a great many others; also, there are a great number of cases in which greater accuracy than can be got with a good slide-rule is not required; for instance, the internal resistance of batteries, the multiplying power of shunts, the strains on suspended wires, &c.; therefore, in all these cases it is simply useless, besides increasing the chances of error, to work out the results, which are based on such observations, to five or six places of figures.

An ordinary well-made single slide-rule will solve all the following problems; but as there are occasionally ones in which two slides with three radii are required, it is really better to commence with the best procurable, as one gets used to the reading on a particular rule.

A small T-square made by scratching a fine straight line on a piece of transparent horn, to which is fastened a small bar of wood at right angles to the line, is a very useful adjunct to the slide-rule, enabling the reading to be read more easily, and calculations to be made in which several multiplications and divisions are performed, without having to write down anything but the answer.

The real stumbling block with the slide-rule is its numeration—namely, to know how many figures the answer consists of. I found the rules given in Heather's "Drawing and Measuring Instruments" very clear and easy to understand; if the numeration be once thoroughly mastered, I feel certain that the slide-rule will always be used where it is possible to do so, it being really an almost universal table, in which are given an infinite number of values for an infinite number of conditions.

To abbreviate as much as possible, let the letters on the left indicate which lines are to be used, a letter inverted signifying that the slide is to be inverted and two quantities separated by a line to mean that one of them is to be set to the other. Thus the following will denote:—

$$\frac{A}{O} \frac{2}{4} \frac{5}{6}$$

that if 2 on A be set to 4 on the inverted line C, 5 on A will be against 1.6 on C.

I shall commence with the problems in connection with the electric light.

(1.) To find the candle-power of arc, having obtained a balance in the photometer. Then—

$$\frac{q \text{ inv.}}{D} = \frac{\text{arc's distance from screen}}{\text{candle-power of arc}} = \frac{\text{candle's distance.}}{\text{candle's power.}}$$

Ex.—Let the arc's distance be 300in., and the candle's to vary from 7.5, 8, 8.75, then—

$$\frac{q \text{ inv.}}{D} = \frac{1}{300} \frac{1,600}{7.5} \frac{1,405}{8} \frac{1,175}{8.75} \text{ candles}$$

(2.) To find the horse-power developed in the arc—

$$\frac{A}{O \text{ inv.}} = \frac{\text{difference of potentials of 2 carbons in Volts}}{\text{strength of current in Amperes}} = \frac{\text{horsepower}}{746}$$

$$\text{Ex.—} \frac{A}{O \text{ inv.}} = \frac{24 \text{ Volts}}{20 \text{ Amperes}} = \frac{645 \text{ horse-power}}{746}$$

(3.) To find the candles per horse-power—

$$\frac{O \text{ inv.}}{A} = \frac{\text{candle-power of arc}}{1} = \frac{\text{h.-power in arc.}}{666 \text{ candles per h.-power}}$$

$$\text{Ex.—} \frac{O \text{ inv.}}{A} = \frac{1}{1,600} = \frac{2.4}{666}$$

(4.) If the constant of the galvanometer for Amperes be given—

$$\frac{A}{B} = \frac{\text{deflection on galvanometer}}{\text{current in Amperes.}}$$

$$\text{Ex.—} \frac{A}{B} = \frac{1}{2.48} \frac{17^\circ}{42.2} \frac{27^\circ}{67} \frac{33.6^\circ}{83.1} \text{ Amperes.}$$

(5.) Similarly, when the multiplying-power of a shunt is given, it is easy to read off at once what the true deflections are.

(6.) If the multiplying power μ is not calculated, but the shunt's and galvanometer's resistance are given—Then,

$$\frac{A}{B} = \frac{\text{shunt's res.}}{\text{galvanometer's + shunt's res.}} = \frac{\text{ang. deflection}}{\text{true deflection}}$$

and against 1 on A will be the multiplying power, "on B.

(7.) To find the joint resistance of two wires, "a and b;

$$\frac{A}{B} = \frac{a+b}{a} \quad \text{the joint res.}$$

Ex.—17 and 28.

$$\frac{A}{B} = \frac{17+28}{17} = \frac{45}{17} \quad 28$$

10.59 their joint res.

(8.) To find number of divisions = ϕ on galvanometer scale, which correspond to 1 micro Ampère, having obtained a deflection "D, with a known electromotive force E, through a known resistance R.

$$\text{Then, } \frac{A}{B} = \frac{E}{RD} \quad \text{Resistance } \phi \times 10^6$$

(9.) To find the strength of a current which produces "cubic inches of hydrogen an hour—
A 26 number of inches of hydrogen per hour
B 1 strength of current in Amperes

(10.) To determine weight of any substance decomposed by a current in an hour.

$$\frac{A}{B} = \frac{1.76}{\text{electric equivalent of body}} \quad \text{current in Amperes}$$

weight in grains decomposed per hour

The slide-rule is very handy and useful for calculating the resistance of pure copper wires, of given dimensions. The following are some of the problems.

(11.) To calculate the number of feet to the Ohm for pure copper wire when the weight per foot is given in grains.

$$\frac{A}{B} = \frac{95}{20} \quad \text{Feet per Ohm} \quad \text{Grains per foot}$$

(12.) Diameter in mils being given to find weight in grains per foot.

$$\frac{C}{D} = \frac{53}{6} \quad \text{Weight in grains per foot} \quad \text{diameter in mils}$$

(13.) Diameter in mils being given to find resistance per thousand feet.

$$\frac{C \text{ inv.}}{D} = \frac{270}{6} \quad \text{Resistance per thousand feet} \quad \text{Diameter in mils}$$

(14.) Two of the three following data being given, to find the third; length in feet, diameter in mils or resistance.

$$\begin{array}{l} \text{Then} \\ A \text{ Length of wire} \\ B \text{ total resistance} \\ C \text{ 9.72} \\ D \text{ Diameter} \end{array}$$

(15.) If weight be given instead of diameter.

$$\begin{array}{l} \text{Then} \\ A \text{ Total weight in grains} \\ B \text{ 21} \\ C \text{ Total resistance} \\ D \text{ length of wire} \end{array}$$

(16.) To determine the conductivity per cent. having obtained the measured and calculated resistance.

$$\frac{A}{B} = \frac{\text{Measured Res.}}{\text{Calculated R.}} \quad \frac{100}{\text{Conductivity}}$$

(17.) To determine the true resistance of a line when different results are obtained by first measuring with a zinc current and then a copper current.

$$\begin{array}{l} A \text{ Res. by one current} \\ B \text{ 1} \\ C \text{ Resistance by other current} \\ D \text{ True resistance of line} \end{array}$$

There are a great many more problems which can be easily solved at sight by the use of the slide-rule, such as finding the resistance of a wire at one temperature when its resistance at another is known; the strain on suspended wires when the length of span and sag is given, &c.; but, as I have already occupied so much space, I must reserve them for a future letter.

If I have not made myself sufficiently clear in the above, I shall be very glad to explain any difficulties.

S. Hampstead.

Arthur Wright.

AERIAL NAVIGATION.

[19603.]—KNOWING that many of your readers take a great interest in practical aeronautics, I send you the following extract from one of our technical journals. The remarks, I may add, were called forth by the suggestion, made seriously, that the offer of one million dollars by the Government would be sufficient to bring out a solution of the problem from amongst the American inventors. It is an indication of the fact already recognised and becoming more apparent every day, that the minds of thoughtful men are directed to the problem of transferring passengers and freight directly through

the air instead of on the surface of the water or land. The theory of the air-ship and flying has already been elaborated to a great extent, especially by the engineers of France, and while the average "flying-machine" inventor is not above the "perpetual-motion" machine man, the scientific aspects of these two problems are entirely different.

When transfer of messages becomes as rapid as the electric current in the telegraph and telephone; when the railroads and steam-vessels are fast being pushed to what at present is believed to be their limit of speed, the investigator naturally looks to some medium of transfer where the obstruction shall be a minimum, and his thoughts fly to the clouds. It is needless to dwell upon the advantages which aerial navigation would offer could it be carried out successfully. Can it be carried out successfully? The fact that the bird flies independent of the motion of the air; is buoyed up and impelled solely by its own displacement and its own energy of impulse, is the evident reply that it is theoretically possible. Investigators of the question of the practicability of flying-machines have therefore attempted to analyse the scientific principles of the flight of the bird, and while they have fairly succeeded in such analyses, the logical conclusion has been that at the present time, with the materials of construction at hand, it is impractical to approximate the bird's flight. This impracticality is due to the fact that we cannot with any known form of prime mover obtain the requisite proportion of power to weight and volume conveyed, as represented in the physical structure and motion of the bird. Men of practical knowledge and scientific attainments who are giving this question proper attention are now working in the direction of reducing the weight of the prime mover per horsepower and the cross-section of the vessel it is intended to propel as much as possible. This is the right course to pursue, though we are still somewhat sceptical of practical success with the materials of construction and motive power at present in use. While we admit the probability of success, actual success seems deferred to some later day. Nor do we incline to the opinion that the air-ship of the future will be one that is a close imitation of the bird's flight, but are led to believe rather that it will approach the principle of the vessel's transit through water. In such a case the air-ship will have to perform two functions. There will be needed one appliance to keep the vessel suspended in the air. The ship must be partially filled with some fluid of sufficient lightness to float in the air and still carry additional weight. The balloon is an illustration of this part of the problem. In addition to this, there must be the paddle, screw, or similar appliance, which acts against the atmosphere to propel the vessel. Now, we are prepared to see the real difficulties of the problem. For, in order that the vessel may float and carry passengers and freight, it must be of prodigious size, relative to the weight which it can carry. Therefore, a small weight of machinery can only be used as motive power, while a great power becomes necessary. In a vessel pushing through the water the propeller or paddle impinges upon a practically incompressible, inelastic, dense medium, and this causes the motion of the vessel. But the air upon which the propelling device of the air-ship must impinge is easily compressed, elastic and not dense, consequently a very rapid motion and great surface of the propeller will become necessary. If the air-ship is ever to be a practical success, the speed must be very great, and the greater the speed the greater becomes the resistance of the air. "Flying-machine men" rarely speak of obtaining less than 150 miles an hour; do they ever reflect when they make this statement that they must overcome a resistance of the air of over 100lb. per square foot to accomplish this speed? The theory of the air-ship is one of the most interesting problems of the day, and those who have given it most attention best see the obstacles to its practical success at the present time, though they may not be insurmountable. But some day the problem of the flying-machine will have to be met as a commercial necessity, and it should never be regarded hastily in the light of an impossibility or placed in the category of chimeras, where perpetual-motion machines properly belong.

Brattleboro, Vt.

C. T. Fisher.

THE CONDENSING OF GRAPE-JUICE IN THE VACUUM PAN.

[19604.]—A NEW application of the well-known condensing process in the vacuum-pan to grape-juice before the setting in of fermentation is of considerable importance, both to the consumers of wine, and especially to wine-growing countries such as Italy and Spain. The condensation of fresh grape-juice, by an operation similar to that employed for the condensed Swiss milk, promises a wide field of usefulness. It brings (without any injury to the wine-making qualities of the juice) its bulk down to the fifth of its original quantity, and leaves it fit for transportation under any circumstances, and preservation for any time.

Experiments on a large scale have effectually

proved that the condensing process under a sufficient exhaustion of air in the vacuum-pan in no way alters the grape-juice, and that after its regeneration through the addition of water after fermentation, exactly the same wine is obtained as from the uncondensed grape-juice.

The attempt to condense wine, even with very complicated and costly apparatus, never led to any satisfactory results, and a previous study of its components might have spared many fruitless experiments. But it is entirely different with grape-juice, for as long as fermentation has not set in, it contains no elements which can volatilise with water by evaporation in the vacuum-pan.

The experiments which were made by Dr. Springmühl, with the most perfect vacuum and machinery of an Italian milk-condensing manufactory, extended over 60 different sorts of Italian and Spanish grapes, the quantity condensed each time being 600 to 800 litres.

The Italian and Spanish Governments granted patents for the new application of the condensing process to Dr. Springmühl, who conducted the very interesting experiments with Italian and Spanish grapes. It was my good fortune to be present at all these experiments, and to analyse the grape-juice before, as well as after, condensation, and later, of the wine prepared from it. Only fresh grapes were used, and not less than 600 litres of unfermented juice were condensed each time, as it was found that in a small apparatus, and with a smaller quantity of grape-juice, a less uniform and less perfect result was obtained. The grapes were first plucked from the stalk, and the juice extracted from the skin by crushing in a cylinder machine between porcelain rollers; even the last drops of juice were extracted from the grape by a centrifugal machine, and all the juice so obtained was then put in tinned copper pails, which were warmed slightly in a steam-heated vessel filled with water.

The juice then passed through silvered wire sieves into a large vessel, from which it ascended the suction-pipe of the vacuum-pan.

The apparatus, which is made of strong tinned copper-plate, is capable of holding 1,200 litres, and is heated by steam through a double bottom. The cylinder-shaped vacuum-pan has a hemispherical dome and bottom, and is provided with all the necessary requisites and instruments.

Before the commencement of the condensation, the highest possible vacuum was produced, and the vacuum-gauge never indicated less than 65 centimetres before the sucking up of the juice.

The liquid was then subjected to a gradually progressive evaporation under the lowest possible temperature, and kept in a state of gentle ebullition during three hours, constant care being taken that the vacuum should be kept perfect.

The temperature of the juice never reached the point at which the slightest change could take place in the quality of the must, when powerful pneumatic machines were used for the exhaustion of air.

In three hours the condensing was over, the condensed juice was a thickened fluid like syrup; after dilution with the corresponding quantity of water, the so regenerated grape juice could not be distinguished from the original not condensed.

The constituents of the condensed grape-juice showed no difference from those of the fresh grape-juice; after being cooled in a cooling apparatus like that used for condensed milk, it proved itself to be unchangeable not only when closed up in air-tight vessels, but also when exposed to the air.

In order to make wine from it, exactly the same quantity of water was added as was evaporated by the condensing process, and the regenerated grape-juice was subjected to fermentation the same as fresh must.

The wine thus produced was fully identical with that obtained by the usual process, and this was proved by all kinds of experiments in the most satisfactory manner.

During the condensing of the juice, the grape-skins were dried in a separate vacuum-drying-machine at the lowest possible temperature. They are used later on in the making of wine, in giving it its peculiar colour and flavour. The process of condensing grape-juice, as described above, is for the present of importance, especially to Italy and Spain; but ere long the Northern countries of Europe will derive great benefits from it, because they themselves will be able to procure a good must, from which they can make excellent and genuine wines at cheap prices.

Italy produces an immense quantity of grapes, but the art of making good wines is still in its infancy, in consequence of which France buys every year large quantities of grapes as well as wines from Italy, with very good results, for the French know how to turn the grapes into good wines or to improve the Italian wines, thus enabling them to export those wines as French produce to all parts of the world. During the first nine months of 1881, although 1880 was not a good vintage, Italy exported to France more than 160 millions of litres of wine.

It is, I think, to be desired that this method of condensing Italian and Spanish grape-juice may soon be widely adopted, as it would put a check on those flourishing artificial wine manufacturers in Northern Europe.

John Suchy, M.D., Ph.D., M.A.

FRET-CUTTING.

[19606.]—I HAVE just been looking through some of the volumes of the *ENGLISH MECHANIC*, and find in them a good many useful hints. I am not sure of mine being of any use, but I give it. It is this. I have worked some time at fretwork, and some of the patterns I had to destroy, not having time, and I may say patience, to copy them. I at last hit upon a plan. Having pasted the pattern on the wood, and having cut out the pattern, I put the wood, with the pattern, in water, so as to loosen the paper. When loosed I take all up carefully with the paper pattern still on, but loose. I then paste a sheet of paper, fool's-cap, and after carefully taking off all the loose particles of water with a soft cloth or duster, I put the pasted side down on the pattern, pressing it well, then take it off the wood, the pattern adhering to it, and thus preserved. Now, when this sheet is pasted on a new piece of wood to work you will have the first with the second pattern; repeating the steeping, and pasting another sheet on it, you will have three of the same pattern pressed.

Fret-Work.

ETHOXO LIMELIGHT.

[19606.]—If "Ethoxo" (19559) will kindly supply full particulars of the limelight he refers to and where country exhibitors may apply for the same, I am sure he will confer a great boon upon amateurs like myself, who are rather timid when using mixed gases. I see from the papers only at Wakefield last week, during a children's entertainment, the oxygen bag burst with a loud report, but, fortunately, did not kill anyone, although the room was filled with lime-dust from the plaster of the walls.

Lanternist.

Warman's Clock Pendulum Bobs.—In the figures illustrating this letter, p. 401, "Fig. 4" belongs to the lowest diagram only, the others being different views of Fig. 3.

Fret-Saws and the Lathe.—In the diagram illustrating letter 19558, p. 401, the pin, C, in the lower-rod being round, the hole burnt through the connecting-rod should have been shown round. In line 15 read "true to perpendicular when the 2in. piece is cut out."

The Danger of Electric Lighting.—A committee of the Franklin Institute has recently reported on the dangers of electric lighting. The committee specify a number of precautions to be taken, which are, in substance, as follows:—1. The conducting wires, both to and from the machine, should be suitably insulated throughout. 2. The insulation should be inspected at suitable intervals, being liable to impairment, especially at supporting hooks, or sharp bends, or where abrasion may occur. 3. Conductors formed of numerous short pieces of wire should be avoided as far as possible; where they have to be used, the jointed ends should be made as secure as possible by wrapping, so as to prevent short arcs. 4. A continuous wire should be provided, and no attempt made to cause the current to pass back to the machine through the earth. The wires should not be carried near metallic bodies like lines of shafting or gas or water-pipes, since accidental contact in such a case would effectually ground that part of the wire. Where the wire has to cross metallic bodies, the insulation should be made better than usual. 5. The ready occurrence of cross contacts or short circuits must be avoided. Thus the conducting wires from different machines, or from different parts of the same machine, should be kept as far apart as convenient, and the wires should not be allowed to sag or bend in wide curves, except where necessary for raising or lowering the lamp. The portions of a building selected for running the wires should be the least liable to become partially conducting through moisture (ceilings are preferable to walls, floors, &c.) 6. The wires should be of sufficient size to carry the most powerful current used without dangerous heating. 7. To avoid danger to life from discharge through the body, the wires should, wherever convenient, be placed out of reach either by choice of location or by heavy insulation. 8. Where arc-lamps are used, they should be covered with a glass globe, and placed below to retain any heated committee believe that, if these taken, electric lighting will be

REPLIES TO QUERIES.

. In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[44758].—Immersion Paraboloid Condenser.

—In a reply on this subject, Dr. Edmunds touches upon one point in a manner that is misleading, and upon another point erroneously, as I proceed to show. 1. He refers to the action of the immersion paraboloid on balsam-mounted objects viewed with an air-lens, and he states that under these circumstances objects may be illuminated by light totally reflected downwards upon them from the top surface of the cover-glass, which he regards as "invaluable." Now, as the object referred to by the original querist, "Autares," was Möller's probe plate, any experiments with this kind of illumination must clearly be confined to the average object on the probe plate. We may, therefore take the larger form of *Surirella gemma* as the object. With such an object, then, it is perfectly well known to those experienced in the mysteries of dark-ground illumination by the immersion paraboloid, using air lenses, that so far from this illumination being "invaluable," as Dr. Edmunds asserts, it is absolutely worthless, for the very simple reason that such an object in balsam is too diaphanous to be viewed as an opaque object. It is incapable of reflecting light under these conditions to any extent that could merit serious attention. The image of *Surirella gemma* in balsam when thus illuminated is well known to be a mere haze of diffused light, in which nothing of fine superficial structure can be distinguished. And this is not a matter dependent on any peculiarity of the objective used. For the most perfect air-lenses by Powell and Lealand, Spencer, Tolles, and Zeiss, all agree in proving that that illumination of balsam mounted objects (*i.e.*, fine test-objects) is quite futile. 2. Further on Dr. Edmunds makes a mistake in stating that "with objects set in balsam under a water-front lens, the back field is insured with illumination beyond 49° from the optic axis." He has here confused the action altogether. Every elementary treatise on optics gives the "critical" angle for water as about 49°; but that figure is the critical angle between water and air. With the immersion paraboloid in homogeneous contact with the base of the slide, and using a water immersion objective, the effective critical angle is that between glass and water, say, 62°; the black field in this case therefore requires an illumination beyond 62° from the optic axis, not 49° as stated by Dr. Edmunds. It may possibly interest "Autares" to know that the whole gamut of effects to be obtained by the immersion-paraboloid have been worked out by one or other of the experts in high-power manipulation, both here and in America, and the consensus of opinion is that the apparatus is of no practical value.—AKARIA.

[44758].—Immersion Paraboloid Condenser.—ERRATUM.—My reply at page 406 to this query contains a typographical error that needs correction. With objects set in balsam under a water-front lens the black field is insured by illumination beyond 61° (not 49°) from the optic axis. At this angle the black field is got by total internal reflection from the top surface of the crown glass cover; but at any lower angle, down to about 49°, the dark field with high power water-front lenses depends upon limitation of aperture in the lens itself. I find that a very fine water-front sixteenth, made for me in 1873 by Powell and Lealand, gives a black field with illumination beyond 50° from the optic axis. A fine water-front eighth, by Tolles, requires 53° of obliquity in the illumination. The study of the beautiful positive images upon black field that are got by the immersion paraboloid, is best commenced with a fine podura scale set upon the slide in air, with cover close down upon the scale, and a fine water-front lens with accurate correction collar. Next *Amphipleura pellucida*, set in the same way, should be studied until the diatom is shown in thallium green, with sharp black bands. These two objects are admirably set for this purpose by Wheeler, and when their manipulation is realised other work will be easy. With objects set in air upon the slide, the use of direct sunlight with the immersion paraboloid needs no precaution, and gives magnificent images.—J. E., M.D.

[44967].—Steam Propeller.—If "Backwoodsman" means by double propellers twin screws, his boiler will have sufficient power, provided it is, as I presume, of the usual American type. Propellers 2ft. 9in. dia. will be large enough; but he should run his engines faster, say, 200 revols. per minute.—ENGINEER.

[44967].—Steam Propeller.—To "SUNLIGHT."—In altering present arrangement, I would advise you to proceed with due caution. If any alteration was made to convert your present screw into a twin one, it would have to be done as follows:—Present single engine replaced by two single

cylinders, each 6in. bore and 6in. or 7in. stroke. You have at present just over, in round figures, 50 square inches on the piston with your single cylinder. The utmost you could do is to use a pair of 6in. cylinders, each of which would have, therefore, an area of 28 square inches. This gives a slightly enlarged area of piston; but as you would be able to use a cut-off of $\frac{1}{3}$ ds the extra area would not be fatal. A larger pair of cylinders would take more steam than the boiler would supply. You could then use a pair of 28in. to 30in. propellers. The feed-heater you name has been long in use successfully, where the feed is sent in by a pump; but with an injector there would be but little gain in the way of heating the feed, for this reason:—An injector properly used would send in the feed at 200 degrees. The additional heat gained by the heater would not amount to but a very trifling gain. The real gain is in this way. The coil of tubing being heated by the waste-heat and the water being able to circulate from the boiler, the heater really acts as additional heating surface, equal to adding more length to the boiler, or in any way increasing its heating-surface. It is due to this, and not to the few extra degrees of heat, that you get a gain of 1-6th in the case you quote. In any case, you would find a heater so arranged would help the engine, as it renders very essential aid to the boiler. The economy is the most strongly marked if you send the feed in with a pump worked by the engine. Will this information meet your wants? If not, will be pleased to further advise.—SUNLIGHT.

[45364].—Flotsam.—If the substance referred to burns "brightly and completely," it is, no doubt, a hydrocarbon, and may be "paraffin," which finds its way probably from some submarine veins. On the other hand, it may be produced by some fish; so that it is tolerably clear no definite answer can be given without specimens for analysis. "Labrador" should send samples to those likely to be interested.—T. G. L.

[45387].—Tempered Glass.—Ordinary crown glass properly annealed will answer. The plates must be heated, say, a little beyond the temperature to which they will be subjected, and then allowed to cool very slowly. Probably pressing between hot plates of iron, similar to Siemens' method of hardening, would do.—T. P.

[45406].—Enamel for Slates.—There is some useful information on enamelling slate in Vol. XII., p. 22; but possibly since then, for it is eleven years ago, improvements, or new processes, have been introduced.—E. L. T.

[45424].—Problem.—This problem is not so simple as it appears. Assuming the premises to be of the same value during the whole term of the lease, the exact rental is found as follows, taking money at 4 per cent. £50 extra rental is paid during the past four years:—

Present value of £1 per ann. for 4 years	£
" " £50	3-63
" " £1 due at the end of 10 years..... x	181-50
" " £50 per ann. paid during the last 4 years of 14 years' lease.....	122-62
The annuity £1 will purchase for 14 years..... x	0-947
The annuity £122-62 will purchase for 14 years.....	£11-612
The exact rental is therefore £261-612. Consequently A., during the first 10 years, pays £11-612 less than the exact rental, and B. pays £38-388 more than the exact rental for the four years of his holding.	
The annuity £1 will purchase for 14 years is..... x 1050	0-947
The annuity £1,050 will purchase, for 14 years, giving A.'s annual interest	99-435
But present value of £1 for 4 years = x	3-63
Value at the end 10 years of £1,050, paid as purchase for lease, being A.'s interest.....	= 360-95
From which has to be deducted the amount per annum for 10 years, of £11,612. This, for £1, is 12-006....	139-41
Amount to be paid to A.	£221-54
Taking another view of it, B has a fair claim to deduct from the.....	£99-435
Payable to A. for 4 years, the.....	38-388
Which he has to pay to the landlord in excess of exact rent, giving an annual payment of.....	61-047
Present value of £1 per ann. for 4 years x 363	
Giving the amount payable to A.	= £221-60
Nearly the same as before.	

a verge-watch, which I shall not forget to send.—
A FELLOW WORKMAN.

[45607].—Verge Watch.—I should think that "Measmerist" has had very little experience with watches in general by the wording of his query; so he must not expect to make a "good job" of a verge watch without some more practice. I will do my best to put him in the way to surmount his difficulties; but if the watch is like some that I have had experience with, it will require the exercise of a little patience. He asks: How deep should the escape-wheel be on the pallets? Prior to pitching the "escape depth" I should advise him to look to the truth of the escape-wheel, if he has not already done so; for if some teeth are a shade longer than others, a very unequal depth will be the result. Having made sure of this, put the wheel in, and also the verge; and first turn your attention to the "drop," which is the distance which the tooth falls in dropping on to the pallet, when it has escaped from the opposite side. It should be "equal," or the same on both pallets. If, for instance, you find that the drop is much greater on the lower than the upper pallet, it can be lessened by putting the "dovetail" further through the potence; of course it will require moving, but a very slight distance. When you have made this right, you can pitch the depth; when the 'escape-tooth has passed the pallet, with one finger on the balance, guide the pallet back slightly, and see what shake there is between the tooth and edge of pallet; if it is a good wheel, you may allow just enough for freedom, and no more; if there is much, let the wheel in until right. If the steady-pins in the potence and cock fit well, you will not need to shift the follower after the escape-wheel is put in. In trying one of the train-depths, the great object to be aimed at is smoothness. Let us suppose that we have the centre and third wheels in the plates, and wish to try the depth; take the plates between the thumb and first finger of the left hand, putting the pressure over the third pivots, so as to "bind" the wheel; now move the centre wheel round with a "peg," and if it runs smooth the depth is right, but if the centre wheel jumps in the pinion it will require looking at more closely to see whether it is deep or shallow. If the tooth falls on the leaf of the pinion just as it is entering, the depth will be too shallow, or if when just past the centre, too deep, and likely to lock in the pinion. I hope that I have made this clear; if not, shall be happy to answer any further questions.—ANOTHER IN THE TRADE.

[45613].—Water Motor.—Tuerk's patent positive rotary hydraulic motor is the most compact and reliable, and was awarded two Centennial Medals at Philadelphia and two Diplomas of Merit for economy of water; the smallest size can be put in vest-pocket. The following is the approximate working average of water consumed by the different sized motors at a pressure of 45lb. on the square inch:—

No.	gal. per minute.	developing	to h.p.
1	2	1/2	1/2 h.p.
2	12	1	1 h.p.
3	20	1 1/2	1 1/2 h.p.
4	25	2	2 h.p.
5	65	3	3 h.p.
6	80	4	4 h.p.
7	250	5	5 h.p.

[45621].—Caledonian Engines.—The wheel-base of 42—48 class is 15ft. 9in.—CARSTAIRS.

[45624].—Gelatin Plates.—You would best save both time and trouble by obtaining the dry plates ready for use instead of the emulsion. If you coated your own plates, it would take some little time, &c., as you would need a drying-box, &c. Not only so, but far more regular results would be gained by purchasing, as a good gelatin plate will keep for a long time if kept in the dark.—SUNLIGHT.

[45625].—Angular Aperture.—One approximate way is to lay the micro body horizontally on a graduated arc, the centre of the objective being co-incidental with the centre from which the arc is struck. This being divided into parts of a circle, place the micro on it, and a short distance away a candle. Look through the tube and optical system and move the instrument horizontally until just a faint crescent of light appears. Note the position of this on the graduated arc. Now move the instrument sideways until the reverse side of the o.g. is similarly illuminated. The distance between these two points may be roughly termed the angle of aperture. That is, with that particular object-glass, the candle should be placed at a distance from the o.g. equal to its focal length.—SUNLIGHT.

[45625].—Angular Aperture.—A rough-and-ready method of measuring the angular aperture of a lens is the following: Fix your lens in a horizontal tube, such as that used for an ordinary microscope, but with no stage work in the way and no eyepiece. Place a lighted candle or edge of a lamp-flame at about 2ft. distant from the lens, the flame being on a level with the axis of the horizontal

tube. On looking into the tube from the point where the eyepiece would be in using the lens microscopically, there will be seen a real image of the candle at the back of the lens (its posterior conjugate focus when the lens is acting tele-scopically). Now shift the candle on one side until its flame is bisected by the lateral edge of the field. Next traverse the candle back until its flame is bisected by the other edge of the field. The angle subtending the arc through which the candle has moved from one side of the field to the other will be the angular aperture of the lens.—G. O. EDMUNDS.

[45628].—Rheumatism.—It is not necessary to reside in any particular place in order to effect a cure for sciatica or neuralgia. The following are considered healthy watering-places:—Dover, Ramsgate, Margate, Brighton, Weston-super-Mare, and Weymouth. Chills and colds should especially be avoided. Avoid exposure to wet and cold winds and the damp night air. As regards medicine, it would be advisable to consult a physician.—G. FRYER.

[45629].—Ventilating Grates.—Having constructed several of these on a plan of my own I cannot praise their action too highly, the admission of a plentiful supply of warmed air preventing any cold draughts, thoroughly ventilating the room, and materially reducing the amount of fuel required. The only objection, if any, is that the air is rendered a little too dry if anything. The great trick is to have more area for the air to enter the room than there is for it to get out by the chimney. For example, the size of the entrances in the room in which I am now writing is 48 square inches, while the chimney has only a total area at the narrowest part of about 24 square inches.—R. P.

[45629].—Ventilating Grates.—These grates are the means of supplying warm fresh air to dwelling-rooms, and they may be made in many forms, but the best are those which deliver the air in a vertical direction. There is no inconvenience from damp on the walls, for the simple reason that the fire itself warms the walls, and prevents any deposition of moisture, and, what is of more importance, the circulation is so perfect when proper arrangements are made, that the air has not time to become cooled and deposit its vapour in the form of moisture on the walls. "E. T. S." must, I imagine, be thinking of the systems of heating by hot-water pipes, which are objectionable on many grounds, and which by merely warming the air and leaving the surrounding objects cold, naturally facilitate the condensation of vapour upon them.—NUN. DOX.

[45630].—Lathe.—The class of backstay you want is a very simple one. It bolts on to the saddle of the lathe, and consequently travels just behind the cut. It is like an arm with a jaw to carry two wood blocks to clip the shaft with, at the upper part, with a flange foot to bolt to the slots in the saddle. Respecting the guide-screw, what size pinion have you on the mandril, and how many teeth? I write this from home, or would refer to and quote you the necessary wheels with several sizes of pinions. But you have simply to gear the screw so that it goes just one-fourth the speed of the mandril. You also need to say the number of threads to the inch the present guide-screw has also.—SUNLIGHT.

[45632].—To Restore Paintings Blackened by Hydrogen Sulphide.—Paintings damaged by the formation of sulphide of lead are restored by the continued action of light and air, the black sulphide of lead becoming oxidised and converted into white sulphate of lead.—F. I. C.

[45633].—One-Cylinder Locomotive.—I think "One-Cylinder Locomotive" would find that his idea would not answer. He must remember that if he put large driving-wheels on that they would have the same momentum when they were at quarter-stroke as when they were on the dead-points, so that it would not work fairly then; he must have something to form an equilibrium. He must remember that a flywheel, when driving machinery, is suspended from a centre, and generally of great diameter, so that the centrifugal force is very strong, and if he made his wheels large enough for the centrifugal force to do any good, his engine would not have power enough to work them. His best plan, I think, would be to put a pair of engines to it at once.—SNOWBALL.

[45633].—One-Cylinder Locomotive.—A small locomotive would certainly work very well with one cylinder, but I advise you, in fitting up the slide-valve, to be careful, and see that it does not admit steam to the cylinder while the crank is on the dead centre, as that would seriously impede progress.—G. L. SCOTT.

[45633].—One-Cylinder Loco.—I have more than once met with locos. with one cylinder, and they ran fairly well when once started. But as the engine frequently stops on the dead centres,

they would require to be started by hand, so the engine might be got off the centre. Once motion they would run fairly well, but not steadily as a double-cylinder one. Do not let drivers so large that the cylinder is unable to drive the wheels at a fair speed. If so, a single eng would be decidedly a bad arrangement.—SUNLIGHT.

[45636].—Turning in Tin Edges.—There several ways of doing what you require, but w out you can work at the lathe and forge it woul impossible to make the machine you want. I require a great quantity of circles turned should advise you to have a screw press and fitted a pair of dies, which can be made to the circles and turn up the edge at the same. I can send you the name and address of a top make the presses and tools if you adverti address in this journal.—G. L. SCOTT.

[45638].—Object-Glasses.—E. T. J. Page 411, issue of Dec. 30th, 1881. instead of "a 2in. lens," read, "a three one-inch lens two inches apart."—E.

[45638].—Object-Glasses.—In "E. T. J."—Crown-glass occasions than plate-glass in the ratio of .032 to .033 ing to Brewster, page 373), which to interfere practically with the "E. T. J." uses. A flint-glass con of so diameter, placed between the eyepiece, very much improves the definition one a foot or two from the eyepiece, increasing the distance with further experience.—ASAP HINDER.

[45640].—Tidal Communication Between Liverpool and Manchester.—I cannot put my hand at present on the difference in the elevation of Liverpool and Manchester, but I should think that it would be too great to allow of the tide running up unless the channel was of a very great depth. The effect of the bar at the entrance of any river will affect the distance that the tide will flow up that river; for instance, if the bar is very high, the tide will not go up the tidal gow so far as if there was no bar there. The length of time it will take for the tide to run up, th presuming that you can get it to do so, will depend on the difference in the levels of the two pines. If the two extremes are near about the same level, it would be about two hours running up, and it w take about eight hours running back; if the levels are such as the tide barely reaches there, the figures may be nearly reversed. I cannot speak fully as to the extent of the damage the friction of the tides would do; but from what I have seen of the country below Warrington, it would be very great, owing to the ground being soft, and then the current would easily and quickly undermine and eat away the sides to a greater extent in its new bed than in the old river where it has already conformed to the action of the tides. To prevent this the sides could be pitched with large stones cemented together at a great expense; and then I have seen the sides give way under pressure of tide and wind combined. This subject is what I have thought should be taken up and carried on—sooner the better, not as a tidal communication, but as a great ship canal, with all the necessary locks, &c.; and not to stop short at Manchester, but continue on across the country to the Humber. Of course, you understand that if you have a tidal course, you would have to employ a steam tug to take the vessel up, and then you must note and make provision that if by some means the vessel could not reach Manchester in the course of a single tide, she does not lie aground, but must be kept afloat, or you will not have shippers venturing up; also note that you cannot expect to be able with a full-loaded vessel to go up at any tides. Whereas, by means of a canal whose level was fixed to suit neap tides, you can work the traffic to and fro independent of tides. The cost could be cut for a far less amount than the river, and by its being free from the flow of water, the expense of keeping in repair will also be less.—WORKING TOM.

[45642].—Green Mould on Brick Houses A wash of water-glass will prevent the growth green mould, which may be removed by application of weak sulphuric acid and water. If house were mine, I should apply these solutions anyone who attempted to remove the "green mould," which I consider rather an improvement than a defect.—NUN. DOX.

[45647].—Circular Cistern.—"H. G." I have his girders at least four times as strong as breaking-weight. It is impossible to give him proper section without knowing the centre of rolled joists on which the tank would be BRICKS.

[45648].—Carbonic Acid Gas.—22.5 g marble and 1403.8 grams hydrochloric acid (24 with an equal volume of water) will give 44.5 of carbon dioxide, which, if generated in a bottle, 5 litres capacity, will give a pressure

300lb. to the sq. inch. The experiment is dangerous. The bottle should be of very strong wrought iron. Hydrosodic carbonate (bicarbonate of soda) and dilute sulphuric acid are the usual ingredients employed.—F. I. C.

[45651].—**Valve.**—It is impossible, so far as I know, to make a valve that will keep tight without pressure; but can't you fix a small spring valve on the vessel, the valve of course to open inside the vessel, then when filling press down the spring, and when full release it. A valve similar to those seen on model steam-engines is what I mean.—G. L. SCOTT.

[45651].—**Valve.**—If you could increase the size of the vessel containing the valve, an arrangement could be employed to close the valve that would make sure of its working properly; but unless there was an extension in some direction to allow this, I hardly see how it could be done. If a stuffing-box might be used, then I think perhaps it might be managed.—SUNLIGHT.

[45652].—**Gas Manager.**—No amount of apprenticeship to any particular branch of trade will qualify anyone for the position of gas manager, unless the student has exceptional chances of obtaining information otherwise than in the workshop. A thorough knowledge must be gained of the lower branches, such as setting retorts, laying mains, fitting up in houses; also a knowledge of all gas fittings and material used in same, construction of meters, wet and dry, and the mechanical part of gas-works, from the hydraulic main to the meter, consisting of scrubbing, condensing, purifying, and exhausting. Having acquired this, he must study the constituents of coal and lime, also pure and impure gas, how to remove impurities and produce a good light: to do this, a study of chemistry is indispensable; add to this book-keeping, management of workmen, and how to make a small gas-works pay; having attained this, the student will be capable of managing a gas works.—ON GUARD.

[45653].—**Caledonian Engines.**—I am not sure of all the dates asked for, but believe the following to be correct:—No. 570, Dübs, 1871; 324, Neilson, 1871. About No. 491, "R. N. H." has naturally got confused, owing to the changing of the numbers. The engine now bearing that number is a six-coupled 4ft. saddle tank; I don't remember the date. The one formerly numbered 491 is, as I stated in my last letter, now 167—170 class, a bogie tank, four-coupled certainly, but built by Neilson 1874, not by Dübs. The six-coupled tank is built by Dübs. The eight-wheeled tanks vary in date; some came out in 1880. The 140 class are somewhat older. No. 167, Neilson, 1873. All have outside cylinders. "R. N. H." may note that inside cylinders are the exception, not the rule, on the C. R., there being not more than half a dozen inside-cylinder engines altogether. I only know four—viz., 540, 541, 542, 543. Nos. 542 and 543 are heavy six-coupled engines; wheels, 5ft.; cylinders, 17 by 24; built, Neilson, 1868, for L. C. and D. R., but sold to C. R. Co. Both 540 and 543 classes have inside bearings throughout. 540 and 541, I believe, were originally Scottish North-Eastern. 570 is not a tank engine, but has a four-wheeled tender inside bearings throughout; wheel-base, 13ft. 9in. 324 is similar, both classes being representatives of the standard type of mineral engines on the Cal. Ry.—CARSTAIRS.

[45655].—**Pump.**—I have not time this week to enable me to make sketches. No doubt, amongst the many contributors you will get what you ask; but I may just say one thing—that an engine 1½ in. by 3 in. would only drive a sewing-machine if run at a good speed: this means boiler pressure, so that you will need to use at least 25lb. to 30lb. pressure.—SUNLIGHT.

[45656].—**Railway Plant.**—An answer to this query must apply to those companies only whose "Acts" have been consulted; but as a general rule, it may be taken for granted that railway companies are bound to provide waggons for carrying the goods offered. As a rule, merchants provide their own waggons for coal, &c., because they cannot always unload at the pleasure of the railway company, and cannot afford the "rent" charged while the trucks remain unemptied.—NUN. DOB.

[45656].—**Railway Plant.**—I always thought that merchants provided their own trucks for economy sake, as, for instance, they get a less rate when goods are carried from station to station in their own trucks. Also, if the Railway Co.'s trucks are not unloaded twenty-four hours after notice of arrival, it means 3s. per day demurrage is accruing; whereas, if the goods are in the merchant's own trucks, he has to pay only 6d. per day siding rent after they have been standing in the siding one week. I do not know of any law on the subject; but this I know. Some years since, in making a pressing application to the L. and N. W. Railway Co. for a reduced rate, we were informed if we provided our own trucks we could have a reduced rate.—WORKING TOM.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

- 45102. Emigration for Assayers, p. 194.
- 45106. Dynamo-Electric Machines. To Mr. R. Kennedy, 194.
- 45120. Mechanical Model, 194.
- 45148. Swiss Transferring Pictures, 195.
- 45149. Adjusting Fine Balances, 195.
- 45151. Glass, 195.
- 45153. Manganese Mud, 195.
- 45158. Old Map of Wales, 195.
- 45340. Specific Heat, p. 290.
- 45358. Sulphate of Strontium, 290.
- 45391. Centring Wagon Wheel Axles, 290.
- 45384. Friendly Societies Valuation, 290.
- 45392. Manufacture of Soluble Cocoa, 290.
- 45105. Slate Cutting, 290.

USEFUL AND SCIENTIFIC NOTES.

Alizarine Ink.—That which is called in trade "Alizarine Ink" has nothing in common with alizarine, either natural or artificial. The name was applied to an improved kind of ink, over thirty years ago, probably because the manufacturers of the ink desired to mislead the public as well as experts. The name "alizerine ink" is applied to a writing fluid, in which the iron is maintained in a *ferrous* (protoxide) condition, and in perfect solution, which is accomplished by slightly acidulating the liquid with acetic, or sometimes with sulphuric, acid. The liquid has usually a rather pale greenish or bluish colour, and the writing is at first green, not black. Not long afterwards, however, the acid menstruum evaporates, leaving a very thin layer of the ferrous tannate, which gradually oxidises in the air and turns to black ferric tannate. Contrary to what might be expected, steel pens are not usually much corroded by properly prepared alizarine inks; the first coating of oxide which is produced upon the pen generally adheres so firmly that further action is very much retarded. The very pale tint of such a writing-fluid is frequently heightened by the addition of some indigo-solution, best in form of indigo-carmin (see last number, page 338). A good formula for making so-called alizarine ink is the following:—Powdered nutgalls, 40 parts; solution of acetate of iron, 15; gum arabic, 10; wood-vinegar, 10; indigo-carmin, 5; and water, 100 parts. Prepare the solution of acetate of iron by pouring a sufficient quantity of wood-vinegar upon scrap-iron contained in a cask, and allow it to act upon the iron for at least eight days. Macerate the powdered nutgalls for eight days with the 100 parts of water mixed with the 10 parts of wood-vinegar. Before mixing the strained liquid obtained from the nutgalls with the iron-solution, it is necessary to ascertain whether the quantity of acetic acid present is sufficient to keep the ferrous acetate in solution. For this purpose, 10 volumes of the liquid nutgall extract are mixed with one volume of the iron-solution. If a clear mixture results, and of a dark-green colour in thin layers, the liquid contains enough acid; but if a black, opaque liquid results, the acid is deficient. In the latter case, more wood-vinegar must be very gradually and cautiously added from a measured volume, until the liquid is clear and dark green, and the requisite amount of acid, determined by this experiment, must be added to the extract of nutgalls. The gum-arabic is next dissolved in the latter, the iron-solution then added, and finally the indigo-carmin, or as much thereof as may be required to produce the desired tint.—*New Remedies.*

Electric Lights.—In concluding his report upon the different systems of lighting which were exhibited at the Paris Exposition, Du Moncel says that the systems of incandescence are already numerous, and doubtless many others will soon be added. Most of them differ from one another only by the composition of the incandescent carbon and its mode of fabrication. It is impossible to base any correct judgment on the more or less brilliant aspect of the lamps, for, as they are fed by electric generators of very different intensities, those which have the strongest currents naturally furnish the most brilliant and whitest light. It would therefore be imprudent, he thinks, to pronounce in favour of any single system until a serious examination and comparison has been made by a commission of disinterested scientific men. There is, however, reason to hope for a satisfactory solution of the problem of household illumination by electricity.

QUERIES.

[45658].—**Old Violin.**—I have an old fiddle, dated inside on a paper label, in German text: "Ignazio Pense, P. Italia La Cremona, A.D. 1715." It is of peculiar construction, having eight pegs, and the tail being pierced for eight strings. Its breadth at bottom 8 in., and across the belly where the strings are attached to the tail piece 10 in.; its depth of chest from outside to outside where the bridge stands is 3 in.; full length of body or chest 14 in. Can any reader inform me of any particular name of this fiddle? Or, whether it is of any particular value? The tone is very full and soft.—G. J. VALVE.

[45659].—**Polishing Shell of Tortoise.**—Will some kind reader answer the following? How to clean and polish shell of tortoise?—A. S. K.

[45660].—**Hydraulic Hammer.**—Will "Sunlight," or some other correspondent, kindly explain the construction and mode of working the above?—G. H.

[45661].—**Worms in Cistern.**—I have a slate cistern, in the water of which is generated a number of red worms about 2 in. long. I often clean it out thoroughly, but they appear again very quickly. Can any brother reader inform me if they are injurious or not? Also, the cause and remedy? There is a zinc cover to cistern, and, about 2 ft. above that, a wooden platform rather old and exposed to the weather. A crack in the cistern was a short time ago filled up with resin and tallow. Water is from New River Co.—AQUA PURA.

[45662].—**Water-Closet.**—Will any of our readers tell me what can be the cause of the water leaking out of the copper dish of a common pan-closet? I have examined the dish, which proves to be sound, but still the water leaks away till there is only about ½ in. of water sent left, and then the dish is not half-full. I rather think it has done so a good while without anyone knowing, as the valve in the cistern was bad till about two months ago, when I repaired it, and it is only since then that it has been found out.—FLATO.

[45663].—**Music.**—I am a fair pianist with written music, but have acquired no power of extemporising or even playing such random harmony as many a worse musician can rattle off when he "tries a piano." Shall be grateful for any helps and hints.—J. M. B.

[45664].—**Collodion Dry Plates.**—Will Mr. Lancaster, or some other reader, give a way of preparing the above plates for lantern slides?—F. W. D.

[45665].—**Picture-Frames.**—Please give me the manner in which the chandeliers on oak picture-frames are gilded, showing the pores of the wood through the gilt. I hardly think it can be put on in the last. I have by me a quantity of what is, I think, termed "bronze powder."—J. W.

[45666].—**To "Sunlight."**—Will you kindly give me your opinion on the following?—Whether an engine having a cylinder of 1½ in., and requiring a pressure of 40 lb., or an engine having a cylinder of 2 in. needing a pressure of 20 lb., will use the most steam, supposing the stroke in each to be in the usual proportions?—AUGUST FIREMAN.

[45667].—**Varnish for Gas-Pipes.**—How is the paint or varnish made which is used on gas-pipes?—DREY.

[45668].—**Horizontal Engine.**—I have a very strong engine, 2½ bore, 5 in. stroke. Would "Sunlight," or "Tubal Cain," please state what power it is? And, whether it is capable of doing as much work as two men, as I have a machine which two men turn with cranks? If the engine will work it I shall be glad. What pressure of steam ought I to have in boiler?—W. H. L.

[45669].—**To "Jack of All Trades."**—Thanks for your reply. I am very sorry I did not make myself fully understood. The burnished bands (No. 45493) are about 1 or 2 of an inch in width, are made of some composition, and are fixed straight over the joint or mitre of the frame, I presume, to cover bad joint. If you can inform me how to make and fix, I shall deem it a very great favour.—BODOL.

[45670].—**English Clock-Spring.**—Having had some difficulty in adjusting the tension of an English clock-spring, sometimes making it so tight that the gut broke, and at others making it so slack that the clock would not go. Will any reader tell me how far to turn the ratchet wheel behind the dial? And, state whether the tension of the spring should be adjusted before or after the clock is wound up?—C. W.

[45671].—**Wood Turning.**—I will feel much obliged to some kind reader who can give me the necessary information how to turn oval hammer shafts 3 ft. long in oval chucks without springing in the centre! The ordinary stay for circular shafts will not do for oval shafts.—J. H. COYLE.

[45672].—**Balloon.**—I wish to construct a calico balloon large enough to carry one person with ballast and all necessary gear when inflated with ordinary carburetted hydrogen gas, but am at a loss to know the following:—How to calculate the weight of the balloon and net? How to make the net to fit the balloon when inflated, and the size of oval and mesh necessary for the same? What sort of varnish will make the calico gas-tight? And, how am I to construct the valve or the top? I shall feel much obliged if any of your correspondents can give me this and any other information relative to the construction of the balloon.—A. B. C.

[45673].—**Violin.**—Would "Fiddler," or any other practical experimenter, tell me whether it has been ascertained that Swiss pine is the best wood that can be used for the breast soundboard of the violin? What would be the effect of using sycamore, rosewood, or pear-tree wood instead? I should also like to know whether there is any advantage in making the back and breast of joined halves? An early reply would much oblige.—SOUNDPOST.

[45674].—**L. N. W. R. Engines.**—Will any correspondent oblige me with dimensions of "Pegasus," No. 1840?—CLIDE.

[45675].—**Carbon Rods from Coke and Sulphur.**—Would Mr. Albert Smith describe more fully the process by which he makes carbon rods from coke and sulphur?—J. HILLOP.

[45676].—**Colar Gold Fields.**—Would any correspondent give me some particulars as to the climate of the Colar gold fields? Is it healthy for Englishmen or not?—MINER.

[45677].—**How to Dress Rabbit Skins?**—Have we no practical furriers or curriers as subscribers? I want to dress a rabbit or hare skin, so that when done it shall be brown or white leather inside and soft the same as skins you buy at shops. This question has been asked several times within the last two or three years, but the only answer has been the alum and saltpetre dodge, which leaves the skins like stiff parchment. Some of us would not mind the extra trouble or time on a favourite cat or rabbit skin if we could turn it out properly. Will some-one kindly give the process from the time the carrier receives the raw skin until he returns it turned into leather?—NORR.

[45678].—**Test for Arsenic in Copper.**—Will some of our chemical readers kindly give me particulars of the most accurate and quickest method for testing (quantitatively), firstly, arsenic in refined copper; and, secondly, arsenic in copper precipitate?—ARSENICUM.

[45679].—**Chilled Car-Wheels.**—Can any of our readers give me some ideas concerning the above—the best class of iron to use? Also, the time they ought to stop in chill?—GALLO.

[45680].—**Soft Metal.**—I am told that the above (a mixture of lead and tin, or zinc and tin) is now extensively used for machine bearings instead of brass. Can anyone tell me what proportions of each to use in casting? And, whether these bearings are durable?—F. M. I.

[45681].—**Church Bell.**—I want to re-hang a church bell, which is at present hung very difficult to ring, and I would be obliged if some correspondent would let me know the proper way to hang a bell so as to be easily rung? At present there are a number of metal segments bolted round rim of bell wheel, which, I imagine, should be only at tip of wheel. The bell is about 50wt. A small sketch would greatly oblige—TONES.

[45682].—**Variable Stars.**—Could any of your correspondents kindly inform me as to the exact time at which Algol, or any of the variable stars, may be observed at their different magnitudes? I have watched Algol for a considerable time, but have never yet seen it at its minimum.—J. BISHOP, High-street, Berwick-on-Tweed.

[45683].—**Beef and Hams.**—Will some of "ours" kindly tell me if it is practicable to cook rounds of beef and hams by steam? If so, please give time or joints from 20lb. to 60lb. Also, give description of best steamer for same.—Y. USA COOK

[45684].—**Photographs Coloured with Water-Colours.**—In *ENGLISH MECHANIC* of Dec. 23 1881, there appeared a most interesting article entitled, "Cheap and Effective Finished Enlargements." Herein was described in a very clear way how photographs can be coloured with oil colours. Will anyone kindly inform me how the same thing can be best done with water-colours?—T. H. WALTER.

[45685].—**Chinese White.**—Can anyone tell me how to re-moisten Chinese white, such as is sold in bottles for water-colour painting? I find it soon dries up after it is once opened, and water only makes it work gritty and rough instead of smooth.—VATHECK.

[45686].—**Taking Leaf Impressions.**—Some years ago I remember a friend of mine showing me some impressions of leaves which he had taken on photographic paper, but he said they were not permanent, and required fixing. Would some photographer kindly explain the process and preparation of the paper? And, say how to render them permanent, when exposed in an ordinary scrap-book? These, taken from "life," and preserved, I imagine, would form a valuable aid to the study of botany, and probably some students in this branch may be able to give me the desired information.—J. W. F. S.

[45687].—**Testing Commercial Nitrate of Soda.**—Would Albert Smith, or "Analyst," inform me of a ready method of testing nitrate of soda for its percentage of refraction? Or, perhaps, what would be more to the point, its value as a source of nitric acid to the vitriol manufacturer? I am aware that the amount of chloride is ascertained sometimes by solution of nitrate of silver, and the sulphate by barium chloride; but I want, if possible, to determine its value by one test, or two at the most. If standard solutions are required, please explain preparation and quantity of article to be taken for a test.—J. W. F. S.

[45688].—**Mersenius.**—While thanking "F.R.A.S." (1863, p. 380) for his notice of the query in letter 18513 regarding Mersenius, I would just observe that it is not for any interior object in Mersenius itself, but, as I wrote, an interior object within a small crater on the south-east wall of Mersenius, that I wish information. With Neison's description of Mersenius, I am familiar. The mound lettered P I have frequently observed.—ACONITE.

[45689].—**Names and Proportions of Rivet Heads.**—Will some of your correspondents give sketches and sizes for the above? And, say what snap head and conical heads are?—W. CLARK.

[45690].—**Model Locomotive.**—As I wish to make a model locomotive to scale, will "Sunlight," or a reader of the "E. M.," kindly give me dimensions of the J. W. R. 7ft. express engines, a sketch of which was given in Vol. XXXIV, No. 692? Or, say whether any dimensioned drawings have been published in the *Engineer* or *Kommerring*? If so, what dates?—E. J. E.

The pegs of my violin were
rd places on pegs and in

holes so as to make them fit better, I found they were so tight that I could scarcely move them without using a small wrench. How may I hit the happy medium?—YOUNG FIDDLER.

[45691].—**Cementing Speculum.**—Will Mr. Lancaster, or other correspondent, say if I would be likely to succeed with a speculum composed of three 5in. glass discs, each 3in. thick, ground and cemented together? What would be the best cement to stand the grinding?—BORUNG AUSTRALIA.

[45692].—**Slow Motion for Micro. Stand.**—To "Sunlight."—Please tell me how to make the slow motion for a micro. stand? I have made the other parts. I thought of moulding dissolved rubber for the spring, but cannot prevent the sticking.—ONE WHO WILL BE GRATEFUL.

[45693].—**Wood-Engraving Machinery.**—Would any kind reader say how wood-engraving and letter-cutting is done by machinery, having seen some cut in Rock and Maple? The Americans were the first that cut them, and they are now made at home. I should be greatly obliged if any kind reader would say how they are done, and if one can be made, with a rough sketch of same.—A. Y. Z.

[45694].—**Ivory.**—I should be glad to know if an ivory comb can be safely washed in the ordinary way with soda and water? Or else how? Also, whether ivory is more brittle in use than the usual bone or vulcanite?—EXMOUTH.

[45695].—**Ornamental Glass-Work.**—I should feel obliged if any of your readers would inform me how to quick glass the same as used for the black ornamental work? I want to try a few experiments with glass on copper.—T. BRADLEY.

[45696].—**The Cape and Natal.**—I am a carpenter and joiner by trade, and am desirous of emigrating to the Cape or Natal. Will any of your numerous readers kindly inform me (1) the cheapest and best route to take, (2) about the cost, (3) What are the wages of carpenters at the Cape? (4) does it present to one in my occupation a good field for emigration? (5) I am a good scholar, having competed at one or two Government examinations. Would this assist me to any other occupation that would be more remunerative than that of the building trade?—PHOS.

[45697].—**Leclanche Battery.**—Would Mr. Lancaster, or other sound electrician, say if this plan of a Leclanche battery would work well? And, if not, why? A white earthenware jar—crook, 5in. diameter, and 5in. deep, a plate of coke in the bottom, with an inch deep of broken coke, and some small pieces of needle manganese, a layer of white blotting paper 1/2 in. thick, and a cake of amalgamated zinc suspended in the fluid or lying on the blotting paper, exciting fluid half saturated solution of sal-ammoniac 3/4 in. deep, the wires from the plate of coke and from the zinc to be carefully insulated. This form of battery suggests itself to me as cheap, easily made, and easily renewed—and a useful form, if there be no serious objection.—B. F.

[45698].—**Watch Repairing.**—An individual, thinking to put his watch in better order, unscrewed the balance cock, the watch being wound up; consequently, the pallets shifted, and the watch "ran down," but in so doing, the teeth of the crown-wheel—it's a verge—got damaged and knocked out of equality. I have attempted to re-cut them, and have succeeded pretty near, but not to my satisfaction, as there is a little irregularity still perceptible in the tick. Perhaps my tools are defective. Would any of the experienced and clever give me a hint as to the *modus operandi*, and the tools requisite for such an operation, as I should like very much to master it? It perhaps requires a more powerful glass. Al-o, I would feel obliged to know the least quantity of tools for doing a pivot effectively? And, where such could be obtained, second hand and cheap? Some short time ago a series of papers on the Watch, &c., appeared in the "E. M.," the author of which mentioned something regarding a translation of a most useful little work on Watch Repairs, &c., being in progress. Has it yet appeared?—ING. TREE.

[45699].—**Tools for Bending Iron.**—I wish some readers of the *ENGLISH MECHANIC* would kindly give me a description of some tools for bending iron—such as hooks and flat iron—on its edge, &c.? If anyone could give me a sketch I should be glad.—W. J. W.

[45700].—**Musical Box.**—I have a large musical box to repair. It plays the tunes all right, but some of the notes sometimes make a curious quacking noise, and at other times sound all right. Could any of our correspondents kindly tell me the reason? Also, for what purpose are those little steel springs which are underneath the points of the comb?—WATCHMAKER.

[45701].—**Yacht.**—What is the best and most approved method known of protecting the inside of a steel built vessel from rust in fresh water? And, how is the preparation applied? What is the best description and proper thickness of metal pipes other than lead for the distribution of hot and cold water pressure supply on board ship? And, how should they be prepared for protection against corrosion from rust?—J. W. BARRS, M. Inst. C.E.

[45702].—**Dynamo-Machine.**—In "Ours" of Dec. 16 is a letter from "Anglo-Dane," in which he mentions a dynamo-machine which will deposit copper—about 2lb. p. r. 24 hours. As this is the very thing I want, would it be asking too much to ask him to give me a few particulars of the machine to enable me to make one? The letter referred to is 18622, page 356.—KENTON.

[45703].—**Case-hardening Bicycle Bearings.**—Would some reader tell me the way to case-harden a pair of bicycle bearings?—J. G.

[45704].—**Master and Apprentice.**—If a master dies, leaving an apprentice, if his widow, now his sole executrix, carries on the business by the aid of a suitable manager, is such apprentice legally compelled to serve his time to such widow and executrix? Or, must he, if willing, have new indentures?—R. S., Ipswich.

[45705].—**Piano-Strings.**—I have a grand piano-forte which has had rough usage, and many of the wires are rusted. I should very much like to thoroughly re-string it, and any information as to detail, and the procuring of the proper materials will be gladly received. I may mention that I am naturally musical, and the tuning will be an easy matter if I can get over any mechanical difficulties that may crop up.—BARNABO.

[45706].—**Cut Crystals.**—Will any correspondent tell me how the crystals are made, dog's, horses', &c., heads, as seen in pins?—P. M.

[45707].—**Removing Burnt Clay from Castings.**—Can any of your readers tell me how I can remove clay that has been burnt into metal while casting in a clay mould?—FOUNDER.

[45708].—**Gilding Solution.**—Can any of your readers oblige me with the formula for compounding a solution which, when painted on glass and heated, leaves a film of bright gold? It consists of a solution of some gum in an essential oil and a gold salt—I presume the chloride—dissolved in the mixture. The gold deposited to require no burnishing.—GILT SCALE.

[45709].—**Magnet.**—To Mr. LANCASTER.—I have got a 12in. by 2in. by 3/4 in. H. S. magnet, which I wish to use for a magnetic machine. It has got weak by lying by for some time, and I wish to know if it would be possible to magnetise it without hardening? I have seen many directions in back numbers, but, being a novice in the line, they are not explicit enough. Would you be so good as to state the quantity of wire and size, and, if necessary, that it should go round the whole horse-shoe? Or, would it do to cross midway? The battery power and the time required, as it has been magnetised before, which pole of the magnet goes to the copper of the battery? I have an intensity coil—would it be advantageous to attach it thereto? Having seen some of the bought magnetic machines with cast-iron bobbins, this plan I have adopted. Do you think it better than wood?—NOVICE.

[45710].—**Rotary Pill Machine.**—Will some of our numerous friends kindly aid me in making this machine—by drawing, if possible?—E. M.

[45711].—**Continuous Brakes.**—Would some correspondent kindly give description (with drawing, if possible) of the vacuum ejectors used on the G.N.R. and S.E.R. engines for Smith's vacuum brake? Also, could anyone inform me how the vacuum is created on the Midland engines for the Sanders and Clayton automatic vacuum brake? Why are the G.W.R. and Midland engines, which work the Sanders vacuum brake on their trains, fitted with steam brakes on their own wheels? A description of the steam brakes just mentioned would oblige. Also, the steam brake which, I hear, is being fitted to some L. and N.W.R. engines, and the steam brake on the large S.W.R. bogie engines. What is the principle of the Heberlein brake and Hardy's vacuum brake on the L. and Y.R.? Sketches to illustrate descriptions would greatly oblige, as I am anxious to learn all I can about railway brakes.—BRAKE-BLOCK.

[45712].—**Trigonometry.**—In reading a work on the steam-engine, I find the following—viz., to find at what part of the stroke any given amount of lap on the steam side will cut off the steam. Rule.—dd the lap on the steam side of the lead, divide the sum by half the length of stroke of the valve. In a table of natural sines find the s.c. whose sine is equal to the quotient thus obtained. To this add 90°, and from the sum of these two sines subtract the s.c. whose cosine is equal to the lap on the steam side divided by half the stroke of the valve. Find the cosine of the remaining arc, add 1 to it, and multiply the sum by half the stroke of the piston, and the product is the length of that part of the stroke made by the piston before the steam is cut off. I should be obliged if "M.I.M.E.," or someone, would show me (and decide) it will be of use to other readers) how the result is arrived at in the case of a slide-valve whose stroke is 30in., and the lap on the steam side equal 5in., lead 3/4 in. stroke of piston 4ft.? I have tables of logarithmic STEAM.

[45713].—**L. Y. R. Tank Engines.**—To "R. N. H."—Many thanks for your reply to my query. Will you kindly help me further by saying in what way the tanks of the 79 class are shorter? Do they come forward and incline the driving splasher? Also, are the cab, sand-bunker splasher, and sand-boxes similar to 257 (decoupled) class? Also, it is not asking too much, what is the capacity of both tanks?—CENTAUR.

[45714].—**Valves.**—The valves of my 40 hp. horizontal engine leak a little. How am I to proceed to put them to rights, what tools I will require, &c., and oblige?—C.

[45715].—**Old G. W. Engines.**—"The Flying Dutchman," in the answer 45527, in last week's "E. M.," refers to the "Thunderer" engine on the Great Western Railway in former times as being on much the same principle as the "Fontaine" engine now talked about in America. He speaks of it as the "old engine," but gives no further particulars. He would much oblige by giving particulars of the principle. And, if he can, dimensions and date!—STUDENT.

[45716].—**Hydraulic Accumulator.**—A ram for an hydraulic accumulator is 12in. diameter. What weight is required to keep up a constant pressure of 700lb. per square inch? Please show working of rule.—J. B.

[45717].—**Watch-Springs.**—Can any of "ours" inform me of the best method of preserving watch springs from rust in hot climates? I find many springs are completely spoiled by the atmosphere, which is very moist. Any suggestion would be kindly received.—W. D.

[45718].—**Fishing Stockings.**—Would some of "ours" kindly tell me how to waterproof the above? I may state they are made of canvas. I can manage to m. it in indiarubber, but cannot make it set. Any hints will be useful.—ON GUARD.

[45719].—**Metal Spinning.**—How can I fix a piece of copper in the lathe in order to spin it into the shape of a bowl or hemisphere, without making a hole in it?—ATROS.

numerated all the items of investment. Since execution of that instrument one trustee has died, and since his death one form of investment, a Government stock, has been paid off and another Government stock accepted in lieu; but as the account now stands it appears to me that there is no proof that it is a trust account, and in the event of the death of the trustee I fear a difficulty might arise about it. Would an affidavit by the trustee be sufficient? In this case, the appointment of a new trustee is not desirable, as the cost is so great; the present trustee being all that is necessary.—C. O.

USEFUL AND SCIENTIFIC NOTES.

Noises in the Telephone.—According to *La Lumière Electrique*, M. Adar has made further observations on the sounds heard by means of telephones. If one or two telephone receivers be placed in a circuit, and a new file be placed on one of the wires, and if at the same time it be rubbed with a piece of iron attached to the second wire nothing will be heard as a rule; if, however, the file be magnetised, marked sounds will at once be heard, and, what is yet more curious, these sounds will be noticed when copper is used as a rubber. If the file be heated the sounds become much louder. The heating may be produced by the action of rubbing itself or by other means, which may, perhaps, serve to indicate that a thermo-electric action accompanies this class of phenomena. The friction of copper against copper, or iron against iron, and generally any two pieces of the same metal causes no appreciable sound, but if the end of one of the telephone wires be terminated by a heated copper plate, and the other by an iron plate, marked sounds will be heard in the telephones at each contact between the two plates, which cannot be done when they do not differ in temperature. In this case even percussion produces no results. If, instead of heating them, we interpolate a damp intermediary between the two plates, such as water, sounds will be heard at the moment of the contact; but it is necessary that the metals should be of a different nature, or no results will follow.

Mitre Cutting Machine and Corner Cramp.—Messrs. Booth Brothers, of Dublin, are just introducing a registered mitre cutting machine which supplies picture-frame makers and amateurs with a tool by means of which picture-frame mitres can be cut with speed and accuracy; the moulding leaves the machine with a perfectly smooth joint ready for nailing, dispensing with the use of the saw and the plane. They have also a registered corner cramp for nailing picture-frame mitres. The ends of the pieces of moulding to form the frame, having first been cut to an accurate angle of 45°, in the mitre cutting machine are inserted between the fixed jaws of the corner cramp, the movable plate is then screwed down firmly against them, and they are thus held while the ends are being securely nailed together.

Measuring the Power of Belts.—The *Mechanical Engineer* mentions a simple, and, it thinks, effective device for measuring the power of driving-belts, without going into any tedious dynamometric calculations. An ordinary two-part clamp, with a hook on one plate, is secured to the belt, and to the hook is attached a common spring-balance such as is often used. The other end of this in turn is fastened to the nearest wall or timber that will give a direct pull. The engine is then started, and the reading of the spring-balance at the moment the belt slips is the actual resistance or tension of the belt on the pulley. This, multiplied by the speed of the belt per minute, gives the total foot-pounds transmitted by it for the time reckoned. This will, it is thought, prove a very useful device for parties hiring power, as there cannot be any question of accuracy of calculation, any theories of width of belt per horse-power, or any error of any kind, because the actual dead pull of the particular belt in question under test, with all its perfections or imperfections as they actually exist, is given.

Underground Life in England.—According to *Les Mondes*, the proposed tunnel under the English Channel has led to some statistical inquiries which have shown that the number of persons in Great Britain who are engaged in underground employment is 378,151. The length of the galleries in which their labours are carried on is not less than 58,744 miles. The greatest depth of the Channel is 180 feet and the lowest part of the tunnel will not be over 200 feet below the surface. The greatest depth of the coal-mines is about 2,800 feet, and the least is about 300 feet. The Channel tunnel will only form about one-thirtieth of one per cent. of the total subterranean excavations.

A BILL has been lodged for the construction of an electric railway under the Thames to connect Waterloo and Charing-cross stations. The gradients on either side will be such that very little power will be required to work the line.

ANSWERS TO CORRESPONDENTS.

* * All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 31, Tavistock-street, Covent Garden, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

* * Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 4, and unacknowledged elsewhere:—

J. K. EADDALE.—Buck and Hickman.—W. B. Coulcher.—C. J. Warmington.—Rev. A. Willan.—R. A. Lea.—Rev. E. A. Gillett.—Pat. Steam Boiler Co.—G. A. Ames.—W. MacCartan.—L'Abbe Guibé.—W. L. Stephens.—J. Chadwick.—Rev. J. Shaw.—J. Heppli.—L. New.—E. G. Mason.—Rowson, Drew, and Co.—R. C. Mawson.—Jabes Francis.—J. Woodworth.—J. Bridges.—A. T. Hare.—Rev. F. N. Oxenham.—J. Mabson.—W. Boun.—T. Shillitoe.—G. G. Baker.—C. T. Morgan.—Thurso Mechanics' Institute.—E. Prentice.—C. Jubber.—Venables and Co.—J. Lucas.—H. T. Ward.—T. M. Clapham.—A. Schencker.—P. Vallance.—Dr. J. C. Robertson.—Rev. Dr. Richards.—W. H. Hyde.—G. Calver.—W. J. Brown.—Mottershead and Co.—Major Johnston.—Baylis, Thomas, and Co.—R. Murray.—W. M. Bell.—A. Mechanic.—M. H. Bridle.—H. H.—W. London.—Meteor.—Sunlight.—F. H. Wenham.—H. A. Wassell.—Jack of All Trades.

BRAMM—N. North-road. (A method of turning spirals in p. 311, Vol. XXX.; "How to Define Spirals," p. 590, Vol. XXXIII.)—T. C. (We cannot; you should apply to some of the electric lighting companies. You will find a good deal of information on the subject in back numbers.)—F. G. (We do not know that there is any regular appointed agency; but we imagine some of our advertisers could supply you.)—AN AMATEUR. (Watt's manual of "Electro-Metallurgy," published by Lockwood and Co., Stationers' Hall-court, E.C., at 3s. 6d., is the best cheap book.)—A. E. L. (Hughes, Drury-lane, for wire; Stanton, Shoe-lane, for sheet metal. 2. Heat red and bury in ashes until cool; heat again and plunge when red into soap, tallow, sealing-wax, &c. See hundreds of methods in back volumes.)—CIVIL. (We do not understand your object. If it is made heavier than the water it will sink; if lighter, it will float. You can keep it midway for a time by making the lower half of the water salt.)—G. FRYER. (The manufacture of condensed milk was described on p. 296, Vol. XXXII. 2. Raspberry vinegar is made by several recipes. Here is one: Equal parts of bruised ripe raspberries and white wine vinegar. Macerate for three days, press, strain, and add a pound of crushed loaf-sugar to each pint. Boil, skim, and bottle when cool. Brandy is added if liked.)—TIM. (The sum you name should certainly purchase a first class English lever—not a chronograph or a chronometer. We cannot recommend makers. Consult our advertisement pages.)—J. BELL. (What is it you want to know about the satellites of Mars? They are visible only in large instruments, and you will find an article on their discovery on page 1, Vol. XXVI. See also the indices of subsequent volumes.)—J. K. S. (Any large bookseller in Liverpool will answer your question. We do not know the book.)—UNPRACTICAL. (Perhaps a watch-maker can remedy it. It is a very common complaint in Geneva watches. See the articles on "The Watch, and How to Repair it.")—BEGINNER. (Consult Mr. Lancaster's articles "How to Make a Telescope," p. 176, Vol. XXXI.; p. 565, Vol. XXXIII.; p. 29, present volume. A first-class 2 in. o.g., and it is always advisable to use the best, will cost the £2 you mention. If you refer to the indices you will find several papers on the construction of telescopes.)—NOVICE IN THE ART. (Consult the indices of back volumes and the advertisements. Most handbooks of the art specify the apparatus necessary, and the price is easily obtained by consulting the catalogues of respectable makers.)—JOHN O'VEILL. (1. Query inadmissible. 2. It is oxide of magnesium, prepared by heating the carbonate in a crucible until all the carbonic acid is driven off. 3. They mostly require a "tap," but possibly the action requires cleaning. 4. Several good designs are to be found in a little handbook published at the office of the *Journal of Horticulture*.)—J. PROBERT. (The supposed cause of fires alluded to is well known. We saw no reason for the insertion of the letter, but are equally obliged to you all the same.)—C. E. CORK. (No examinations are held specially for the office, which is usually elected to by the members of each sanitary authority, subject to the approval of the Local Government Board.)—NO NAME. (The man cannot marry again during the woman's lifetime, unless he obtains a divorce. The desertion does not render the marriage void.)—T. M. (You saw a meteor.)—WORKING TOM. (We agree to each condition, and will publish if suitable, or return at once if not.)—A. BOURQUET. (1. We think they must. 2. We think not; but a good deal depends on the character of the poison. 3. No.)—SCRIPTURUS. (The copyright was the property of the magazine, unless you specially reserved it.)—JOHN BATCHELOR. (1. If the summons was served in a wrong

name, &c., why did you take it? If the plaintiff can satisfy the registrar or judge that it has come to your knowledge, an order will probably be made. Whether you owe the money or not, you had better attend. If no order is made, and the registrar is satisfied the summons has been wrongly served, you cannot be made to pay the costs. 2. Anybody can draw up a will. In your mother's case, the property being all personal, you all share equally. The will is perfectly legal, if what you say is correct; but is no executor named? If not, you and your sister will have to administer to the estate.)—CARE CANEM. (Not much can be done; but you can try a paste of chloride of lime. Allow it to dry on, and then brush off. Apply it several times; but in all probability the wood is permanently stained.)—OLD DAN. (The whole art of hard and soft soldering was fully described so recently as the last volume. See pp. 170, 264, 334, 455.)—G. B. C. (Try tapping gently, or apply heat to start it.)—C. B. H. (Manganese. See index to Vol. XXXII, or No. 783, p. 98.)—JAMES EXO. (See No. 850, p. 427.)—SAMUEL ARLIDGE. (See the indices to Vols. XXXI. and XXXII. We have, in those volumes and others, exhausted the subject—for a time, at least.)—F. R. KING. (G.N.R. 8ft. express on p. 190, Vol. XXX.; p. 140, Vol. XXXIX.; p. 445, Vol. XXXVIII. The last is a large illustration, Jan. 10, 1879.)—CHEMISTS' APPARATUS. (If you cannot consult our back volumes, look in some such books as Cooke's "Practical Receipts.")—W. HONEY. (You must purchase or make a coil for the first thing, and you will find plenty of instructions for that in back numbers. See pp. 286, 387, Vol. XXXIII.)—S. L. J. (Try the application of permanganate of iron.)—W. H. PAUL. (We can hardly say, but you can easily try. We do not know the thickness of the felt you are using.)

ZENO.—M. A. L.—Your queries can only appear in the "Sixpenny Sale Column."

Superabundance of Pollen in Indian Corn.—Nature evidently intends to secure the fertilisation of the young ovules in the Indian Corn (*Zea Mays*) beyond all chance of failure. In the autumn of 1875, I made a large number of careful counts and estimates, which resulted in fixing upon twenty-five hundred as the average number of pollen grains in each anther. Each panicle of male flowers (the "tassel") was found by careful estimates, to contain about 7,200 stamens, so that the number of pollen grains produced by each plant is about eighteen millions. Allowing two ears of one thousand kernels each, to each plant (a very high estimate), there are still nine thousand pollen grains for every ovule to be fertilised!—*American Naturalist*.

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What offers, cash or exchange, for "English Mechanic" from 4th January, 1887, to present date, all in good condition, packed each year separately? Also *Photo. News* from 2nd April, 1884, to present date. Prefer adoption of lantern of modern make. Difference adjusted.—Address, S. J., Holyhead.

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planed, in order that the iron bolt will slide freely. The latter must be made so that the under part of it will be below the surface of the cast-iron to insure its binding it well down on the bed. And now comes an important feature in the construction of this instrument, and that is the chucking and boring out, or rather turning out, the hole to receive the stem of the T-piece; to do this, a true surface-chuck must be used, and the casting so set or adjusted upon it, that the hole can be turned its desired size, which will be 1 1/2 in.; while upon the chuck, the screw should be cut for the metal ring seen in Fig. 1 to fit on to. I should here mention that it will be necessary to see what amount is to be turned off the casting; if the lathe to which it is to be made is rather more than, say, 5 in. or 5 1/2 in., it may be left a little longer, but this is a matter that will strike anyone at once. When the hole is bored and the screw cut and faced off, it may be removed from the chuck, and the hole drilled and tapped for the binding-screw. When this hole is tapped, a piece of metal must be fitted to the hole, the front being filed to the curve of the 1 1/2 hole, the screw fitted to its place, and the iron and metal all ground out together with a lead grinder; when this is done, the binding-screw will take immediate effect upon the stem of upper slide. Good progress may now be said to be made, and to finish off this part, it only remains to fit in the two steel pins with the cross-screws, which are for the stop of the top slide to butt against, that sets the rest to turn a surface or cylinder perfectly true.

We will now proceed to plane up the main or T-slide, and the best way to hold this on the planing machine is to have a socket into which the stem will go held by a strong screw, and then supported at each end, so that the top angles and the inside can be all planed at one and the same setting; but as this is a tool only likely to be in the possession of makers, the amateur must seek another means of holding it on the machine, and it can be done by bolts and parallel pieces. At the same time I should recommend any one trying to make such a tool as this to get some professional man to do the planing for him. Before we can go any further the metal-work must be also planed up, it only need be to be made, the metal-work might be got up with a file without being planed, but in these enlightened times the idea strikes one as being so out of the way that we assume that it is planed. When this is done the cast-iron T-piece should be got up to a surface with a scraper, and when fitting up any of the other metal parts it is better to turn the stem and fit it into its place, and there let it be held while all the other work is fitted, it will be more easily fixed, and not be likely to be damaged by the vice. Now, to turn this is also a part which requires great care, as it must be held upon a true plate in the same manner as the shoe in which the hole is bored to receive it. The utmost accuracy is necessary in holding this upon the chuck. It will be seen directly that if it is not true and true stem fitted, the bed of the slide rest will not be perfectly true to that of the lathe, and if this is the case, it will never do good work, and may puzzle the maker to know where the error is. When this part is finished so far, we may begin to get the metal-work fitted to its place. It will be observed that the loose side strip is fitted to the rest, the one at the back being cast in the solid with the plate, get the plate up to a true surface first, and then the loose piece must be next to the plate by two steel screws, J-shaped, the holes being elongated to allow the slide to be adjusted, two set-screws, N-thread, for this purpose being in front. The screws at their places and the slides surfaced, they may be ground together, but not with emery. The same

process as described for chuck work must be again used, and that is a little clean oil-stone powder perfectly free from grit. I explained before that the best way to procure this is to break a small piece of an oil-stone and pound it on a piece of iron. When well ground, carefully remove all the cutting substance, and rub the slides well together with clean oil; the next part will be the two steel bars in which the tool-box slides, and the best way to do these will be to get a piece of steel 3/4 in. by 3/4 in., sufficiently long for the two, and file or plane them up in one piece, to get them true on the flats and V together. It will be necessary to use the turner's square with the angle pieces fitted the same as described in the article on "Oval Chuck" of July 8th, 1881, page 415. While the two bars are intact, it is more convenient to drill the four holes for the screws. This done, the bars may be cut in half. Before fixing either of these, the tool-box must, of course, be planed up, the receptacle being 9-16 in. square. This is our standard size, but the square groove, in which the pads for holding down the tool slide, should be a bare 16th of an inch above the 9-16; in other words, the tool-box should be a little deeper than it is wide. When this part is planed up, the slides must be got out to fit the V of the steel bars. The latter can then be fixed to their places, the left-hand one being the stationary one, and should be steady, pinned with two small steel pins, the screw for holding the bars down should be made the same thread as those of lower slide—viz., J, the bar on the right-hand side must now be placed and held, so that the metal tool-box is firmly against the opposite one, and the holes marked off on the metal from the steel; the holes for the second bar being tapped in the metal, those in the steel should be filed slightly oval, just to allow the bar to be adjusted by the set-screw; this done, the slide may be ground up as before, the two set-screws for this slide are rather different to those on the lower slide. The one on the front end is countersunk into the side of the steel bar, the other projecting, and both having behind their heads a short steel pin driven into the lower plate; as these screws are, so to speak, unscrewed, they butt against the pin, and send the bar forward.

We will assume that the two slides are satisfactory, and proceed to get some of the main screws made, and into their places: those right and left of the tool-box may be the first, and they must be cut with 10 threads to the inch, square threads. I may point out for the convenience of any one making such a rest and not having the proper threads, that I shall be glad to lend them, as far as these two screws are concerned; it is not absolutely necessary that they should be of this particular pitch. The screws made, to drill and tap the holes is not one of the most easy things to accomplish, and if only one single tool-box is being made, a piece of metal must be soldered on the opposite side to form a corresponding centre to drill the holes in a straight line: equal care must be exercised in tapping them. On each side of the tool-box, it will be observed, there is a steel pillar; this is for the lever to propel the tool-box backwards and forwards, the lever is fitted to the stem of one of the pads, and a slot about 3/4 in. long allows the slide to work freely; but this movement is now superseded by the slide being made endless, and this is done by a steel collar being fitted to the left-hand screw, and another steel piece being fitted to the front side of it. Consequently, the collar working between the short steel stud and the latter piece, when the screw is turned, the slide moves in either direction without the aid of the lever. On the right-hand side another short stud is fitted for the point of the screw on the same side to take effect against the right-hand screw forming a stop, and

the other the means of inserting and withdrawing the cut, the two pads for holding down the cutter, form the last part of the upper portion of this rest; the one having the lever fitted must be made from a forging. The other can be cut from a piece of plain steel. They should be tapped with the thread and then placed upon a true arbor-chuck all the turning done, and the recess in the bottom, half an inch in diameter, turned out. This recess is for the loose washer, which is eventually attached to the end of the screw, and is fixed or released by the latter at will.

On the top of the tool-box over each of the screws will be seen another square-headed screw. I had better just mention that before tapping the holes for the two main screws, a metal plug should be fitted, through which the screws pass, this being done and the screws tapped partly in the plug, and the other half in the tool-box, the screws on the top will draw the plug up and fix the screw wherever it is required. This, then, finishes the upper part so far, and we will now look upon it as ready for polishing, and proceed to get the main screw in the long slide. The first thing to do will be to bore the cast iron; this may be done by various means, one way, and a certain way of getting the holes true is, set it carefully on the saddle of a self-acting lathe; but as few possess this valuable adjunct to a workshop, I will give an easy way of doing the same thing.

First line out the work to get the centre for the two holes, and then bore a small hole through each end, and with a pin countersink the pin fitting the hole already drilled; make the holes the desired size; the one at the right-hand end will be full half an inch, to allow the screw to pass freely through it, the opposite hole will be larger, as it has a socket fitted to it to receive the end of the screw; it should, therefore, be three-quarters of an inch. The end of the screw must be turned down to the bottom of the thread and fitted into the plug; the object of this end having two fittings is for the purpose of attaching the spiral apparatus. The screw is pinned across the plug, and in order to get the pin into its place, a hole must be drilled through the cast-iron slide; the ends of the pin must be under the diameter of the steel fitting, to admit of its working freely, the end that projects will be seen to have a nut on it, for the purpose of binding the spiral wheels on. The plain part is half an inch long. All these fittings may be done before the screw is cut, but I should recommend that it is cut first in case of an accident. The right hand end has a collar which bears against the end of the cast iron, which collar is fitted into the metal end plate, and should be about 1/2 of an inch in diameter, and project very slightly beyond the face of the metal, so that it can be adjusted to take up any end play, or what is sometimes termed back lash. The metal-plate is fixed to the cast iron by two steel screws, a plain part sufficiently long for the micrometer head, which is 2 1/2 inch long, and another inch for the square on which the winch handle fits.

In cutting the screw some care will be required, and can only be done with the aid of the before-mentioned self-acting and screw-cutting lathe, as it is a square thread of 10 to the inch. It is not absolutely necessary that it should be a square thread, but for ornamental purposes it should be ten threads to the inch, as all screws for the various chucks and cutters are of that particular pitch. The screw then being cut and in its place we come to the nut which must be, of course, tapped with proper square thread tap, and the upper surface must be filed off until it is exactly level with the top of the cast-iron slide. Here also care must be exercised, and the principal reason for this, I will point out, if it should be filed below it

and the nut is screwed tight up to the gun-metal slide, it will naturally spring the screw, and will not work except just in the centre. Two countersunk holes must be made in the metal, and two steel screws, well fitted, to hold the nut in its place.

As will be seen, the screw in this case is covered with a metal cover, to keep out the dirt and shavings. The way in which this cover is made is from a piece of good steel tubing, or metal will do equally as well, either of which should be turned perfectly true, and cut in half, which can be done either in a planing-machine, or in the lathe with a circular saw. The nut must now be cut away, in order that it may pass freely over the metal cover. There are two ways of doing this; either to file the top away or to cut out a circular groove. The latter we always do, as it makes a better job and can be easily done with a rose-cutter running in a drill-spindle from the overhead motion. The nut fixed on a steel arbor, and moved the required distance by the segment stops. The micrometer is fitted on to the plain part of the screw, and pinned across and divided into twenty, with a figure at every other line: the usual way to figure it is—0 1 2 3 4 5 6 7 8 9, the 0 being the zero, or starting-point. We sometimes have a scale divided on the face of the cast-iron slide, which is a very useful addition; the reader for it must agree as to the starting-point with the 0 on the micrometer, and a line at every turn of the screw, which will be one-tenth of an inch.

A few remarks relative to what is termed back lash may be useful: in all screws with square threads there is almost a certainty of there being a little, and it is usual to cut the nut right along and have two screws at the top to bring the nut together; but this does not have the desired effect, as it only tightens the nut on the screw, but does not prevent the loss of time, but if the nut is cut in two the other way and two screws fitted so as to draw it together endways, it causes the nut to close upon the sides of the screw, and the screw may be then adjusted to the greatest nicety. I always have them made in this way now, and never have loss of time in any way whatever.

I hope if these few remarks are carried out that little difficulty will be found in making a tool of this kind, and it is, without doubt, one of the most useful additions that can be made to any lathe, and in order to facilitate matters, I am quite willing to allow castings to be had from my patterns. I do not think I need expatiate here upon the finishing of such work, because I have done so in previous pages, and as space is valuable in this journal. I will conclude by wishing success to all who essay to make an ornamental turning slide-rest.

THE INTERNATIONAL ELECTRIC EXHIBITION.

THE Electric Exhibition at the Crystal Palace, though it can hardly claim so much of the international character as its predecessor at Paris, will, when complete, give the visitor a better idea of the practical applications of electricity than he can gather from written descriptions of its uses. Like all similar exhibitions, it was found impossible to get everything in readiness by any definite date, without putting those exhibitors who showed a commendable punctuality to the inconvenience and expense of delay. The directors accordingly determined to dispense with an inauguration, and the exhibition has now been open for several days. There is every prospect, at the time of writing, that the arrangements for electric lighting will be completed by the 14th inst., the day appointed for the visit of the deputations and delegates, and perhaps by that date also the majority of the exhibitors will have their appliances in

working order. The arrangements for the display of electric lighting are excellent, for the different styles and types will each have its allotted section, and the whole of the building will be illuminated by the new light when the exhibition is complete. At the Tropical end (the north), and the Byzantine Court, the Anglo-American Brush Electric Light Corporation will show one arc light said to be of 150,000 candle-power, 40 arc lights of 2,000 candle-power, and sundry others of smaller power; the same company will illuminate the Alhambra Court with 600 incandescent lamps of the Lane Fox type, ranging in power from 10 to 100 candles. The Electric Light and Power Company have already put their lamps, supplied by Weston dynamo-machines, in action in the north nave, and Messrs. Siemens are preparing to occupy the south end of the building with a variety of their lamps, while they also light the dining-saloon with from 50 to 60 Swan incandescent lamps. Mr. Crompton will have 12 of his lamps in the transept, thus lighting the theatre, and 2 in the Chinese court. Messrs. Hammond will light the whole of the corridors and staircases from the low-level station to the Palace with a number of Brush lamps of different kinds. The Compagnie Générale d'Electricité show an example of Jablochkoff's candles adapted to the lighting of the auditorium and stage of a theatre (the opera theatre), while the low-level station of the L. B. and S. C. Railway is entirely illuminated by the same system. The company also shows an example of street lighting. The British Electric Light Company will illuminate a portion of the nave, the Egyptian Court, and the portion of the building on the opposite side by means of the Brockie lamp, and some of their dynamos will be driven by Hodson's rotary engine—a device which has considerable interest quite apart from electric lighting. The Electric Lighting Supply Company show Hedges' patent lamps in the west corridor. Hawkes and Company have six arc lights of 6,000 candle-power in the south-west gallery, while many other exhibitors have one or more lamps in different parts of the building. Amongst the novelties is a new incandescent lamp shown by the School of Submarine Telegraphy. Messrs. Strode have incandescent lamps in ornamental stands, Mr. G. W. Wigner has a regulator actuated by water pressure; Mr. Blackwell shows a Swan incandescent lamp, supported by one of his new Bunsen batteries, and most remarkable, perhaps, is the exhibit of the Country Mansions Portable and Economical Electric Light Company, the description of which sounds too good to be true. They have a room in the S.W. gallery in which they are to exhibit incandescent lamps supplied by a special battery requiring no acids and giving off no smell, and all at an "insignificant first cost." Edison deserves a special note to himself. His machines are in the basement, and he has a special saloon in the west corridor, where his unique system will be fully displayed. We have not attempted to mention all the names of exhibitors of electric lighting appliances, but there can be no doubt that so far as that branch of the exhibition is concerned the show will be complete and unexampled. Intimately connected with the lighting are the dynamo-machines and batteries, and here we find some interesting historical landmarks of electrical progress, for S. A. Varley and Co.'s exhibit includes the original machine provisionally protected in 1866, in which the "action and reaction" principle that forms the basis of the present methods of economically producing electricity was first introduced. Ladd and Co. exhibit Ladd's dynamo-machine, invented in March, 1867, and his magneto-machine which dates from 1866. The exhibit includes also an autograph letter from P. Reis dated 1863 de-

scribing his telephone. Siemens Brothers exhibit a considerable number of machines, several in operation, while the Electric Lighting Supply Co., show a Franklin dynamo driven by an Otto gas-engine through Hedges' belt frictional gear with strap-tightening apparatus. Batteries and battery parts are shown by several firms, Mr. Blackwell having a good exhibit, while Dr. Gladstone and Mr. Tribe exhibit their air-battery and the copper-zinc couple, together with accumulators of the Planté and Faure type, illustrating the effects of local action, as referred to in our "Scientific News."

The next most important branch of the exhibition is, probably, that relating to telephones, microphones, &c., and here we find that several of the exhibitors have taken the field early, notably the Messrs. Gent, of Leicester, who have one of their transmitting and receiving instruments fitted at the corner of the south-west gallery in working order. Blakey, Emmott, and Co. show Crossley's instruments, and in the south-east gallery Mr. Pope Cox, of Plymouth, has Adler's instruments; the Edison-Gower-Bell Telephone Company show various forms, but their speciality is the arrangement for musical purposes and the exchange system. Professor Dolbear has a "boudoir" fitted up in the Tropical department in which his telephones will be exhibited in working order. Mr. Faulkner shows, amongst a number of other exhibits, the Altandi Electro-magnetic Holophone; and several other firms help to make this portion of the Exhibition probably the most interesting of all.

Amongst the telegraphs proper the General Post Office exhibit is complete, and is shown on a table in the centre of the north nave; adjoining is Mr. C. V. Walker's complete exhibit, arranged in chronological order, of the system of railway signalling arrangements as adopted on the South-Eastern Railway, including the original system of intercommunication between passengers, guards, and drivers. The Exchange Telegraph Company and the Automatic Telegraph Company exhibit automatic type-printing instruments for transmitting news from a central station to a number of receiving stations, one of the transmitters exhibited by the former company being capable of working 1,500 receivers simultaneously. The Telegraph Construction and Maintenance Co. exhibit specimens of submarine cables, illustrating the progress of that branch of the art, and a proposed system of establishing communication between light-ships and the shore, showing a method of preventing fouling and twisting of the telegraph lines as the lightships swing to the tide. The Eastern Telegraph Co. have also an interesting exhibit, including specimens of the cable-boring worm, sea adders found on cables when lifted, and several soundings from the bottom of the sea taken at various depths. The School of Submarine Telegraphy have a number of appliances specially adapted for teaching, including long artificial cables, with mirror galvanometers and siphon-recorders, and a collection of testing and signalling apparatus.

Lightning-conductors are exhibited by various firms, and Mr. Vyle, of Middlesbrough, shows his patent easily-tested conductor. Amongst the measuring instruments there are the patent meters of Mr. C. V. Boys, shown in various forms by Mr. Lorraine, of Westminster; while Mr. Paterson shows the several kinds of meters devised by Profs. Ayrton and Perry. Several improved systems of railway signalling are exhibited, the most interesting of which are the automatic methods, by which the train is made to signal itself. Mr. T. Powell's plan is shown by Messrs. Apps in a large working model. This is a centre-rail system, in which the train is always in contact

The signal stations on its section, so that the drivers and signalmen can always see its position, while drivers of following trains are automatically warned. The Electric Railway Signal Co., of Mansfield, exhibit King's system, in which a passing car itself works the signals in its rear and gives notice of its approach to stations in advance. Mr. E. A. Sullivan shows his electric fog and night-signals, which are, however, under the control of the signalman. Electric clocks form also an interesting feature in the exhibition. Mr. F. T. Field, of Exeter, showing a system in which any number of clocks are worked by one regulator, the whole arrangement being electrically self-acting, neither the regulator or the clocks requiring winding, setting, or adjusting. Mr. E. Webster, of St. John's Wood, exhibits an arrangement having a similar object, but which can be applied to existing clocks. Amongst the miscellaneous exhibits are several electric tell-tales, which are said to be capable of recording the amounts placed in the tills, and to be so arranged that they cannot be falsified. Mr. Brailsford, of the Thames Conservancy, exhibits his water-level indicators as adopted by the Conservancy board, which are adapted for use in water-reservoirs, tanks, steam-boilers, and tidal ways, indicating the fluctuations in the height of water at any required distance by means of a single wire. Messrs. Chubb will add variety to the Exhibition by their exhibit of the patent electric time-lock for safe and strong-room doors. This time-lock is so arranged that it can be set to open or close the lock at any desired times—that is to say, that even with the key the lock cannot be turned except during certain hours. Dr. J. H. Poynting, of Taunton, shows a specimen of electric engraving on hardened steel, and also a specimen of printing by electricity, the work of Sir Joseph Banks in 1802. Mr. Serrell, of New York, shows a silk-spinning machine, which is regulated and controlled by electricity; and a serigraph, silk-testing machine, which records by electrical means, the defects in a thread of silk passed through it at the rate of a mile in eight minutes. Messrs. Dan Walters and Co. exhibit their improved wire-covering machine, and the Messrs. Becker show the W. Voss induction electrical machine.

The space at our disposal it is impossible to do more than give a general idea of the character of the exhibition, and at the present time it is impossible to speak of the exhibits themselves. So few are in position. There can be no question that the display of electric lighting appliances will be magnificent in its way, far superior to that at Paris; but except in certain cases it will not be easy to form an accurate judgment as to the relative merits of the different systems. Electric lights and appliances of that kind are abundant in production, and the many ingenious devices shown bear ample witness to the progress that has been made in this branch of the art of utilizing electricity. Finally, it may be said, that the Exhibition when completely arranged, will be a remarkable collection of a number of appliances which, a few years ago, were in many cases treated of, and which, to the observant eye, will speak plainly enough of the part which electricity will ultimately play in social life. By the time these appliances have been brought to the notice of the public, the arrangements for the electric lighting will probably be fairly complete, but we suspect the month will be approaching its end before all the exhibits are placed in working order. Meanwhile, visitors will have a better opportunity of inspecting those exhibits which are in working order, and there are sufficient signs to profitably occupy the attention of several hours.

PRACTICAL NOTES ON PLUMBING.—XXIV.*

By P. J. DAVIES, H.M.A.S.P., & Co.

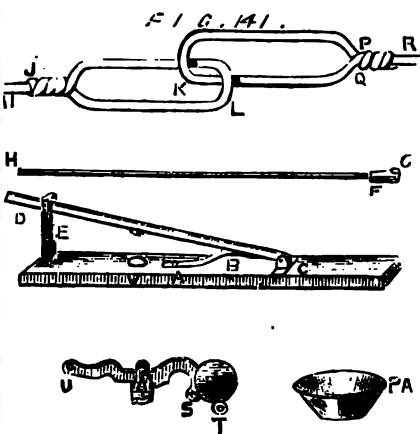
Inside Work, or Sanitary Plumbing.—Wiring Closets, Fixing Regulator Closets.

THE first thing after having run the cranks is to do the wiring. It is a very general thing with good tradesmen to fix the wires as they proceed with the cranks, and in many cases it is, no doubt, an advantage.

Before attempting to fix a length of wire, first secure one end to a nail or any other fixture, and with the pliers stretch the wire as much as possible, that is without injuring the wire. It will, of course, be understood that a pair of good cutting pliers are indispensable. When at this work myself, I always use two pairs, one for holding the wire near the link, and the other for twisting the wire. A very little practice will teach you the extent of tension to put on the wire when stretching it.

When making the links, see that the end of the wire used to twist round the main wire is truly turned, and each turn true with the other, cutting off the end close up to the twist, as shown at G, Fig. 140. Do not leave it in the slovenly manner shown at W D, Fig. 139.

Under certain circumstances you will require links formed in the wire, as shown at K L, Fig. 141. This should always be done between the



first crank and the lever of the container, as shown at F A, Fig. 137. It is quite as well to place a link between the ball-lever and the crank in cistern work, as the ball often drops more quickly than the valve, and thereby bends the wire. The cause of this is very simple, viz:—that a weight falls through a given space of air much more quickly than through the denser matter water; the necessity for placing the link between the first crank and the lever is that, not unfrequently the lever gets quickly pushed down before the ball-lever can drag up the wire; remember always that, that which gives motion necessarily moves first.

T, Fig. 141, is the ball-lever as fixed at K, Fig. 137, and D, 136. Always fix this lever to pull the valve "plumb"—that is, not out of the upright. Levers should be made as they were originally with brass standing lugs A, as, when made of iron they rust and become stiff in action.

Spring Boards.

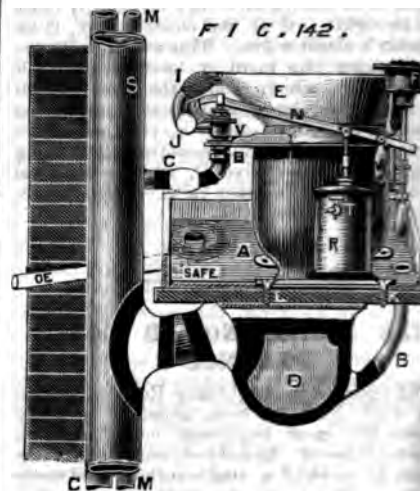
A B C, &c., Fig. 141, illustrates the spring-board for actuating the spring-valve, as shown at L, Fig. 137. A B is the spring, O the lug, D the lever, E the guides, H F G is the rod and sling; on the rod is cut a long screw, which screws into the eye of the sling, in order to lengthen or shorten according to circumstances; at H is another screw which screws into the socket-link of the spring-valve. The manner of fitting the spring-board is by fixing it over the top of the cistern, so that the hole V in the board is vertical over the spring-valve link, and the end of the lever D turned to suit the proper working of the wire; the sling of the rod couples the rod to the lever, the rod and sling should be ordered to suit the depth of the cistern, with plenty of screw for the sling to allow for cutting off if necessary. P A is a diagram of a

* From the Building News. All rights reserved.

coffin-pan for a pan-closet: these pans are sometimes spun and at other times hammered. The latter are most to be relied upon for good wear.

Fixing Regulator Closets.

Fig. 142 illustrates one of Underhay's

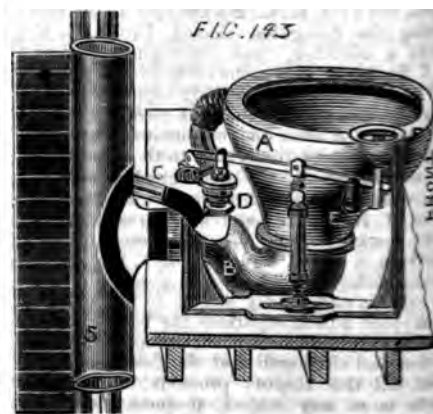


regulator pan-closets, fixed over a U-trap; the safe overflow runs into the band of the trap: the proper plan is to cause this pipe to deliver over a head, as shown by the pipe O F. B is the bellows-regulator, made with zinc or copper: those of copper are, of course, much the best for durability.

Servants' Closets.

From a sanitary point of view, and assuming always that they are properly flushed, these closets are very good, and as there are not any working parts everlasting, all that are required are a good trap and hopper, a cottage or balloon-shaped basin (Sharp's pattern). I deem it best to fix these basins over a properly constructed U-trap, as here you can have (when the basin is fixed below the floor-line) a good drop for the soil from the basin into the trap. It has another advantage, namely, driving away the soil, as the water, having a distance of about 2ft. to fall from the fan to the water-line in the trap, necessarily gains force and has power accordingly.

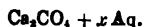
It is preferable, that is, where practicable, to flush these closets through a service-box or small waste-preventing cistern, having a 1½ in. or 1 in. lead pipe; but when this is not easily practicable, it is best to work from charged pipes, as described in chapter 22. In such cases the valve is best fitted with a regulator, so that it will be impossible to get a less quantity than about two or three gallons each time the handle is pulled. The parts of this w.c. are as follows—Fig. 142 is the closet-pan, B the leaden trap: in this case it should be a knee trap, because it is fixed above the basement



floor-line, and requires to be connected with solder to the soil-pipe S. In all cases with this kind of work it is absolutely necessary that the

hole in a chalk rock, as the oxidation of able matter charges the water with carbon and the continually exerted solvent action carbonated water produces a notable effect use of time.

is an important compound which is inter-between the usual carbonate and lime, ch may be called the orthocarbonate. It



compound is formed when slacked lime is to the air, and it hardens when mixed with moreover it possesses considerable im- in relation to mortars and cements. scellaneous uses of carbonate of lime are merous. Here, for example, is some -a fine form of chalk—which is prepared ating and washing chalk. When this is ith linseed oil, it forms putty—a cement of especial value to the glazier. The pre-alk of the pharmacist is merely a care- pared whitening, and here are samples nd coloured for use as face powder. e of carbonate of lime in the soda process ne may be taken as an example of its use important chemical industries; but the use of carbonate of lime consists, in its ent as a source of lime for building pur- hulk is often used to rub on surfaces with of increasing friction, as, for example, tight-rope dancer chalks his boots, or a layer chalks the end of the cue with which the ball. The leather facings of the wind in organ are often chalked, in order to the tendency of the air to escape, and Mr. is just arranged an experiment to illustrate a greater effectiveness of chalked leather leather in preventing the escape of wind neertina.

ASTE IN COMBUSTION.

TURE on this subject was delivered by fessor W. Chandler Roberts, F.R.S., at e Abatement Exhibition, South Kensington lecturer pointed out that the work the e of the exhibition were endeavouring to was a continuation of that which occu- tention of Parliament in 1819-20, when mmittees was appointed to consider the 'actory furnaces on public health, and in en another committee inquired into the nd expediency of preventing the nuisance " and a valuable report was issued con- e evidence of Faraday, who expressed his e reduction of smoke from coal fires e houses could "be effected in a very ec." As professor in the School of Mines, rts felt great pleasure in being able to he effort now being made for the abate- moke. The School had been associated work, Sir H. de la Beche, its founder, yon Playfair, its first Professor of Chem- ing in 1846 made a valuable report to ning, in which they said that "It cannot ment be questioned that the continued f smoke is an unnecessary consequence of sion of fuel," and that, "as an abstract it can be dispensed with." Alluding to rts in this direction, Professor Roberts l that the "Transactions of the Royal for 1881 contained the description of a consumed its own smoke and in which it was so perfect that "incense made no n burned in it, neither did red herrings erson." Probably the first attempt to o smoke nuisance was made by James 1795. Passing to the more immediate his lecture, Professor Roberts gave at h the chemical and physical reasons for at incomplete combustion was wasteful, shed numerical illustrations. He pointed re combustion of a complex fuel, such as enerally used for household purposes, was ed by the evolution of compounds of d hydrogen. These compounds became the presence of air into others which, ng more stable, contained less carbon. on became separated in the flocculent, dition that constituted smoke. This ided carbon could be burnt only by a supply of air at a sufficiently high re. After all, the quantity of carbon t was comparatively small when compared volume of air through which it was dia-, as every cubic foot of the densest smoke l be produced only contained one grain- carbon. Small as the amount was, its effects had been abundantly proved. The eferred at length to the work of Dr. nd expressed his belief that for domestic e should ultimately adopt Dr. Siemens' erting our fuel into gas and burning it ce quite separate from that in which the reduced. Count Rumford had said, early utury, that he never visited London ishing to be able to compute the immense

amount of coal in the black cloud that hung over the city. We had now data that were not avail- able to Count Rumford, and estimating the amount of coal burnt in domestic fireplaces during the past year at 5,000,000 tons, Professor Roberts con- sidered that the soot in the pall that might hang over London in a single day would be equivalent to at least 50 tons of coal, while there was good reason to fear that the carbon in the half-burnt form of carbonic oxide gas was at least five times as much. He insisted on the fact that the presence of soot was always an indication of imperfect com- bustion, and therefore of waste.

THE GULF STREAM AND THE PANAMA CANAL.*

By JAS. GEIKIE, LL.D., F.R.S., &c.

NONE of the great "rivers of the ocean" has been so frequently and carefully studied as the Gulf Stream of the North Atlantic. Its course, its depth and breadth, its temperature, &c., have all been laboriously investigated, while its influence on the climate of North-Western Europe has formed a very fruitful subject of discussion. The origin of the stream is well known. The Caribbean Sea and the Gulf of Mexico are full-charged with the heated waters of the great Equatorial current, and it is from this broad and deep reservoir that the famous Gulf Stream issues by the Straits of Florida to flow in a north-easterly direction to- wards the coasts of Europe. At the narrowest place in the Straits the stream measures 30 statute miles in breadth and 1,950 ft. in depth, but it gradually widens as it passes north until it spreads out over an enormous area. It has been perfectly well ascertained that the superficial stratum of the ocean throughout the whole vast space between the great Bank of Newfoundland and the coasts of France has a higher temperature than the normal of those latitudes, and is flowing persistently in a northerly and north-easterly direction towards the coasts of Greenland, Iceland, and Spitzbergen. It is doubtful whether all this body of heated water has passed through the Straits of Florida, and some physicists have maintained that only a very insignificant portion indeed has actually streamed out of the Gulf of Mexico. These writers have, therefore, held that a stoppage of the Gulf Stream would have only an infinitesimal effect upon the general temperature of the North Atlantic and the climate of North-Western Europe. This view, however, has been completely upset by Dr. Croll, whose estimate of the enormous heating-power of the Gulf Stream is now very generally accepted. According to this eminent physicist and geologist, the total quantity of heat conveyed by that current is probably equal to that of a stream 50 miles broad and 1,000 ft. deep, flowing at the rate of 4 miles an hour, and having a mean temperature of not less than 65°—a temperature which gradually falls as the current goes north until it is cooled down to at least 40°. This estimate gives us 5,578,690,000,000 cubic feet of water per hour, and consequently the total quantity of heat transferred from the Tropics by this current amounts to 154,959,700,000,000,000 foot-pounds per diem. Even if we reduce this estimate one-half, the stoppage of the Gulf Stream would still deprive the Atlantic of a quantity of heat equal to one-fourth of all that is received directly from the sun by that area.

It is beyond doubt, therefore, that the passage of so great a body of heated water into the North Atlantic, over the surface of which it spreads for so many thousands of square miles, must have a most powerful influence on the climate of those regions to which its heat is brought by prevalent winds. This is the case more especially with France, our own islands, Norway, the Faroes, and Iceland. With us the prevalent winds are westerly and south-westerly, and these, as they sweep across the Atlantic, flch warmth and moisture from the Gulf Stream, which they part with as they pass over us in their course towards the North-East. How very materially our climate is thus affected will be readily seen if we compare the mean winter and summer temperatures of places in the same latitudes of North America and Europe. Thus at Bordeaux, in N. lat. 44° 50', we have a winter temperature of + 41° F., and a summer mean of + 69° 12° F., while at Halifax (Nova Scotia), in the same latitude (N. lat. 44° 39'), the winter mean is + 22° 6', and that of summer + 63° 5'. Again, at Killybegs (Ireland), in N. lat. 54° 38', the winter temperature is + 41° 4', and that of summer + 58° 7'—the winter and summer means of a corresponding latitude on the Labrador coast being + 5° and + 49° respec- tively. Once more, at Wick (N. lat. 55° 25') the winter temperature is + 38° 5', and that of summer + 56° 5', while at Hebron (Labrador), in N. lat. 58° 16', we get a winter mean of - 5° 1', and a summer mean of + 46° 1'. Now were the Gulf Stream to be stopped the temperature of the mari-

time regions of North-Western Europe would probably fall as low as that of corresponding lati- tudes in America. In the event of that stream being diverted out of the North Atlantic, the Polar currents flowing south would of course occupy the greater portion of the oceanic surface to the west of us, and hence our west and south- west winds would be cold and ungenial. Were such a catastrophe to happen we may be sure that the Scandinavian Peninsula and a large part of our own islands would not be habitable by civilised man, while Iceland would become as inaccessible as Franz Josef Land is now. Our own shores would be frost-bound for a large part of the year, and perennial snow and glaciers would appear in our mountain districts. On the other hand, if we could suppose the body of warm water now flow- ing into the North Atlantic to be largely increased in volume, there can be just as little doubt that the climate of North-Western Europe would be much improved, and even Spitzbergen and Novaya Zemlya might be rendered fit abodes for civilised communities.

Strange as it may appear, the records of geology assure us that such changes in the climate of North-Western Europe have actually happened within a comparatively recent period—certainly within the human epoch. Thus it has been well ascertained that at a time when rude tribes of men, unacquainted with the use of metal, were hunting reindeer in Southern France, a vast area in Northern Europe was buried under a great sheet of ice—a veritable *mer de glace*—like those ice-sheets which cover up such extensive areas in the Arctic and Antarctic regions. Had anyone at that time approached the shores of North-Western Europe he would have encountered, some 50 miles outside of the present western shores of Iceland and the Hebrides, a vast vertical wall of ice, like that which confronted Sir J. Clark Ross, Com- modore Wilkes, and the *Challenger* Expedition, and barred all approach to the Antarctic pole. Could our voyager have surmounted the Sesto- Hibernian ice-wall he would have discovered that he stood on the verge of an interminable plain of snow and ice, extending eastward as far as eye could reach. Here and there upon the far horizon he would have observed a few inconspicuous rocky hills, representing the upper portions of our highest mountains—for the ice which then buried our low grounds was not less than 3,000 ft. thick. Had he advanced inland until he reached those rocky heights he would have found the ice plain sweeping away in all directions, and bounded only by the horizon; and had he continued his journey towards the East, across what is now the German Ocean, he would have encountered nothing to break the monotonous level until he approached a low line of snow-covered hills and mounds, marking the site of the ice-crowned Scandinavian Peninsula. After attaining these hills, had our imaginary wanderer now shaped his course towards the South, he must next have traversed a distance of more than 500 miles before he reached the termination of the ice-sheet in Saxony. During this extraordinary condition of things the Arctic-alpine plants and animals (which are now characteristic of lofty elevations in Central and North-Western Europe, and of the low grounds of the higher latitudes) occupied the low-lying plains and valleys of middle Europe—a Barlike that of Lapland growing in South Germany, Switzerland, &c., and pines and spruces flourish- ing in North-Eastern France, while reindeer, glutton, Arctic fox, lemming, marmot, and others were the prevailing animals of those regions. When we think of the conditions which now obtain in Europe, can we conceive of any stronger contrast than that which is suggested by the few facts which are here summarised? Instead of the splendid navies of war-ships, ocean-liners, and other craft which now crowd its waters, the English Channel had formerly its fleets of ice-floes, and the walrus haunted the coasts of Northern France! When such extreme conditions obtained it can hardly be doubted that the Gulf Stream, as we know it now, had no existence in the North Atlantic.

Now let us look at another picture of the past, but still within the human epoch. There was a time, then, when the European climate was so genial that many delicate southern species of plants flourished luxuriantly in regions where they can- not now exist. Thus, in the neighbourhood of Paris the fig-tree, the Judas-tree, the laurel of the Canary Islands, and other Southern species found a congenial habitat. The Canary laurel does not grow further north now than near Toulon, on the borders of the Mediterranean. It flowers in winter, and repeated frosts would, therefore, pre- vent it reproducing its kind. That the plant formerly flourished near Paris is thus a striking proof of changed climatic conditions; and we can- not doubt that at one time the winters in Northern France must have been extremely genial. More- over, we know from the character of the plants with which the Canary laurel was associated in that region that the climate must have been

* From the *British Trade Journal*.

exempt from extremes—the summers were neither so dry nor so hot, and the winters were very much milder. The land and fresh-water shells which were contemporaneous with that remarkable flora in North-Western Europe tell precisely the same tale, and this is still further illustrated and confirmed by the character of the mammalian fauna. Among the commoner animals at that time occupants of England, France, &c., were hippopotami, elephants, rhinoceroses, lions, tigers, hyenas, &c., and vast numbers of cervine and bovine animals which still occupy the temperate latitudes of Europe. That such genial climatic conditions were due in large measure to a great increase in the volume of warm water flowing into the North Atlantic seems just as certain as that the Arctic climate of the Glacial Period was largely induced by a very considerable decrease or even an entire stoppage of that heat-bearing current. The presence of many Mediterranean shells in the ancient raised beaches of Scandinavia, the occurrence of mussel-banks in the coast-lands of Spitzbergen, the appearance here and there off the coasts of Scotland, the Faröes, and Iceland, of southern species of shell-fish, and the presence of isolated colonies of southern molluscs in the Gulf of St. Lawrence are all indicative of a former much greater influx of warm water into Northern regions than is now the case. Those remarkable colonies of Southern species are living evidence of the last epoch of extremely genial conditions experienced in North-Western Europe—an epoch during which great forest growths overspread wide

caused by the last great increase in the eccentricity of the earth's orbit. As the next period of high eccentricity will not occur for many thousands of years, we need have no apprehension that we shall be deprived of the genial influence of our friendly Gulf Stream in the immediate future. And when we reflect upon the magnitude of the submergence of Central America which would be required to divert that stream into the Pacific, we may be equally reassured that we are not likely to suffer from its loss in our day; for before it could be sensibly diminished in volume by this means the Isthmus of Darien would need to be sunk to a depth of not less than 800ft., and, perhaps even 1,000ft. We may therefore contemplate with perfect composure the formation of any number of canals across that isthmus. The great work of the famous French engineer will have as much effect upon the Gulf Stream and the climate of North-Western Europe as the emptying of a teapotful of boiling water into the Arctic Ocean would have in raising the annual temperature in Greenland.

AMATEUR MECHANICS.*

(Continued from p. 422.)

Hints concerning Centring and Steadying.

TO centre a cylindrical piece of metal readily and accurately is a very simple matter when the workman is provided with tools especially designed for the purpose, and it is not difficult when an

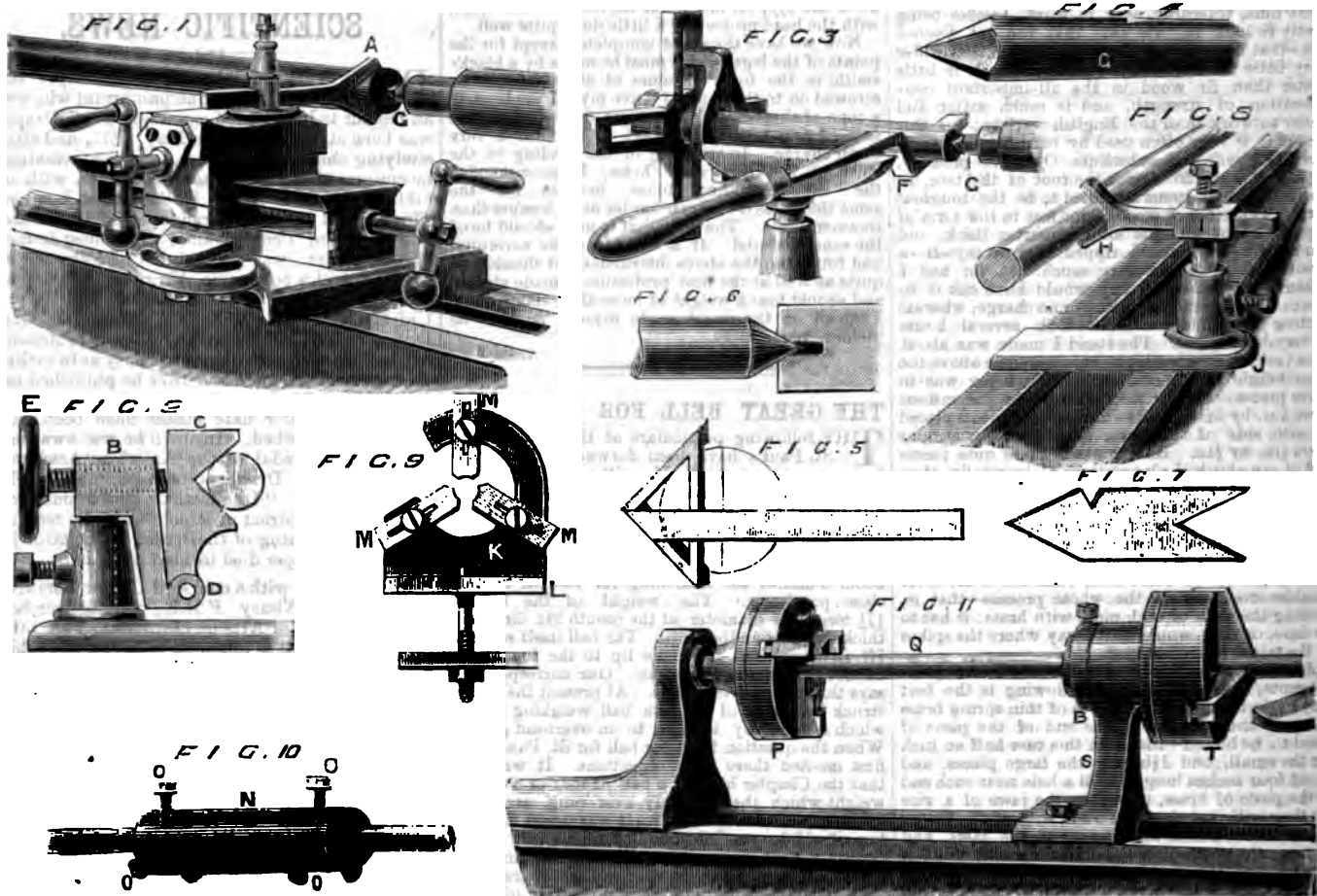
drill. The angle of square-centre, G, for very hard material, should be a little more obtuse than that shown in Fig. 4. In any case, it should be of good material and well tempered.

In Fig. 2 is shown a centring tool which is designed to take the place of the engine-rest and fork in Fig. 1. The part B is fitted in place of the ordinary tool-rest, and steel jaw, C, which has in it a V-shaped notch, is fitted to the part B at D. A screw, E, passes through the upper end of the part B, and bears against the jaw, C. After what has already been said in connection with the engine-rest, the manner of using this contrivance will be readily understood.

In Fig. 3 the hand tool, F, is employed for steadying the shaft and bringing it to a centre. This tool is bent to form a right-angled notch for receiving the shaft, and when in use it is supported by the tool-rest after the manner of an ordinary hand turning-tool.

Work that is too large to be readily centred in this manner is often centred approximately by means of the universal square, as shown in Fig. 4. A diametrical line is drawn along the tongue of the square, the work is then turned through a quarter of a revolution, and another line is drawn. The intersection of these lines will be the centre, at least approximately.

This point may now be marked with a centre punch, and the work may be tested in a lathe. If it is found to revolve truly on the centres, it may be drilled; otherwise the centre must be corrected



regions in the North—covering the British Islands, the Inner and Outer Hebrides, the Orkney and Shetland Islands, all Norway up to the extreme North, and most extensive areas which to-day lie submerged in the sea.

Thus, it will be seen how greatly the climate of North-Western Europe has been, and may yet again be, modified by changes in the flow of the Gulf Stream. Now, if we glance at a map of America it will be observed that only a narrow neck of land separates the Gulf of Mexico from the waters of the Pacific, and it is conceivable that, were this isthmus to be submerged, the great body of heated water that at present finds its way north through the Straits of Florida, might flow directly into the Pacific Ocean. There is no evidence, however, to show that the barrier of Darien has been thus submerged within any recent geological period, and consequently the great changes of climate referred to above could not have been brought about in this way. They were most probably induced, as Dr. Croll has shown, by a remarkable series of physical mutations which accompanied and were

engine-lathe or even an engine-rest is available; but to do it easily and properly in an ordinary plain foot-lathe may puzzle some of the amateur mechanics.

Although some of these methods are well known, they will nevertheless be described for the benefit of some who may require the information.

The method of centring shown in Fig. 1 is one of the most common where the lathe is provided with an engine-rest. A forked tool, A, is clamped in the tool-post in such a position that a line drawn from the point of the tail centre will bisect the angle of the fork. A square pointed centre, G, is inserted in the tail spindle and moved against the end of the rod, being centred with a slight pressure, the tool A being at the same time moved forward by the screw of the engine-rest until the rod turns smoothly in the fork and the square-pointed centre has found the centre of the rod; the tail-spindle is then moved forward until the cavity is sufficiently deep to permit of starting the centre

with the centre-punch, and the work again tested in the lathe.

After centring by any of these methods, the centre must be drilled and countersunk with a suitable tool, so that it will fit the lathe-centre, as shown in Fig. 6. The angle of the lathe-centre should be sixty degrees. To insure uniformity in everything pertaining to the centres, the centre gauge, shown in Fig. 7, should be used for getting the required angle on the lathe centres and on the drills used in centring.

The matter of steadying long, slender rods while being turned in the lathe is often perplexing.

In some cases it may be done tolerably well in the manner illustrated in Fig. 8. The fork, H, is supported by the standard, I, which is inserted in the socket of the rest support, J. The device shown in Fig. 2 may be used in a similar way.

Fig. 9 represents a steady rest, the construction of which will hardly need explanation. For light work it may be made of wood; the upright being secured to the cross piece, L, which rests upon the lathe-bed. The slotted pieces, M, are adjustable

* From the *Scientific American Supplement*.

wise to accommodate the size and position of shaft. When it is required to support a bar it is not round, the sleeve, N, shown in Fig. 1, is employed. It slips over the shaft and rests in the steady rest. The bar is centred by screws, O.

A device shown in Fig. 11 is used where a mandril lathe is not at hand. A piece of pipe, Q, is held by the chuck P, and is secured set screw in the sleeve B, which is journaled in standard S, and carries the chuck T. This arrangement may also be employed for the ends of long rods where it is not desirable to put them regularly on the centres of the

HOW TO MAKE A CAMERA-STAND.

An old camera-stand, which had served me faithfully for years, having finally broken, I determined to obtain a new one. I say "old," for on pricing them I found that I could get such a one as I wanted under about five or thirty shillings. Not being willing to send this sum without good reason, I resolved to make one, and I succeeded in doing this with a deal of labour, but at a total cost of a little half-a-crown. As I have used the stand for some time, and find it work exceedingly well, it possibly be useful to describe exactly how it made.

I begin, then, at the beginning. The wood best for the purpose is English ash; it is very heavy, is extremely tough, and, at the same time, tolerably easy to work, besides being not so liable to look at. Be sure that you get English ash, that is, not American—for though they differ little in appearance, American ash is little better than fir wood in the all-important condition of strength, and is much softer and easier to work than the English variety; for this reason it is very often used by carpenters instead, and is a very poor substitute. Obtain, if possible, a piece of wood from near the root of the tree, as it is, at least, generally, said to be the toughest.

The piece of wood I got was in the form of a plank about an inch and a quarter thick, and four feet long, and I ripped this up myself—a deal of labour very much lost, for had I taken it to a sawmill they would have cut it to a few minutes for little or no charge, whereas I had to do it with a hand-saw took several hours of hard work. The stand I made was about nine inches high; this is a little above the height of camera stands. Each leg was in three pieces: a lower thick one, whose dimensions were 1 in. by 1 in., and two upper thin pieces placed on the side of the lower one; their dimensions were 1 in. by 1 in. Having sawn these nine pieces of my plank, I planed them all carefully, then I made them more comfortable to hold in the hand, besides much improving appearance. Then both ends of all the thin pieces and one end of each thick piece had to be squared, and then came what I think was the most essential part of the whole process—that is, the ends of each piece with brass; it has to be so, or they would split away where the spikes triangle are inserted.

A considerable number of unsuccessful attempts I found that the following is the best to do this:—Take a piece of thin spring brass of the breadth of the end of the piece of wood to be bound—that is in this case half an inch small, and 1 in. for the large pieces, and four inches long. Drill a hole near each end of each piece of brass, then open the jaws of a vice and will just clear the wood without the brass; a brass across the opening of the jaws, and set the piece of wood down upon it until it is upon the wood, then bore holes through drilled in the brass, and screw it firmly on. This operation is performed successfully, it will be quite tight, and the wood will never come from the end. When this is done, you have three pieces ready to put together, which I did in the following manner, making each leg, as before said, of one thick and two thin pieces: bore a hole at one end of each piece, and another about three inches from the same end, then take some brass wire one eighth of an inch diameter, or more, and make of it three small bolts. This is easily done as follows: to make the head, a small square piece of brass (a blank washer square does very well), drill in that a hole in a piece of the thick wire will just fit tight; solder it in with a spirit-lamp or Bunsen burner; solder is good the head will never come off; crew about half-an-inch of the bolt at the end, and make a nut in the same way as you the head, but screwing it, of course, instead of dering it on. Then, to build up the legs, bore two thin pieces and one thick one, place so that the holes at the ends of the thin

pieces are opposite the hole in the thick piece, put the bolt through, and screw it up; then you have the leg in a state in which it will fold upon the slightest provocation; to prevent which another pin is put through the other set of holes, which are at the end of the thick piece, and eight inches from the ends of the thin pieces; this one may be a simple pin of thick wire; a bolt would be unnecessary.

When the three legs are built up in this way, all that is needed to complete the stand is the triangle at the top. This is best made of brass, but that is both troublesome and rather expensive, as it is necessary first to make a pattern of wood, which is a difficult bit of joiner's work, and then send it to a brassfounder, and have it cast in brass. Accordingly, I made the triangle for my stand of wood, and it does very well. The wood I used was birch one inch thick, and the method of making it was thus. First make an equilateral triangle of about nine inches in the side, then cut off about two inches of each angle, and cut out the sides of the triangle in the form of the arc of a circle. The effect of this is to have what we might call three ends, to which it is easy to fix the camera legs. Bore a hole through each of these in such a way that when the triangle is laid flat the holes may be horizontal; through each hole drive a thick wire, leaving about half-an-inch projecting at each end. In order to fix the legs to this triangle, bore holes in the free ends of the two thin pieces, and fit them on to the projecting bits of wire above mentioned; then the two pieces of the leg must be pulled together a little below the triangle, and fixed there. The simplest way to do this is by means of a small hook and eye, or, instead of the hook, a screw nail, with the head projecting a little does quite well.

Now we have the stand complete, except for the points of the legs, which must be made by a blacksmith, in the form of cones of sheet-iron to be screwed on to the legs. I have myself made such a cone of sheet-brass; but it was difficult, and not so good as a smith will make of iron for a very small charge. In speaking of the binding of the ends of the legs with brass, I recommended the use of spring brass, because for the same thickness it is much harder and stronger than common brass. The wire that is used should be of the same material. If a stand is made carefully, and following the above instructions, it should last quite as well as the best professional-made stands, and should bear a weight of more than 100 pounds. I can sit on the one I made myself, without its yielding perceptibly.

THE GREAT BELL FOR ST. PAUL'S.

THE following particulars of the great bell for St. Paul's have been forwarded by a well-known correspondent, Mr. W. S. Franks, of Leicester, who has had an opportunity of personally inspecting what is, we believe, the largest bell ever cast in England. It is standing mouth upwards at the foundry of Messrs. Taylor, Loughborough, and struck as it stands, the deep boom is almost too deafening for the ear in such close proximity. The weight of the bell is 17½ tons; its diameter at the mouth 9 ft. 6 in., and thickness at soundbow 8½ in. The bell itself exceeds 7 ft. in height, but from the lip to the top of the cannons it measures 8 ft. 10 in. Our correspondent says that the note is E flat. At present the bell is struck by means of an iron ball weighing 600 lb., which is slung by a chain to an overhead girder. When the question for a big bell for St. Paul's was first mooted there were objections. It was said that the Chapter had got a bell of four or five tons weight which they scarcely ever rang, and what did they want with more? It was urged that the tower which was destined for the bell would certainly come down; that the neighbouring men of business would be disturbed in their operations; that nobody in England could cast a big bell. This last allegation has been satisfactorily set at rest. A bell weighing some seventeen tons and a half—that is four tons heavier than the great bell at Westminster—has actually been cast in a satisfactory manner by a Leicestershire firm. There is an idea in England that all big bells are necessarily named Tom. Peter, of York, and Harry of Canterbury suffice to counterbalance the Toms of Oxford and of Lincoln. Tom or no Tom, however, the big bell of London outweighs its rivals both of Lincoln and Oxford by many a ton. It is, indeed, insignificant beside the vast and partly-ruined monsters of Moscow, but with the great bells of Western Europe it can vie very fairly. Moreover, it is said to be excellent not only in size but in quality, which may be frankly admitted to be the more important excellence of the two. Sir E. Beckett, calculating the weight of the great Russian bells by their dimensions, makes the great bell of Moscow 220 tons in weight, and another 110 tons, but practically these are bells only in name. The great bells of Western Europe, those of Rouen (destroyed), Olmutz, and Vienna alone exceed the weight of the new bell, and that only by a few

hundredweight, but the most famous bell—that of Erfurt—weighs much less (13 tons 15 cwt.). Mr. Froude has somewhere called bells a special and characteristic creation of the Middle Ages. They are, no doubt, specially characteristic of that side of the Middle Ages which, if not the most historically true, is the most poetically impressive—its mystical and romantic side. The conclusion that they are out of place in a modern town is a hasty and an unphilosophical one. Except in a very confined space, and at too low a level, bells are by no means intrusive. When Big Ben was hung the same prophecies of evil were made, and with all his drawbacks, exaggerated as they have been, Ben has been long accepted as a rather pleasant ingredient of the *streptitus* of our modern Rome, than which the old one could hardly have been more noisy, as it probably was not wealthier, and certainly not half so smoky. A rival at the other end of the Embankment will be far enough off to enter into no indecent competition, and the greater size of the new bell will enable it to master the louder roar of the neighbouring streets, though wood and asphalt have come to its assistance beforehand in that matter. Only it is to be hoped that the tower will be well looked to before the bell is hung. Report has it that the Midland Railway is shy of a passenger some eighteen tons in weight, and some 9 ft. high by 10 ft. broad, and that the bell will have to be brought by road, meeting, let us hope, with no opposition from alarmed highway boards, and not crushing in more culverts, cellars, and other traps of their kind than is reasonable.

SCIENTIFIC NEWS.

BY the death of John William Draper the United States has lost an immigrant who was an honour to his adopted country. Prof. Draper was born at St. Helen's, in May, 1811, and after studying chemistry, physics, and mathematics, he emigrated to the States in 1833, without taking his degree at the University of London. Three years later he graduated M.D. of the University of Pennsylvania, and almost immediately after was appointed Professor of Chemistry at a college in Virginia, whence he removed in 1839 to take a similar post in the University of New York. Since 1868 Dr. Draper had retired from active duty as professor, but his pen continued almost as busy as in earlier years. Between 1834 and 1874 he published no fewer than fifty memoirs of scientific value, and since the latter date others have been collected and published. In 1876 he was awarded the Rumford Medal of the American Academy of Sciences. Dr. Draper is, perhaps, most widely known by his "Intellectual Development of Europe," an abstract of which work he read at the Oxford meeting of the British Association in 1860. Dr. Draper died in his 71st year.

In connection with a course of Cantor Lectures which Captain Abney, F.R.S., will deliver before the Society of Arts on Jan. 30th, Feb. 6th, 13th, and 20th, it is intended to hold an exhibition of photographic appliances, which will be kept open until the end of February. Intending exhibitors should apply to Mr. H. T. Wood, the secretary of the Society, for particulars.

Amongst the candidates for the chair of Natural History at Edinburgh University, vacated by Sir C. Wyville Thomson, are Prof. E. Ray Lankester, Prof. John Young, and Mr. Patrick Geddes, now lecturer in zoology, and demonstrator of botany at Edinburgh. The appointment rests with the Home Secretary and the endowment from the Parliamentary grant is £160 a year. The income from fees, however, is very large, amounting to some thousands of pounds.

It is stated by one of the "London correspondents" that a "chronological reform" is being discussed by the leading European astronomers, i.e., the introduction of Greenwich time as a uniform standard for all nations. The proposal has, we are told, met with a great deal of favour in Germany and Russia, and also on the other side of the Atlantic. For astronomical and maritime purposes, it would doubtless be an advantage to refer always to G. M. T., and that we suspect is all that will be attempted.

The British Museum meteorites have been arranged in the mineralogical gallery of the new Natural History Museum in Cromwell-road, and Mr. Fletcher, the keeper of the minerals, has prepared a "guide," which contains an excellent introductory essay, and which the Trustees have issued at the price of—one penny.

Dr. Gladstone and Mr. Tribe have been making a number of experiments with Planté and Faure accumulators, and have made the results known under the name of "local action" as is concerned. They state that the following conclusions are warranted: In the Planté or Faure battery, local action necessarily takes place on the negative plate, with the production of sulphate of lead. The production of this sulphate of lead is absolutely requisite in order that the charge should be retained for a sufficient time to be practically available. The investigators found that during the long periods of repose recommended by Planté, the peroxide on the lead plate is wholly or almost wholly destroyed by local action with the formation of a proportionate amount of sulphate of lead. This action is rather a gain than a loss, for in the next stage the sulphate is reduced by electrolytic hydrogen, and the amount of finely divided lead capable of being peroxidised is increased. These researches have an important bearing on the future of the "accumulator."

M. Reysier has made some improvements in the Faure secondary battery, which, though in matters of detail, are important. He found that the felt coverings of the plates became rotten very soon, and has substituted a kind of serge which, after several months' trial, he finds excellent for durability. He also inserts the plates in glass jars, so as to observe whether gases are given off without disturbing the contents. If contacts are set up between the plates, they cause local currents, and the action of the cell deteriorates rapidly. Gas is given off when contacts exist, and also when the cell is fully charged.

The Liverpool Association of Science and Arts had a "musical evening" on the 5th inst. in the saloon of the Philharmonic Hall. The hon. sec., Mr. W. J. Le Couteur, said that by the end of 1882 the Association hoped to have a building of their own and a Students' Club. The programme for the evening included a selection of high-class music, Mr. W. H. Davies, jun., being the accompanist.

The Council of the Meteorological Society, having determined upon holding an Exhibition of Anemometers at the Institution of Civil Engineers, 25, Great George-street, on the evening of March 15th next, the Committee are anxious to obtain as large a collection as possible of various patterns of Anemometers, either full size, models, photographs, or drawings. Special interest will attach to all apparatus bearing upon the history of anemometers and to their modification and improvement. The Committee will also be glad to show any new meteorological apparatus invented and first constructed since the last exhibition.

There seems to be some reason to think that the missing boat from the *Joannette* has been wrecked upon Heron Island. M. Sulkowsky reports that while at Providence Bay an American schooner was lying on board the master of a small boat named. The master said that he had seen the boat and men on board at Heron Island and ranges the effects were "the property of the vessel *Joannette*." The captain of the schooner accordingly left to look for the boat and if possible and necessary, save the crew. A pack of dogs he proposed to use in dragging for the missing schooner.

For the interest we have received the
 presentation of the Rev. J. G. Wood's
 "Theology of the Bible," published in the
 "Theological Review," 1882.

22. The Director, F.R.A.S., has compiled a list of the names of the river Thames, and its tributaries, and the offences by red ink. The list is printed on paper, and the danger or modify the list is indicated by notes on prevailing conditions. The list is printed in red, and the names are printed on card and various other materials. The list is by Mr. Taylor and Mr. Taylor.

It is not for me to pretend to propose a solution, but I should be surprised to see the Government's bill of electronic defence for the country brought before Parliament without the necessary checks and balances.

... of aid,

offered a premium of £500 for the best system of electric lighting for mines.

A Continental observer, M. de Mercjowsky, has lately studied the question whether the lower crustaceans distinguish colours? He experimented chiefly with larvae of Balanus, a cirripede crustacean, also some marine copepoda. The little creatures, inclosed in a vessel, seemed fully alive to the difference between light of any kind and darkness; for whereas, in the dark, they were scattered throughout the vessel, they always gathered about a ray of any light coming from a slit. M. de Mercjowsky considers, however, that it is exclusively the *quantity* of light, not the *quality*, that affects them. Using two slits, one to admit white light, the other coloured, he found that the crustaceans preferred the former light—all gathering round it if the coloured light was deep red or violet, and most of them if the colour was bright red, yellow, or green. They always preferred a bright light like yellow to a sombre one like violet. When two rays of equal intensity were admitted the crustaceans gathered in nearly equal numbers about them, whatever the nature of the colours. There is, then, according to this author, a great difference in the mode of perception of light, between the lower crustaceans and man, and even between them and ants. While we see different colours and their different intensities, the crustaceans see only one colour with different variations of intensity. We perceive colours as colours: they only perceive them as light.

Electricity is now used in mining operations in the Loire valley for transmission of force. At the works of the Compagnie de la Ferronière, two connected Gramme machines are employed to work a drum which stands at the head of an inclined plane 110 metres long, and having a gradient of 0.10 cm. per metre. The generator is 1,200 metres from the drum, and above ground. The load raised is about 800 kilogrammes, and the ascent is accomplished in a minute and a half. The work goes on with great regularity. The starting and stopping can be done as gently as desired. By means of a galvanoscope in the circuit, one can tell at any moment what is being done at the incline, whether the work is stopped, whether the waggons are coming up filled, or not, &c.

Cincinnati has recently taken vigorous action with regard to the smoke nuisance. After a given period (at present unknown to us), the defilement of the air by coal-smoke from any locomotive, boiler furnace, or other source will be treated as a misdemeanor with appropriate penalties. The manufacturers, who naturally think themselves aggrieved, argue that no smoke-consumer at present in use is perfectly adapted to their wants, but it is rightly pointed out that the demand for improvement, once created, will soon be answered, and that the long years of "darkness and dirt" which the people of Cincinnati have endured, may properly be weighed against the temporary inconvenience of a few individuals.

An able engineer of the Parisian Gas Company has been studying the employment of coke in furnaces of manufactories, and is said to have arrived at very satisfactory results. At the chemical work of the Rue Curial, coke is used almost exclusively for heating boilers giving a force of three hundred horse-power, and the expense is not more than with ordinary coal.

Lichens are now recognised to be complex organisms; according to the theory of Schwendener, that they consist of an alga, and a fungus which is parasitic on it. It seems extraordinary that the alga, thus embraced by a parasite, not only continues to live, but increases and multiplies, and is apparently endowed with new vigour. The same alga, alone, becomes discoloured and disappears on the return of the dry season; but in the lichen state it often persists for years. It has been said by M. Rees, that there are no other such cases known of vegetative activity, that is, being prolonged under the influence of a parasite; but M. Cornu has lately called attention to several. Thus, maples are often attacked, late in summer, by an *Erysiphe* which occupies the under surface of the leaves. The parts thus occupied remain green when the rest of the leaf has withered, and even after the leaf has fallen. Similarly with a parasite which attacks leaves and fruits of pears, apples, &c.; indeed, the fact is very general; the chlorophyll

cells attacked retain their green and their vital activity longer than the others. The phenomenon is explained by the fungus counterbalancing the return of nutritive matters towards the reserve-centres. Green algae have a vegetative period, during which they retain in this colour very intense, then they grow yellow and form durable spores, after which the vegetative period dies. In lichens the fungus prevents this development of spores, and so favours the life of the alga. Flowering annuals similarly may be preserved many years by prevention of flowering.

For automatic announcement of fire in theatres, Prof. Obnieri proposes to stretch hemp threads over the whole of the upper stage-space, parallel to the soffits, these threads being fixed at one end, while the other passes over a roller to an attached weight within a case. On the bottom of the case is the knob of an electric contact, which is pressed by the falling weight whenever the thread is ruptured by flame. By simple arrangements, this is made to have the following effects: (1) telegraphic announcement of fire; (2) descent of the fireproof curtain (the current affecting an electromagnet connected with it) (3) opening of a large aperture in the stage roof by an electromagnet, to let out flame and smoke, and (4) admission of water to the stage from a cistern.

In an arrangement of telephone call in which a bell is dispensed with, Herr Schubert, of Breslau furnishes the inductor employed for the microphone with an interrupter, by which, on pressure of a contact, the current of the microphone-battery is sent by a second path, and produces alternating currents which give a loud sound in the telephone of the further station. Even with great distances it is not necessary on this system, to increase the battery power according to the resistance of the line. The method is described in a recent number of *Dingler's Polytechnisches Journal*.

A recent Berlin police order specifies the colouring matters which may, and those which may not be used in production of toys and articles of food. (The list appears in *Deut. Ind. Zeit.*, No. 51.) A Saxon paper says, that a thorough treatment of the question for the whole German empire is very desirable. At present colour is pronounced injurious in one place, and permitted in another. Thus the Berlin order forbids cochineal red, whereas one of the classes of this colour distinguished in Saxony is there pronounced harmless. In Berlin all blue and slip colours, that contain no arsenic, may be used to colour articles of food. These colours, however, are often prepared with the aid of salts of tin, and this is not a matter of indifference, at least as regards children. The ear-colours further require attention in a review of the subject. In the present state of things, the approval of toys coloured with fuchsine containing no arsenic (0.1 gr. used for 29 or more articles), is inadmissible, since, with aniline red with arsenic is forbidden, aniline red without arsenic is not placed among the harmless colours: aniline yellow is forbidden, aniline green conditionally allowed, aniline blue not mentioned. And the resin colours, now so commonly recommended as harmless, are not mentioned.

From a measurement of lung-capacity in 588 boys and 314 girls of schools in St. Petersburg, Dr. Nagorsky concludes as follows:—The capacity of the lungs, relatively to the weight of the body, is about 65 cubic centimetres for each kilogramme of the weight in boys, and 57 cubic centimetres in girls. It is proportional to $\frac{1}{2}$ of the height in boys, and to the square of the height in girls. The ratio between weight and lung-capacity in man is nearly constant: the variations are due mainly to the variable quantity of fat contained in the body.

A Leipzig firm have lately provided an arrangement which would often be found welcome, especially in large cities. This is a small room with (two) desks, into which anyone may go, and for a trifling charge be supplied with materials for writing a letter, with envelopes, wrappers, &c., as required.

EXHAUST steam should not be discharged into brick chimney: the steam will disintegrate the mortar, and the chimney be injured.

LETTERS TO THE EDITOR.

do not hold ourselves responsible for the opinions of correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.

communications should be addressed to the Editor of the ENGLISH MECHANIC, 21, Tavistock-street, Covent-garden,

Cheques and Post-office Orders to be made Payable to

MORRE EDWARDS.

In order to facilitate reference, Correspondents, when using of any Letter previously inserted, will oblige by giving the number of the Letter, as well as the page on which it appears.

would have everyone write what he knows, and as he knows, but no more; and that not in this but in all other subjects: For such a person may have some particular knowledge and experience of the things, knows no more than what everybody does, to keep a clutter with this little pittance of his undertakes to write the whole body of physics: a view whence great inconveniences derive their original." *signed's Essays.*

PHETTS WITHOUT HONOUR—AUTOMATIC RECORD OF TRANSITS BY ELECTRICITY OR PHOTOGRAPHY—THE FIGURE OF AN OBJECT-GLASS REFRACTION—THE LATE DR. J. W. SAPER—MERSENIUS.

[1907.]—THE advent of the year 1882, unaccompanied by signs and wonders of any sort or degree, may possibly serve to undeceive a few (or a very few) of the Conjunction of the Planets, Great Pyramid, and Mother Ship-folk, who so strenuously insisted that the world must, might, could, would, and should to an end in 1881. Possibly the return of a more New Year's Days may even dimly see some of them with the truth of a dictum of George Airy's, which I once heard him say that "the world will last for our time."

I reply to the question with which "Orderic" concludes letter 19566 (p. 404) by saying in the existing state of our knowledge of electricity and photography, I do not think either could be advantageously employed in automatic registration of Star Transits. His, however, has led me thinking over the subject and it seems to me that if Transits are ever recorded electrically, selenium—if it be (of which I am ignorant)—would be the material of which to construct the wires; as the light of the star upon each as its image crossed it would slightly its conductivity. And, as a photographic record of recording transits, might not a series of silvered flues, clear blues be ruled upon a blackened plate, immediately beneath a chronographic cylinder, covered by some very sensitive material, was rotated at the rate? In this case, as the starlight flashed simultaneously through the line, it would impress upon the sensitive film beneath, and, as the ordinary chronographic apparatus, the time might be read off to .01—or even .001 id.

to a certain extent illustrating a statement by Mr. Wassell in letter 19568 (p. 404), it be worth while to mention that I was told by the well-known astronomer (since dead) how Mr. Langham's 20in. object-glass was brought to comparative degree of excellence which it ultimately attained. It was simply by ascertaining a system of diaphragms and patches what parts of the glass produced faulty results; and then re-working those parts only. As was done (so my informant assured me) in the parts of the objective, it is pretty obvious the production "of a true spherical surface certainty" had exceedingly little to do with ultimate performance of the instrument of which I am speaking.

"Gimel" (query 45657, p. 412) will turn back a volume and page from which he does me the honour to quote, he will find that I was speaking of effect of refraction in altering the apparent position of a star (as shown by the circles of a telescope) when that star is at some distance from Meridian. "Gimel" is surely aware that the circle described by a star is inclined to the meridian, while refraction seemingly raises a body vertically to it. Hence, the effect of refraction on a star, either East or West of the Meridian, shift it obliquely, both to its proper hour-angle and parallel of Declination. Five minutes' of a Celestial Globe, with its North Pole tilted, say, 51° 30' above the wooden horizon, make all this clear. On the Meridian though the effect of refraction is to elevate the star, in no way whatever to affect its seeming ascension. If "Gimel's" transit (the axis properly levelled) does not then give the clock error, from two rapidly following stars, near the zenith and the other close to the

horizon, it is because it is not in the Meridian; and he must shift it by the proper azimuth screw until all stars—high, low, and circumpolar alike—give the same error. Moreover, refraction has nothing to do with the equation of time, although longitude has. Inasmuch, though, as on the day when these lines will appear the difference in the equation for a whole hour of longitude is only 0.930 second, or, in other words, the equation at the Land's End on that day would exceed that at Greenwich by about 0.358 second; this, like "the weight of the Elephant," in the celebrated problem—"may safely be neglected."

Students of Physical Science, on both sides of the Atlantic, will mourn the loss of that most earnest worker and original investigator, Dr. J. W. Draper. By the ordinary English reader Professor Draper will perhaps be best remembered as the author of that able "History of the Conflict between Religion and Science," which has run through such very numerous editions in the "International Scientific Series." It is, however, from his "Scientific Memoirs," published some three years ago in New York, that the best idea will be gained of the real originality and excellence of his researches, many alleged recent "discoveries" having been anticipated by him years ago. I remember at the time when the alleged "transmutation of metals" was being most impudently puffed and advertised in every London newspaper that could be got at, inviting attention in these columns to the fact, that in November, 1857, a paper by Dr. Draper appeared in the *Philosophical Magazine*, describing the method by which he succeeded in converting silver into a substance which reflected yellow light and refused to dissolve in nitric acid; and this afforded only a single illustration of his anticipation of "discoveries" of which I have just previously spoken.

If the weather which "Aconite" (query 45683, p. 431) has enjoyed has borne any resemblance to that which has prevailed in the locality whence I write, he will not wonder at the non-redemption of my promise to look at Merseus. Armed with the information supplied by his last query, though, I will attack this object on the first available opportunity.

A Fellow of the Royal Astronomical Society.

ANGLE OF FLAT, &c.

[19608.]—I AM obliged by reply of "Mimas," which will also be interesting to other observers. Cloud and fog seem to be more favourable than would be supposed, to good definition, the radiation being comparatively small.

The angle of the flat comes, I think, under the same category as the ellipse. Theoretically, it is not necessary to be at 45°, but, practically and mechanically, it is best to have the eyepiece as nearly at a right angle with the large tube as may be, and it is always made so for that reason.

It will be seen that a reflection is quite as perfect at one angle as at another, all that is necessary is that the conditions of incidence and reflection are preserved.

"Mimas" finds that a certain angle is necessary to good definition; this is the angle which reflects the axis of the cone along the axis of the eye-tube, or the point of the cone to his eye, and this being fixed, the same angle will always be required; it is probably very nearly a right angle, but its being absolutely so is not important.

I simply alluded to this in my last, as some observers give themselves great trouble to ascertain if it is a right angle, thinking this is necessary to good definition, whereas the only really important point is that the axes of the reflected cone and eyetube should be perfectly coincident.

An ellipse cut at 45° will, when seen at 45°, be a perfect circle, and this is the only test whether the eye-tube is 90° with the large tube.

When testing whether the two axes are coincident, it is desirable to make the flat perfectly concentric with the mirror, say, at focus of 200, and then if it is equally so with the eye draw-tube pushed right in, and also pulled out to lowest power, it may be considered correct, unless Mr. Skelton's plan of the pinholes be adopted, which is more accurate still.

If they are not coincident—that is, not concentric at the different focuses—the eye-tube must be altered to make them so, the flat being meantime kept concentric with the mirror.

Fordingbridge.

T. Westlake.

TELESCOPE MATTERS.

[19609.]—I HAVE to thank Mr. Wassell for his reply, and hope that when his present course of instruction is finished he may have something to say on object-glasses. If the working of specula can be made more a science than an art, cannot the same be done in the case of the o.g.? It is never likely that an 8in. glass can be made for £20, seeing that the rough discs would cost more than that; but ten times that amount seems an extravagant price, being about £40 for each surface.

A good mirror of equal aperture ought to be obtainable for £10, and each of the four objective surfaces should not cost more to figure than the face of a speculum.

But in these pages we are not concerned with prices. If an amateur finds his efforts successful, he does not take into account the time and labour spent on the work; and the same industry, patience, and mechanical aptitude which can produce a speculum, ought, if rightly directed, to produce a good object-glass.

With regard to the mathematics of the subject, I have endeavoured to explain the published methods of computing the curves. If an amateur does not know and cannot obtain from a practical man what are the necessary radii, his only resource is to compute them himself by any of the recognised methods. He cannot work on the principle of the "survival of the fittest." For moderate apertures, spherical curves ought to give satisfaction, but with large glasses, they doubtless have to be altered.

We are not concerned with the question whether or not it is cheaper for the amateur to make than to buy. The correction of an objective for chromatic and spherical aberration is a scientific problem which is well worthy of lengthened attentions. In this matter I am of the same opinion as Mr. Wassell with regard to mirror working, viz., that a certain system must be followed to produce the best results. It is generally assumed that many pairs of curves can be free from spherical error, but I fancy that the best correction for both chromatic and spherical errors can only be attained by a very limited number of combinations of spherical curves.

With regard to Mr. Wassell's suggestion, I will reply to it privately. Orderic Vital.

THE TRAPEZIUM OF ϵ ORIONIS.

[19610.]—THE existence of certain minute stars other than the well-known fifth or sixth in the Trapezium of ϵ Orionis is still a vexed question. It seems difficult to deny that these minute objects have been independently detected by several observers; but it is equally difficult to understand why, if they really exist, they should have been so persistently invisible of late years in powerful telescopes. As some of your readers may be inclined to search during the present apparition of Orion for these faint points, I give a chart of the Trapezium, showing the position of all that have been seen by two persons at least. The six well-known stars are lettered according to Σ 's nomenclature, E being the fifth star, discovered by Σ , and F the sixth, discovered by Sir J. Herschel at Kensington. Some interesting notes on these objects will be found on pp. 18 and 19 of the "Corrections, &c." to the "Handbook of Double Stars." OZ remarks of the magnitudes of E and F, "La grandeur assignée par mon père à E en moyenne de plusieurs estimations faites à Dorpat, est aujourd'hui beaucoup trop faible; selon moi tant E que F pourrait prétendre à la grandeur 10.0 de l'échelle de mon père." This has certainly been the case, at least as far as my observations go, during the last ten years. I have numbered the other objects from 1 to 7, in order of AR for convenience of reference. For obvious reasons there is a slight uncertainty in the exact position of two or three of them, but considering the rudeness of some of the diagrams the discrepancies are very small. The following brief notes on these objects may be of interest.

No. 1 was first seen by Gruithuisen in 1823, with a 4.4in. refractor, of 5ft. focus, power 80; then by Schwabe, on March 13th, 1830, with a refractor of 6ft. focus and a power of 324. This object has not, as far as I know, been noticed since. (Gruithuisen, *Astr. Jahrb.*, 1841, and *Neue Anal.*)

No. 2. This star appears to have been detected by the late Mr. Salter and another, with a 12in. reflector by Bird, on Dec. 9th, 1869, and January 25th, 1870. Nos. 3, 4, and 6 also appear to have been seen on these two occasions, and on January 29th, 1870. It is not stated whether the observers had any knowledge of prior observations. (Denning, *ENGLISH MECHANIC*, January 13, 1871, and *Observatory*, No. 35.)

No. 3. In 1857 M. A. d'Abbadie announced the discovery by M. Porro (a Parisian optician) of a new star (No. 3) in the Trapezium. He first saw it with the aid of a refractor of his own construction of 20in. aperture, and 49ft. focus, power 1200. It was certainly fainter than 6 and 7, which M. Porro says he also saw. He saw it on another occasion with a 9in. refractor of 14ft. focus, power 600, and on March 16th, 1857, he, and another person unaccustomed to observing, again perceived it with the large telescope. (*Monthly Not.* XVII., 245.) The author of the diagram shows a star in about the position of No. 5, which is called Sir J. Herschel's and South's star; but if so it is enormously misplaced. Porro's star is also said by M. d'Abbadie to have been seen by Secchi at Rome on Feb. 10, 1857, but I can find no authority for his assertion, or for his diagram and remarks on p. 266 of the same

suppose, has an annular ring of no cut in broad, running midway between its centre and its circumference; in fact, we may suppose this ring turned clean out. It is represented in the figure by the shaded ring, E F H G. The straight stroke is, say, one-third the diameter of the speculum; now the whole of the motion of the centre-line of this ring of no cut will be represented by the double-headed arrows; the speculum, of course, moves round on its own axis all the while. Now, it is evident that the centre line of the zone of no cut on the face of the polisher, on its right and left part represented in its motion by the arrows G H and E F, keeps almost entirely on a corresponding zone on the face of the speculum during the whole of the stroke, represented by the arrows G H and E F, which are seen to be almost entirely included in the shaded zone; the consequence is that this corresponding zone on the face of the speculum is, during about two-fifths of its revolution, from G to H, and from F to E, receiving little or no cut, and is therefore left above the general level, and so a ring mound is formed corresponding to the ring of no cut on the face of the polisher. Now let us trace the effect represented by the arrows towards the centre line A C, and we at once perceive that the ring of no cut has its effect distributed over a larger area or zone on the face of the speculum, and does not always keep on the shaded zone, and would be, therefore, less effective in leaving the surface of the speculum raised; but it would, nevertheless, extend its influence as far as the arrows extend, which, as the speculum revolved, would take in a circle having a diameter I J. This influence would rapidly decrease from G H and E F, for it will be observed that the second arrow is only about three-fourths of its time on the shaded ring, while the third arrow is only about one-third its time on the shaded ring, while with the other arrows there is not so rapid a decrease of their stay on the shaded ring; thus the mound formed on the face of the speculum would rapidly descend from G H, then linger, and gradually die out at a diameter equal to I J. This is represented in Fig. 2, which is a section of the speculum produced; where the resultant mound is represented by the dark elevation on the face of the speculum, the influence would extend inwards as far as the small circle round the centre of Fig. 1. The amateur should thoroughly master this, for it will then teach him the all-importance of keeping the face of his polisher with an equal amount of cut over all its area. I do not wish to make my letter too long; but I do not think it is a waste of time to impress again and again on his mind these important points. Of course the above example is an exaggerated one; but most amateurs get their polisher into zones of unequal cut: rings are the consequence, and they do not know why: they think there is some mystery about the production of these rings that it is impossible for them, or anyone else, to understand. I hope in my future letters to explain several other causes of rings; and when we understand the cause, the remedy readily suggests itself, and a great deal of annoyance is avoided, and the work becomes pleasant because certain. Amateurs are apt now, if they get rings, to put more or less side motion on, "to run them off," as they say, when they only spread them over a larger area, and thus make them less visible to their comparatively rough mode of testing for them. The definition is not good, and they cannot tell why. Now, there is no need for rings at all to be formed, to have to be run off. The proper way to cure a disease is not to spread it over a larger area of the body in a diluted form, but to remove its local cause. Now, let us see if the application of the side motion will remove the mound we have got on our supposed speculum, or only spread it over a larger area in a diluted form. I will not trouble the Editor to make another drawing, but will try to explain the effect of the side motion from Fig. 1. Let the amateur conceive the arrow G H which represents the whole motion of that part of the ring of no cut, in the position where it has the greatest effect in the production of a corresponding ring-mound on the speculum, to be carried outward by the side motion as far as P. Now, it is evident that here it would still have the same effect in producing a ring, but only a little larger one as the speculum turned round; now, as the arrow would not be allowed to stay long in this position, its effect would not accumulate, and therefore would not be so great as if allowed to remain; it would be carried back to G H, and from thence to a corresponding distance on the other side, say, as far as the third arrow, where its effect to produce a ring-mound would not be lessened by being moved about, but only not being allowed to stay long there it would correspondingly lessen its effect on this particular part, but never lessen its detrimental effect for one moment, and so we see that the whole effect of this part of the ring of no cut is only distributed over a larger zone; the effect would be that the ring-mound would not be so high in any particular part, but it would be much broader, and so a larger area of the speculum would be detri-

mentally affected, and what definition would be gained in decreasing height of ring-mound would be lost in having a larger area of bad figure; the alteration thus produced on the face of the speculum is shown in Fig. 3. I have been forced, after long experience and deep thought on the subject, to the conclusion that the side motion is no help to us at all. I know some amateurs think they get rid of the rings by putting on the side motion, but the reason is their means of testing are not delicate enough, or they are not thoroughly versed in the indications of the testings, and, therefore, the lowered but extended mound escapes their notice. The ring is, I grant, much less distinct, but it can be seen to be spread over a larger area, and thus the side motion becomes a delusion and a snare—a delusion because the enemy is not so visible to the defective sentinels, and therefore thought to have been driven away; but he is only hiding by lying stretched on the ground, and taking aim there, instead of standing upright to do his work; a snare because it diverts the attention from the real cause, and therefore from its real cure, which would be the removal of the cause, to the spreading of the ill effects of the concentrated ring over a larger area, only to form a broader ring. I would rather have my enemy in the open field, if I really wanted to subdue him, than hiding among the grass, although to just keep him invisible to the outer world, by just keeping him at bay in his hiding-places, may be far less trouble than extirpating him.

I will now give a couple of examples of actual experiments—one as to the effect of the side motion on rings, the other the effect of moving the speculum on one side, so that the centre of the polisher always passes on one side of the centre of the speculum. Fig. 4 represents a section of a speculum produced without side motion, by the polisher in a certain condition, which condition I shall have to refer to and explain hereafter. I put the side-motion on so as to carry the mound B into the valley B C, and the valley B C over the mounds B and C, and so, of course, to the same effect on the other side, with the valley C D, and the mounds C and D. Now the effect was that the mounds and valleys were obliterated, but a ringy waviness, if I may be allowed so to describe it, occupied their place, showing that there was a struggle who should leave his mark behind him, as it were, going on between the causes of mound and valley acting alternately over the same area, and where one could leave his mark he would, thus causing the ringy waviness I saw as the result of putting on the side motion. I have thus often been driven to the conclusion that the side motion is not the way to get peace in the land of speculum, as it only puts one bad effect in one way to correct another equally bad effect in the opposite direction, but that the proper way to secure peace was to remove the contending parties altogether; then the land would be naturally at peace, and no inequality of surface possible. Now let us see what the effect of the amount of side-motion I had to put on to obliterate as well as I could the mounds and valley in the centre, was upon the valleys A B and D E, and the mounds A and E. Now it will be observed that these mounds are farther from B and D than B C, and D are from one another, and therefore the amount of side-motion that would carry B into the centre of the valley B C, would not carry A into the centre of the valley A B, and that A and E had only half a valley to contend with on their outside. The consequence was that A and E could be only broadened out on their outside, and only partly lowered on their inside to the general level; the fact is it required more side motion to obliterate the valley A B and D E, than for the valleys B C and D E, because the former were wider; the result was that the testings showed that A and E still remained—lowered it is true, but broadened out, thus disputing like an obstinate foe as long as you have him on your territory every inch of the ground. This is seen in Fig. 5. Now I have no doubt that some amateurs would not have seen the remains of the mounds and valleys in the ringy waviness of the centre, nor the remains of the mounds A and E in the slight but broad ring that delicate and careful testings showed; but it forcibly impressed on my mind this truth, that the proper way to cure the disease was not the side motion, by which the tendency to create a mound was corrected by putting the tendency to create a valley over it and vice versa, and this action was most incomplete where the valleys were different widths, for what is partly effective in one case is not enough where the mounds and valleys are farther apart. Now, the proper remedy is evidently constitutional and not surgical. We want to alter the conditions so that no tendency to unequal cut is found anywhere on the face of the polisher; then, of course, no rings will be produced, and there will be no need of the side motion. The second example I shall give will illustrate the effect of using all side motion—i.e., the moving of that part of the machine that holds the speculum, and on which it revolves, on one side so that the centre of the

polisher will always pass on one side of the centre of the speculum; the side motion eccentric being fixed, the same effect would be produced by the side-motion eccentric being fixed on one side. The former was simply the easiest to do with my form of machine. Fig. 6 represents the section of a speculum produced by a polisher that had the same cause of rings acting in its centre, as that which produced Fig. 4, only the cause of the ring mound A E was removed, the result being Fig. 6; now I placed the speculum axis on which it revolved on one side, so that the centre of the valley B C should come under the centre of the polisher in its stroke, which centre of the polisher was producing the mound C—i.e., I moved the speculum on one side to the amount of half the distance B C, thus throwing the mounds B, C and D, disappeared, and a ringy waviness took their place, like as in the centre of Fig. 5, which I was not satisfied with, and the result was that after scores of experiments, the examples I now give being only types, I had to direct my attention to the primary cause of these rings, and invent a remedy which enabled me to give up the side motion altogether as unnecessary. Most amateurs think that the side motion must be some good, and I was reluctant at one time to give it up, until, by practical consideration and theoretical, I am now fully convinced that it is no use whatever, but rather a snare. I never use it now, and am never troubled with rings except by accident, and then I at once know the cause, and therefore the proper remedy. I have the most perfect control over the figure, and it never takes me longer to figure than the time I am polishing the emery-marks out.

I have up to this point been rather theoretical; I propose in my next letter to be a little more practical, and treat of the cause of the above rings, and how to avoid them in the true way—that is, by removing their cause. It must be observed that the rings in the above examples were produced by one only of five causes of rings that I have discovered, each of which I hope to take up separately and treat of.

H. A. Wassell.

Addenbrook Villa, Stourbridge.

IMPURE MANGANESE AND THE DANGERS OF OXYHYDROGEN GAS.

[19613.]—In reply to Mr. Geo. G. Blackwell, and to your excellent extract from the *Journal of Photography*, I do not believe that manganese is ever intentionally adulterated with coal, soot, charcoal, or other hydrocarbons; nevertheless, I know that such are occasionally found in it. Some years ago a man, making oxygen for a theatre, was killed. The manganese which he used was found to contain pulverised coal. The chemist who sold it was most anxious to discover the cause, and no coal was found in the actual store out of which this had been supplied. It was all a mystery, and an open verdict was returned. Talking to a mechanic on the subject some years after, he told me that that manganese had been ground in a large mill at their works for the chemist, and this mill in ordinary use was for grinding coal into dust, to be blown into a blast furnace. Of course, the cause is now obvious; the residue of coal in the mill had mixed with the first hopper full of manganese, and sent to the theatre, the remainder being free. Since this accident I have discarded manganese altogether, and used common sand, such as is used for a kitchen floor, about four parts by measure of pot. chlorate to three of sand. It is a little slower in its action, no rush or sudden increase in volume, and makes excellent gas. Copper retorts are expensive and soon used up. A Papin's digester, with the safety-valve knocked out and a bent iron tube screwed in, is cheap and excellent. I make the lid air-tight with a sheet of paper, with a big hole in the centre. I find that small and cheap brass valves about the size of a big mushroom, made by Mr. Chadwick, Prince's Ironworks, Salford, each attached with rubber-tubing to the jet-tubes, make explosion in the bags actually impossible, as the gases can pass freely to the jet, but neither can ever return. I forget the price, but believe about 5s. each. You may do what you like with your weights, boy or otherwise, an explosion by intermixture is an absolute impossibility.

Priam.

[19614.]—ADVERTING to my letter (19579) under this head, and to G. G. Blackwell's (19588) in reference thereto, I wish to point out that my warning was expressly addressed to "students of chemistry," who presumably do not obtain their chemicals from wholesale dealers, and do not purchase manganese by the ton. To them I repeat my warning.

That oxide of manganese is sometimes adulterated I know by my own experience. Twice during the last 10 years I have met with badly sophisticated samples. One was purchased by myself, the other submitted to me for analysis.

The following quotation from Roscoe and Schorlemmer's "Treatise on Chemistry" (1877), Vol. I., p. 174, is pertinent to the question:—"It is well known

persons must see at a glance that the only way to prevent such errors, is to establish an absolute mechanical block, and thus render such accidents as those at Penlee, Desford, and Canonbury, impossible. A very interesting diagram has been published to illustrate the impossibility of more than one train being in any block-section at the same time, in cases where the electrical system of interlocking is in use, as on the London, Chatham and Dover, and Metropolitan District Railways. And it is shown that unless three signalmen permitted trains to pass three out-door signals at danger, against three arm galvanometers, and three block indicators which lock the levers, or, including the locked levers, no less than twelve safeguards, the Canonbury disaster could not have occurred.

The verdict of the Coroner's jury, has been received with general satisfaction, more especially because the blame is clearly shown to rest upon the companies' complicated codes of instructions, and also because neither signalman has been committed for manslaughter.

The verdict also forms a very useful precedent for future cases of a similar nature.

Your readers will at once see that when signalmen at Burscough Junction, Leeds, and Canonbury are acquitted when they have made simple mistakes, it would be most unjust to punish those at Desford and Tayport, who have committed the same errors. The whole of the accidents mentioned, are the result of the companies neglecting to provide those well-known appliances which have been so often recommended by the Inspectors of the Board of Trade. Under these circumstances it is satisfactory that the juries are expressing in their verdicts the opinion that the railway servants, ought not to be punished when the true causes of the accidents are due to the neglect of the companies. Clement E. Stretton.

Saxe Coburg-street, Leicester, January 6th.

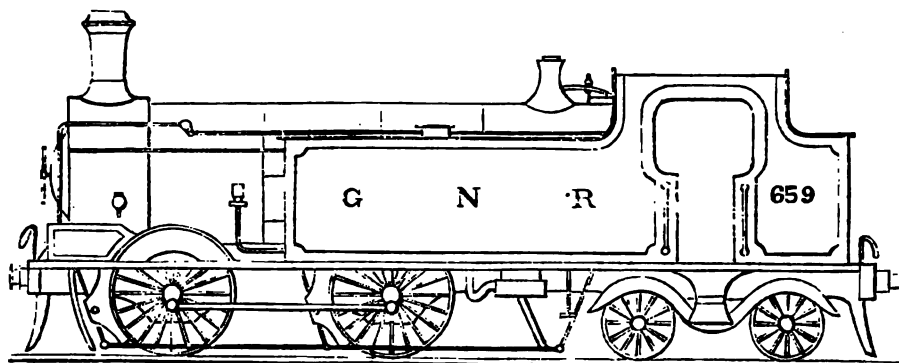
G. N. GOODS ENGINES.

[19628].—In reply to "Iron Horse" I give the dimensions of the Great Northern goods engines.

Diameter of driving-wheels	5 1
" cylinders	1 7
" stroke	2 4
Tractive force	165 lb.
Centre of leading-wheel to centre of driving-wheel	8 5
Centre of driving to centre of trailing	9 2
Length of connecting-rod	6 9
Total length of engine	28 1
Width between frames	4 1 1/2
" outside	7 0
232 tubes, diameter = 1 1/2 in., pitch = 5/8 in., length	11 8
Heating surface—	
Tubes	1,240 sq. ft.
Firebox	112 sq. ft.
Firegrate area = 18.7	
Diameter of boiler	4 3
Length of barrel	11 4
Firebox	6 2
Weight in working order—	
On leading wheels	14 0
" driving	14 15
" trailing	11 5
Total weight	40 0

174, 640, 642, 649, 193 are examples of this class. They pull an average load of 50 waggons (625 tons) at a consumption of 47 lb. per mile.

"E. P." states No. 6 as a 7 ft. single—at the



beginning of 1880 it was, but is now an 8-footer. The old No. 6 was renumbered 46. Another 7-footer which he has omitted is 222, stationed at Peterboro'. No. 3 is an 8-footer and not a tank as "E. P." says. It may interest "Iron Horse" and "E. P." to know that a new style of G.N. tank

has come out; it is a wing tank and totally different in appearance to the old class. The wheels are 5 ft. 2 in. diameter, and cylinders 17 1/2 by 24: two of these are out, Nos. 658 and 659—four more are expected. They work the Bradford local traffic on the new line to Halifax with great satisfaction. I enclose a sketch of one of these tanks.

Meteor.

APPARATUS FOR CONTROLLING THE FLOW OF LIQUIDS.

[19629].—We notice on reading our description of the above that we are made to say, "that for gas, we find it to vary as the density," whereas we wrote as the $\sqrt{\text{density}}$, which possibly your compositor did not notice, but should have written inversely as the square root of the density, as for example, suppose the instrument to be set for gas s.g. .45, air being 1.00, then in passing air, let the amount indicated be 10 ft. per hour, the correct quantity actually passing = $10 \times \sqrt{\frac{.45}{1.00}} = 6.7$ feet per hour. Of course, where great accuracy is required, the temperature and barometer have to be noted; but this will not be required in the case of liquids.

Thorp and Tasker.

THE MOST ECONOMICAL STEAM-ENGINE.

[19630].—In some instances where additional power has been required, in works driven by a condensing steam-engine, a non-condensing-engine, working at a higher boiler-pressure has been added, and the waste or exhaust-steam therefrom, conveyed into the low-pressure boiler of the condensing-engine, in which the steam is "cooked up" again, greatly decreasing the quantity of fuel required for the latter, and in fact utilising and saving nearly all the heat that would otherwise have been thrown away in the exhaust-steam of the high-pressure engine. This plan was first adopted by a firm at Sheffield, about thirty years ago. Cooper's "Hotpot" engine, made by Walter May and Co., was exhibited at the International Exhibition of 1862, and from its undoubted merits obtained honourable mention. At the same time I there exhibited, and was awarded a prize medal, for an engine which I had patented the previous year. The exhaust-steam from a small cylinder was conveyed into an interheater, or tubular chamber situated in the smoke-box of the engine, by means of which the partly-condensed steam from the high-pressure cylinder was expanded or greatly increased in volume, before entering the low-pressure cylinder, from which the steam was discharged into the chimney in a dry state.

The interheater was of considerable capacity, in order to obtain uniformity of pressure, and the steam in the small cylinder was cut off or expanded down to near the pressure in the heater, so that nothing was lost by a sudden fall of pressure in the transfer from one cylinder to the other; this allowed the cranks to be placed at right angles, the areas of the two cylinders being so proportioned as to give equal power to each.

This form of engine obtained some notoriety by being afterwards applied to the steam yacht *Deerhound* belonging to Mr. Lancaster, M.P., of Wigan, to replace former ones that were extravagant of fuel. The interheater was so arranged that a separate fire was employed to heat the steam from the small cylinder, in its passage to the condensing-cylinder. The effect of this fire was so considerable that it was constantly used as a necessity, and proved that much more was required, than to keep the interheater merely hot by a warm jacket.

tions required in the contract were singular. The working boiler-pressure was to be 150 lb. on the square inch—the highest perhaps ever before used at sea; and the engine to be provided with Davison's surface condensers. All this was effected satisfactorily, and the engines are still in use.

The system having been so far proved, I entered into negotiations with some parties for granting licenses, and this brought to light the fact that a prior claim existed for the same arrangement in a boiler patent, though no engine on this principle had ever been constructed before those made by myself. Finding that I could not hold a monopoly, I took no further steps to push the engine into notice for the benefit of others, and from that time till quite recently, it has remained a dead letter. But during the last few years a number of sea-going steamers have been fitted with engines on this principle, and their use will soon become universal; for unlike other forms of compound-engine, the construction is very simple, only two cylinders being required—of different diameters of course—but giving out equal power to cranks at right angles.

Any difficulty of starting when the first crank is on the centre, is got over by letting steam direct from the boiler into the large cylinder by a supplementary valve, which is closed as soon as the engine is fairly going.

F. H. Wenham.

REPLIES TO QUERIES.

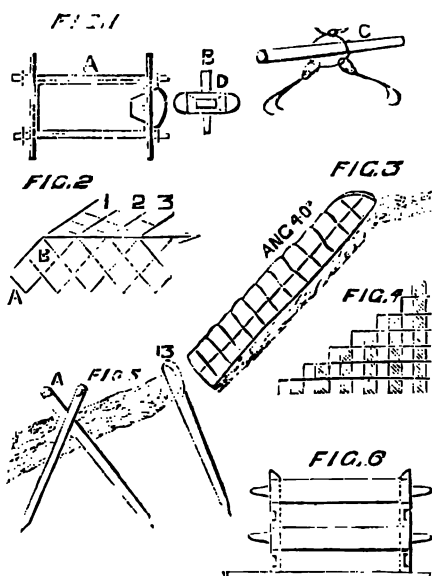
* * In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[45275].—L.C. & D.R. Engines.—As "O. G." does not specify what particulars he requires, I give a brief description of the leading types of engine on the L.C. & D.R. 1st. The "Scotch" engines, numbered from 81 to 94, built by Neilson and Co. Glasgow; so named because they are called after the Scotch rivers and islands. These engines are four-coupled in front, the driving- and leading-wheels being 5 ft. 6 in. in diameter. The frames are outside for all wheels, and the cylinders are inside. In some engines the diameter of cylinder is 16 in., in others 16 1/2 in., the stroke in each being 22 in. These engines have a raised boiler casing, with safety-valves thereon, and the dome is at the smoke-box end of boiler. The heating-surface is 856.6 sq. ft., and there are 1 1/2 in. tubes of 1 1/2 in. diameter. The tank is at the back supported by a pair of trailing-wheels, the axle with Adam's patent axle-boxes. Although they are used for running other trains, the engines are mainly employed in running the trains between Victoria or Holborn and Brixley. They also take the Holborn Viaduct portion of the Granville and boat express between Holborn and Herne-hill. 2nd. The tank engines, designed by Mr. W. Kirtley, built by Neilson and Co. These engines are inside bearings to all wheels, side tanks, the bunker being carried on a trailing bogie. The driving and leading-wheels, which are coupled to 5 ft. 3 in. diameter, and the bogie-wheels 5 ft. 6 in. cylinders which are inside are 17 1/2 in. diameter, 26 in. stroke. The boiler is flush-backed, with dome on centre, and Ramsbottom safety-valve over firebox casing, and contains 202 tubes of 1 1/2 in. diameter. The heating-surface is, I believe, 1,035 sq. ft. The tanks hold 963 gals., and the coal-bunker cubic feet. The engines have screw-down gear. The tractive force is 126 lb., so that the engines are amongst the most powerful in the country some of them having performed the 15-coal test. These engines are numbered from 65 to 74, and 101–112, 101 and 102 are fitted with Hobb vacuum brake. There are some of a similar type numbered from 163–174, built by Kirtley, Leeds, which are, I believe, of similar design, and which are fitted with a steam-brake. The engines run on the Metropolitan extension from Victoria or Clapham Junction, and Clapham-street or G. N. R., or M. R. Station. They work the Crystal Palace traffic between Victoria, Moorgate-street and the Crystal Palace. "O. G." requires any further information, the above or other tank engines, will endeavour to assist him.—CENTRAL.

[45298].—Ingrowing Toe-Nails.—As hundreds are now afflicted with the above, I make free to follow. If "Dejected" wishes to get rid of nail, he must not allow any one to pull it out, or any part of the nail out, but the method of cure. Discard all coverings that are uncomfortable for the toe, and regard length or breadth. Wash the toe in warm water with soap, then in clean water in which a handful of salt is dissolved; feet for five minutes, dry the feet

B is a narrow base-board, held down to the bed of the lathe by the T-rest bolt; C is another piece of board, hinged to the base, at D, by means of two common hinges; the end of this board is prolonged, as shown, for the attachment of weights, for regulating the pressure of the cut. By means of four wooden strips the end of the swing-board is made into a box, to the bottom of which the agate, or other body, E, is cemented with hard pitch. Over the top of the box, and surrounding the slicer, is fixed a "catcher," F, which is merely a slip of tin or sheet-brass. Having got the work cemented down in the right position, the base-board is slid along the lathe-bed till the edge of the slicer falls in the place of the desired cut. The box is then half-filled with fine grinding-emery and water to a rather thick consistency, which is constantly carried under the edge of the slicer into the cut. Weights are hung on to the tail end of the board, according to the pressure required by the material to be cut. Another slice, of any thickness, is obtained simply by advancing the base-board and clamping fast again. This arrangement requires some attention, to see that the emery falls into the cut, and that the edge of the slicer does not run dry, else it will fire, and perhaps cause the work to crack and fly asunder. Where motive-power is available, a far better slitting or edging-mill is shown, in principle, in Fig. 2, which requires no attention till the cut is finished. A is a vertical spindle, driven by the pulley, B; to the bottom of this spindle is attached the slicing-disc, C; at D is a spindle carried on a swing-frame, as shown in the plan; this is brought up to the edge of the disc by a cord with attached weights, carried over a pulley; E is the substance to be cut; F is a shallow box or tray, filled with emery and water to the consistency of treacle; both the work and the slicer are wholly immersed beneath this. The emery is kept well in circulation, constantly flowing over the work. The position of the cuts is determined by raising or lowering the spindle, D, and fixing by the collar and set-screw on the top bearing. This spindle may either be set fast, or allowed to rotate slowly; it is used either way in a machine under my charge. In a large machine, four swing-frames are set round the spindle A, so that one slicer or grinder acts on them together. —F. H. WENHAM.

[45580].—Sea-Wall.—This is a job that wants doing well if done at all, more especially if you have any property likely to be sacrificed. I have forwarded a sketch that will give some idea of what is wanted to make a good job of it. If you have plenty of beach, broken bricks, clinkers—either furnace, foundry, or brick-kiln clinkers—or pottery waste, or, in fact, any rubble, break them up to about 2in. or 3in., and pass through a ½in. screen—keep the fine and coarse separate—and when mixing for concrete use 2 of coarse, 1 of fine, 1 of sand, and 1 of good Portland cement: this is to be well mixed dry, and wet about as wet as damp sand, and filled into the following boxes. These box-ends are made of lin. elm, with deal sides, the sides slipping into the ends tenon and mortise, kept into place by pins, as shown in Fig. 1, A., 11in. deep, 11in. wide, 23in. long; a

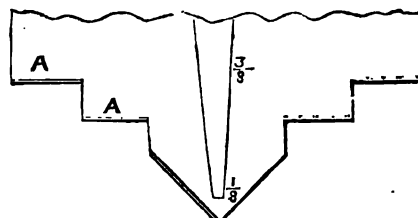


bottom board is fitted into the frame, and a piece (as shown at B) in each end, and held there by a D-pin; these form a key when laid, and convenience for handling with grappling-irons (see C) to transport them by to where they are required. Fig. 2 is the way they are laid and bonded, as to form a series of quoins. Fig. 3 is the wall so built

in situation, at angle 45° or 30°, as the case may be; I should not put in less or more. Fig. 4 is the face of work and the quoins in a vertical line, if it face your weather quarter; but if your weather quarter is to the right or left, build with your quoins, at an angle of 45°, to either right or left; the foot of your wall should butt up against some stakes, driven in about 4ft. If you know of any dealers in bord wood or loppings, you may find plenty of stuff not to be despised for the job, as beech, oak, or birch. I have seen plenty of it about 5ft. long, and before being rift from 6in. to 8in. in diameter, and some good straight stuff, about 3in., that will do for A, Fig. 5, which should be driven, as shown, as thick as you can, and left standing about 1ft. above the ground. Fig. 4 shows you the best way to carry it up—not in a straight course or line, or you will have your bank full of water-pockets every tide, but on an incline, and well pug behind with stiff clay before the tide comes in again. Make the joints with 2 parts of sand and 1 part of Portland cement. The frame for measuring the proportions is shown at Fig. 6. It consists of four frames 9in. deep and 3ft. square. The bottom has four angle pieces made fast in it, so that they may be lifted off one after the other. In the first frame put the small rubble; then the other two frames put on, and fill with coarse; then put the top one on, and fill up with sand and cement; then take the frames off one at a time, and when all is clear of your stuff, well mix, dry and wet up; but mind not to wet like mortar, for more than one-half of the concrete is spoiled that way. Have sufficient boxes for the job, and mould off just slightly, ramming it in until you find the water make its appearance upon the top. In two days knock the pins out of tennons, and slightly tap your boards with wood mallet, and take away mould; in two days more turn upon their edge and tap bottom board off; next day turn over upon the other edge, and in a week from the time they were cast they will be fit for laying. The stuff should be wet upon some scaffold-board or pavement. Keep all mould or humus or clay carefully out of your concrete, as it will render it rotten. The stakes at Fig. 5, B, should be good stiff, rift stuff, and about 5ft. long, driven in within a foot as close as you can. Round the wall should be finished with a coping course as shown, and the top, if clay, should be removed to 6in. deep, then made good with furnace clinkers at bottom, and 2in. of clean beach and sand, the top covered with gas-tar, which will stand some washing if put on at the proper time, and thus you will have a wall that will be likely enough to last through many storms if the wall face the south, or so as to get the sun upon it to get dry. If the face of it is given a few coats of gas-tar it protects the joints and angles. —JACK OF ALL TRADES.

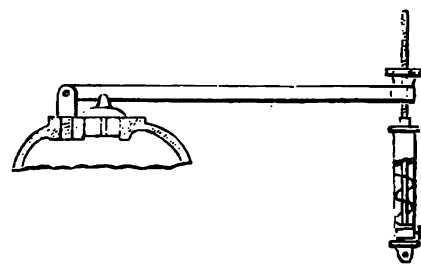
[45601].—De Meritens Secondary Battery.—The plates are merely placed upright in the cells, about ½in. apart, two in each cell, which need not be larger than is necessary to contain them. Connect by wires and binding-screws, or lead strips and clamps. For method of arrangement see textbooks. The order depends on the nature of the charging current, and the work to be done. I am sorry to be unable to send further particulars of motors, &c., on account of want of leisure. If you have sufficient electrical and mechanical knowledge to choose the good and refuse the evil, read Urquhart's book (Crosby Lockwood), it contains good hints, and others, on making a Gramme machine. A thorough account of its construction (the ring and armature is the chief point), with working drawings, would occupy four or five of these pages. With regard to your question (45605), addressed to Mr. Lancaster, see last vol. of Proceedings of Inst. O.E., which I presume you have. Paget Higgs gives a capital article showing how to calculate all dimensions of cores, coils, and wire for electro-magnets of any strength and for any current. —A. TROTTER.

[45616].—Boring.—If "Drill" will make a step-drill, as shown in sketch, and take it through



in one cut, he will make the best job of it. I have found it so, and where I have been very much cramped for room and tools. Above all things, do not mind your bit too proud; a 32nd clearance is enough, and don't crowd it—i.e., not greedily; let the drill be for thickness in section at point and at last step. —JACK OF ALL TRADES.

[45622].—Spring Balance Safety-Valve.—You do not give me any details of size of boiler, &c., so that all I can do is to send you a sketch,



showing the balance, &c. The size of the parts I will give on bearing proportions of boiler, &c. As you will see, the spring-balance is pretty easily made. You take a piece of brass tube of suitable size, and inside it fit a rod and block very much like a piston, as shown; at the bottom end of the tube is a casting with a lug to it, to which a link goes to couple it with the boiler shell. At the top end of the tube is another plug, screwed in and drilled for the rod to pass through; a spiral spring being inclosed between the block on the rod and the screwed cap gives the means of producing the desired pressure. When put together, the spring should be just long enough to fill the box, but not to be in compression; the rod, after passing through the cap, is screwed and passes through an eye on the valve-lever; a brass nut taking on to it by lifting the block compresses the spring, and so gives the pressure. The tube needs a slot cut up one side for about four-fifths its length, in which slides a pin to carry the index pointer. If the tube, therefore, be graduated as the spring is compressed, the index should show the pressure. But to get this graduated correctly requires very accurate adjustment. The lever-valve, &c., I assume you know how to construct. The spring is made by coiling a piece of fine steel wire round a mandril a little smaller than the size of the screw, as when taken off the mandril it will be a little larger. As the spring expands after being coiled, it should be hardened and tempered. —SUNLIGHT.

[45625].—Angular Aperture.—One of the simplest and most accurate methods of measuring the angular apertures of dry objectives, without the use of specially-contrived apparatus, is that known as Dr. Robinson's ("Proceedings Royal Irish Academy" [1858], pp. 38-47), which is briefly as follows:—A pencil of parallel rays is projected in the direction of the axis through the eyepiece, and, after the crossing of the rays in the focal point of the objective, is received on a screen placed a few inches off: the angular diameter of this luminous disc, measured from the focal point of the lens, will be the angular aperture of the objective. For low powers—e.g., those below ½in.—the angular measurement should be the arc subtended to the eye supposed to be at the focus; but with higher powers, the front surface of the objective may be taken as the apex, and the angle will then be very approximately accurate. For measuring very high apertures, Dr. Robinson recommended that the screen should be made to travel "in a cylindrical surface concentric with the focal point" (Quart. Journ. Micr. Sci., III. [1855], p. 164). With those objectives having a "correction-adjustment," it is usual to measure the aperture at "closed," and again at "open" point. Sunlight is most convenient for this method; a sheet of opaque paper with a small hole should be slid on to the tube at the eyepiece end to obscure the direct light from the screen. With immersion objectives some modifications are needed, for we here require to know the angular aperture in the immersion medium, or other dense medium with which it can be compared. Now, the more modern immersion objectives take up (in the words of Prof. G. G. Stokes, "On the Question of a Theoretical Limit to the Apertures of Microscope Objectives," vide Journal of the Royal Microscopical Society I. [1878], p. 139), "a pencil of rays emanating from a radiant immersed in water or balsam of wider aperture than that which in such a medium corresponds to 180° in air, or, in other words, than 2ν, where ν is the critical angle." In order, therefore, to obtain a measurement of aperture in water or balsam wider than that which, in such a medium, corresponds to 180° in air, we must first of all get rid of the limit imposed by the critical angle. If we trace geometrically the air-pencil of 180° through a stratum of water bounded by parallel planes, we find the angular extension of the pencil is about 98°; in balsam or crown glass it is about 82°. It follows then that neglecting the loss of light due to absorption, and to the reflection at the surfaces of entry and exit, the pencil 82° in the water, or 82° in crown glass, corresponds to 180° in

air. If, therefore, we measure the aperture of the highest-angled dry lens in water or in a body of crown glass, we shall always obtain less than 98° or 82° respectively; any wider aperture than 98° in water or 82° in crown glass, being greater than 2° , or twice the critical angle, is consequently greater than corresponds to 180° in air. To obtain such measurements we must have recourse to special means. If a nearly hemispherical lens of crown glass be cemented with balsam on a thin slide, so that the centre of curvature is on the upper surface of the latter, the objective may be connected with the centre by the immersion medium. Dr. Robinson's method is then applicable, and the reading will be the angle in crown glass. If a thick plate of glass, 5 in. or 6 in. in length, say a polished glass paper-weight, $\frac{3}{16}$ in. thick, have its underside finely ground, or if tissue-paper be pasted thereon, the upper surface may be focussed, and Dr. Robinson's method will project a luminous disc on the ground side, which may be marked off and then measured with a scale of tangents: suitable immersion media must, of course, be used to connect the objective with the upper surface of the glass plate. Apertures as high as 114° in crown glass have thus been measured. Professor Abbe's method of measuring apertures must be considered to supersede all others, but the detailed explanation of it would extend this letter far beyond the limits of the Editor's *household*.—AKAKIA.

[45612].—Green Mould.—I would inform "Gardener" that to remove green mould, scraping will avail, but won't prevent its growth; neither do I practically know what will, except dryness. I had two windows at the back of my house, the brickwork of which got very green. To dry it, I scraped one, and then did it over with the silica glass, which, for the time I remained there kept the brickwork clean; but I don't know how it has answered since. At any rate, it is cheap and easily tried.—EDWD. THOS. SCOTT.

[45658].—Old Violin.—Your instrument seems to be one of the old "Violas d'amour." If in good preservation and handsome it might fetch money for a collection, but it is quite obsolete.—C. P. T.

[45660].—Hydraulic Hammers.—As there are two constructions that are applicable to your query, will you kindly restate it. Do you want to know particulars respecting hydraulic stamping machinery, such as used for forging purposes? Or do you refer to the hydraulic or water-hammer used in experiments in physics, in connection with demonstrations in heat.—SUNLIGHT.

[45662].—Water-Closet.—If the pan does not leak and comes up properly against the under side of the container-top at E (Fig. 137, "Practical Notes on Plumbing"), the copper pin is siphoned out. This is often the case when the axle fits properly round the lugs or brass-work. All containers should be properly ventilated off the top (see my articles to appear in the "E. M."). To prove whether the pan siphons out, make a small hole through the patty at or near the pillar supporting the dish wherein the pail works. If the water then goes out, it must be a faulty pan. Make the hole good again.—P. J. DAVIES.

[45662].—Water-Closet.—As "Plato's" copper-dish is sound, can the cause be, when the dish is in position, the rim is not horizontal all round, owing to the crank being not at the right angle that tips the pan up? It may have been bent, or the connecting rod that connects to the handle may be too short as to not allow the pan to go horizontal after being tilted, consequently water will only stand in the pan to the height of the lowest part of the rim; or it may be that the water is partly siphoned out. See the articles on "Plumbing" now appearing in "Ours," which explained this.—WORKING TOM.

[45662].—Water-Closet.—To "PLATO."—The cause is that something has accumulated round the lever of pan, where it works through the container, which is thus kept air-tight, or nearly so. Now, when the water flows over the pan there is a partial vacuum formed in the container, which draws out part of the water. "Plato" can remedy this by drilling small hole into the container, or by carrying small pipe from same out through wall will help to ventilate the container at the same time.—TOM THE PLUMBER.

[45663].—Music.—That "J. M. B." is deficient in the art of playing "random harmony" is not to be regretted. That he is deficient in the art of extemporising—and by this I mean working out musical ideas or sequences in proper harmony—is to be regretted. The inferior musicians, who, when they sit down to "try a piano" can hammer up and down for an hour on different chords, should not be objects of envy to "J. M. B." I can assure him a musician would far prefer his attention on this point to the most accomplished performance of those who—as if from a box—can shake out a formidable array of scales, arpeggios, trills, &c., &c., in ignorance of the laws of harmony

taste. I had better tell "J. M. B." at once that the art of extemporising on invented or given themes, in a way at once agreeable and conformable to the above rules, is more of a gift than an acquirement. The grammar part of it, however, can be acquired. I can scarcely assume that "J. M. B." has studied harmony. Had he done so, he would have been able—certainly to some extent—to play harmonic progressions and modulations. If your correspondent really wishes to be able to sit down to the piano and extemporise logically and grammatically upon whatever takes his fancy, he cannot do better than study harmony. If nothing else, it will give him a readiness in dealing with chords, and their inversions; and he will understand their relation to each other. I should advise "J. M. B." to procure Banister's "Music" (Bell and Sons, 5s.), or some harmony primer—say Dr. Stainer's (Novello and Co., 2s.). If he would conscientiously study these works, he will have gained no inconsiderable knowledge on the theory of music. It is self-evident that the mental effort required to harmonise themes grammatically will familiarise the student with some of the resources at his command when he attempts extemporisation. When "J. M. B." can add a treble, alto, and tenor to a given bass two or three times, each setting to be of a marked character (not a succession of meaningless harmonies) and free from consecutive 5ths and 6ths, &c., he will be surprised to find how much easier it is for him to play correct harmonies on the piano. Thus the more thorough is his knowledge of harmony and modulation, the better will he be able to extemporise. If to his knowledge he adds good taste and a true perception of the beautiful in music, he may in time be able to interest himself and others in developing musical ideas. If he has any musical ideas of his own they will not lose in interest by being first made to pass through the ordeal exacted by musical theory. Such ideas would be improved and expanded if subjected to the tests of theory, and would not (unless they were worthless) be restricted in any way. They would come out purged of their irregularities, and would henceforth stand or fall according to the intrinsic worth and beauty of the melody. In conclusion, I may suggest that nothing comes amiss or is unnecessary in musical theory, if the object of the student is to learn what can be learnt of the art of extemporisation in its highest development. Therefore, the would-be Hummel should make himself acquainted with counterpoint, fugue, and the general principles of composition and musical form.—G. L. PEARCE.

[45663].—Music.—You cannot extemporise unless you have the divine gift. Education will assist you if you have the genius. Can you perform mentally? I can always have a fine concert, and hear each instrument in my mind's ear; this has always been so except in sickness. I think I am to be envied. "Nor iron bars, a prison make." Can you transcribe a song from one key into another? or play it in a minor key, or in a variation of triplets? But all these questions are idle unless you can create a musical idea—a simple one will do. Try Mozart's variations, and you will see what I mean. Very simple, very grand.—FIMBLE.

[45663].—To "Sunlight."—An engine with 16 in. cylinder will have a piston area of 201.06 square inches, whilst the 24 in. cylinder has an area of 452.39 square inches; so that the larger engine would have more than double the piston area. But this is not the whole of the data we get. At a pressure of 20 lb. every cubic inch of water produces 1,241 cubic inches of steam with a theoretical mechanical effect equal to 2,135 lb. raised one foot high for each cubic inch of water evaporated with the 16 in. cylinder, and 40 lb. pressure; every cubic inch of water represents 679 cubic inches of steam with a theoretical mechanical effect equal to 2,261 lb. raised one foot for each inch of water evaporated. Arguing from these data, it is seen that the smallest cylinder would be the most economical by far. A low-pressure gives but little chance of taking advantage of the expansion; and add to this, that the smaller engine is run much faster than the larger one, the advantage in favour of the 16 in. cylinder becomes more and more striking. Even this is by no means all. There are many more reasons I could give you, all showing the advantage of the smaller cylinder and the higher pressure.—SUNLIGHT.

[45668].—Horizontal Engine.—Your cylinder has 4,908 square inches of piston area. On bare theory, it should be just over 2-h.p.; but do not expect to get such out of it except under very exceptional conditions. The engine in question would be about equal to 2½ man-power by the rule? A cylinder of 120 per

pulley on the counter-shaft, take a strap to a larger pulley on the machine. By this means you may utilise your engine for the purpose.—SUNLIGHT.

[45670].—English Clock-Spring.—I expect your spring is in fault. Ascertain how many turns of the barrel are required to wind the clock from the "down" to the top, then take the barrel out of the frame and put the square end of the arbor in the vice, and see how many turns it is capable of making. Suppose you require seven turns and the spring can make 8½, then I should set it up ½ of a turn; that is, after the line is all wound on the barrel you turn the ratch ½ of a turn up. The reason for this is that you use as much of the middle of the pull of the spring as you can, leaving ½ of a turn to spare both top and bottom. If your spring does not make a turn and a half (or at least a turn) more than you want when winding the clock up you must exchange it for one that does, as the spring must not wind full up to the top or run down, so as to lose all power at the bottom. Use harp-string instead of common catgut.—E. PARR.

[45671].—Wood-Turning.—No stay is required; they are first roughed with gouge and finished with the spokeshave. It is held on top of rest by the left hand, the fingers passing over the shaft to keep it from springing, also holding the spokeshave between thumb and forefinger of right hand, the thumb travelling on the rest below it, fingers holding both together. It will take a lot of practice to make anything like good work.—WOOD TURNER.

[45673].—Violin.—Swiss pino has been proved after numberless experiments to produce the finest vibrations for bellies. Pearwood was much used by the old makers for backs. Maple and Sycamore are now generally used for back, neck, and sides. It is immaterial in point of tone whether the belly and back are jointed or not; but as the grain of the belly should be closest in the centre and gradually widen to the edges, it is difficult to obtain a whole piece that fulfils these conditions.—C. P. T.

[45673].—Violin Soundboard.—A soundboard must have a spring. Think over this for ten minutes. We can get a spring from hard wood, but have to thin it down so much that it springs too wide, and not quick enough—viz., for a soundboard. The spring must be as powerful as a thick hard wood can give, and yet be as elastic and quick as a soft wood can give. Note this in a drum-head which has a soft medium (vellum), but is tightened to elasticity. Then soft wood is the best if it could be strained, but this cannot be done. What's the remedy? Various thicknesses according to the diameter of the vibrations required. A solution to this problem has yet to be given. But besides this, the action and reaction has to be assured by the surroundings of the soundboard, which addendums are the foundation of tone. So, the soundboard makes the sound of the string vibrations louder, but the reaction from the weight attached to the edges of the soundboard makes the tone. The said weight represents tension. I think we ought to say weight is tension, for a tightened string, when loaded or covered, is raised in pitch and sounds higher. Where there is weight there is power: hence a bass note is more resonant than a treble. You don't believe it! The Guards' drum is heard across the park long before the fife or other wind instruments. The bass of the Crystal Palace organ is noticed long before you enter the building, while the theme is inaudible until you get closer. The column of air inside the instrument has nothing to do with this resonance, but it is weight or tension that does it, which is equivalent, or more than equivalent, to energy. Besides the bass tone contains all the others, as harmonics to its fundamental, all in one; but reduce its length to make a treble, and you take away its power of resonance. In a soundboard we have a soft, springy medium, with an opportunity of adding weight and tension without stopping the vibration, and so increasing the tone. Professionals say that a violin soundboard should be made to sound D or G, when struck or tapped before strung, and the back a half-tone lower or higher. How can we tell the tone of a box? By sounding it near a long string (a cello will do) tuned two octaves lower, when, if in unison together, the string will respond to the box. The box sounds as upper octave or harmonic to the string, and thus starts the whole. I don't think it is correct to tune or make a violin soundboard to D or G: it ought to be G, because the lowest note which comprises or contains all the other notes. The thinner you make a soundboard (as a box), fitted to sound, the higher will be the tone, and the thicker the lower it will sound. Of course, this thickness may be represented by the surrounding fittings and the general character of soundboard, whereby this rule is altered, and a comparatively thin soundboard is best for the bass. As a general rule, I should make a soundboard as low in tone as possible (lower than G) and

off in those parts that ought to vibrate most.—**FIDDLER.**

[45674].—**L. and N. W. Engines.**—No. 1840, "Pegasus," is not now in existence, the new "Pegasus" being No. 482, a "Precedent," built in 1880. The old one had (outside) cylinders 15 by 20, 7ft. "single" driving-wheels, outside bearings for leading and trailing-wheels, and was built by Mr. Trevithick, the designer of the "Cornwall," about 1849. Her number originally was not 1840. I do not know what it was, however.—**W. B. P.**

[45677].—**How to Dress Rabbit-Skins.**—Mix together some bran and water; soak the skins in it for two or three days, then mix 1lb. of alum and 2oz. of common salt. The skins, having been taken out of the bath, must be scraped thoroughly clean, and a coat of the mixture spread over them on the inside, this remaining on 18 hours, after which they are to be dried with the fleece outwards, and if possible in the sun; when dry, with a good switching and brushing the operation is complete.—**DUSTY.**

[45678].—**Testing for Arsenic in Copper.**—Oxidise two or three grms. of the copper in powder with fuming nitric acid in a dish; add a few cubic centimetres of strong sulphuric acid, and evaporate the liquid to dryness; dissolve the residue in hydrochloric acid, add water, allow the liquid to stand, and filter into a flask. In case the insoluble portion contain sulphate of lead, repeatedly boil in a dish the residue with dilute hydrochloric acid, and pass the liquid through the filter. The residue is then transferred to the filter, washed with hot-water, dried, and weighed. Warm the filtrate to about 70°, and pass a current of sulphuretted hydrogen through it. The copper, lead, bismuth, arsenic, and antimony are precipitated. Having allowed the liquid to stand, pour the supernatant liquid through a filter, and wash by decantation in water containing a little sulphuretted hydrogen; wash back into the flask the small portion of the sulphide adhering to the filter, and gently heat the precipitate with a moderately concentrated solution of potassium sulphide; digest for a short time (a little over half an hour), then add some water to prevent any copper from remaining in solution, and again filter; filter off the sulphides of arsenic and antimony, mixed with sulphur which has been obtained by adding hydrochloric acid to the filtrate, and oxidise them by adding fuming nitric acid (B.P. 86°); concentrate the solution by adding excess of sodium carbonate, evaporate the whole to complete dryness, and fuse in a silver dish. The sulphide of copper containing the small quantity of lead and bismuth is dried and transferred to a porcelain basin, and dissolved in nitric acid. Evaporate the solution to a small bulk, add chloride of ammonium to dissolve the bismuth, and then dilute sulphuric acid. Pour off the clear liquid through a filter when the precipitate has completely settled, and quickly wash two or three times with a little water containing a drop or two of sulphuric acid; rinse the lead sulphate on the filter by means of alcohol and wash the filter paper throughout with alcohol. Do not mix the alcoholic washings with the main quantity of the filtrate. The bismuth is best precipitated as carbonate. Nearly neutralise the filtrate containing the copper, and add excess of ammonium carbonate, gently warm, filter, dissolve the precipitate, which consists partly of bismuth carbonate, partly of basic bismuth sulphate mixed with copper, in a few drops of nitric acid, and again add ammonium carbonate, which reprecipitates the bismuth as pure carbonate free from copper, and heat gently for some time; wash, dry, and ignite the precipitate, and weigh it as bismuth trioxide, taking care to detach the dried carbonate as completely as possible from the paper before incineration. Boil the solution containing the copper, add caustic soda, and continue boiling until the solution is free from ammonia; filter, wash, dry, ignite, and weigh. This gives the percentage of copper. Should it be necessary to find the percentage of arsenic, the fused mass containing the sulphides of arsenic and antimony would have to be treated separately for that purpose; but I have given the estimation of the copper, which I think the easier of the two operations.—**F. I. C.**

[45679].—**Chilled Car-Wheels.**—Use ordinary iron, and allow the castings to remain in the chill until cold.—**CAST IRON.**

[45679].—**Chilled Car-Wheels.**—If "Galio" has just a few wheels to make, he could use No. 3' pig, with a good proportion of hard scrap. That is what I have used for contractors' tip waggons, and they stood well. If he is going in for making car-wheels in large quantities, perhaps he will take a leaf out of some Yankee foundry, where, I am told, about 20 sorts of pig are used together: just after casting, take off top box, and bare the arms all round and between; let them stop in until nearly or entirely cold.—**WORKING TOX.**

[45680].—**Soft Metal.**—If Babbitt's metal is meant, it is a mixture of about 10 tin, 1 copper, 1 antimony; melt copper first, then add tin, then antimony. I have known lead by itself make

excellent bearings for high speed and light work.—**WORKING TOX.**

[45680].—**Soft Metal** is an alloy of 2 tin and 1 lead.—**F. I. C.**

[45682].—**Variable Stars.**—Algol, in the head of Medusa, changes continually from the first to the fourth magnitude; and the time taken up from its greatest diminution to its least is found, at a mean, to be 2d. 20h. 49m. 3s. During four hours it gradually diminishes in lustre, which it recovers during the succeeding four hours; and in the remaining part of the period it invariably preserves its greatest lustre, and after the expiration of the term its diminution again commences. According to observations of Mr. Pigot, the degree of brightness of this star when at its minimum is variable in different periods, and he is of the same opinion with regard to its brightness when at the full; but whether these differences return regularly or not, has not been satisfactorily determined.—**ACONITE.**

[45682].—**Variable Stars.**—The exact time in which Algol changes from a 2nd to a 4th magnitude star is 2d. 20h. 49m., the increase and decrease together do not occupy more than 7 hours, and the minimum only 18m., so that it generally appears as a 2nd mag. Furnished with these data, and combined observation, no doubt, Mr. Bishop will be able to observe it at its minimum.—**A. MANOCK.**

[45683].—**Beef and Hams.**—To "Young Cook's" first question, I should say decidedly, Yes, as it has been done at my home for twenty-five years. Of course steaming is not as rapid in cooking as boiling; but in steaming, you retain all the goodness and flavour of the meat. A piece of meat of 20lb. would take 2 hours to 2½ hours, and a piece of 60lb. about 6 hours, or perhaps longer. We use a steamer for meat in which the steam enters the bottom of the steamer. The meat to be cooked is placed on a perforated tin tray standing on feet about 1in. high, fitting the inside of steamer. As near the bottom of the steamer as possible is placed a small cock to drain off the water from condensed steam. Fish steamers are made slightly different, these having a jacket running round them, in which holes are punched close to the top and inside the jacket, to allow the steam to pass to the inside of steamer. I cannot say if these are the best kind of steamer, as we have never used any other form.—**STICK-IN-THE-MUD.**

[45683].—**Variable Stars.**—Algol (right ascension, 3h. 5m.; declination, +40° 27'). This star may be seen every night in the northern hemisphere. It is usually of the second mag., but in a period of 2d. 20h. 48m. 55s., it goes through a most remarkable cycle of changes. These changes commence by a gradual diminution of the brightness of the star from the second down to the fourth magnitude in a period of three or four hours. At the fourth magnitude the star remains for twenty minutes, and then begins to increase in brightness again until, after another interval of three or four hours, it regains the second magnitude. Algol continues at the second magnitude for about 2d. 13h., when the same series of changes commences anew. The following are the Greenwich times of heliocentric minima of Algol:—

	h.	m.
January 12,	6	45.5
" 23,	18	1.1
" 26,	14	50.0
" 29,	11	38.9
February 1,	8	27.8

—**F. I. C.**

[45684].—**Photographs Coloured with Water-Colours.**—Water-colours are extensively used for tinting photos. I could give you a mass of information on the subject did time and space permit. I should advise you to purchase "Harmonious Colouring," by Newman, price 1s., in which water-tints are fully dealt with. Then there is another mode, by using dry powder-colours. The main point in their favour is that a novice will generally obtain far better results with powder-colours than with either oil or water-tints. Whilst the final coat of varnish gives all the appearance of an oil-painting.—**SUNLIGHT.**

[45684].—**Photographs Coloured.**—I use Rintoul's composition. Gum-water may be rubbed on the face of the photo with a soft rag. Use good colours, and after finishing, pour plain collodion on the photo to glaze it—that is, for small ones. The first tints are washed on, and finished by stippling the face and hands with a fine-pointed sable. Shall be glad to give further particulars.—**E. A. B.**

[45686].—**Taking Leaf-Impressions.**—I should not advise you to prepare your own paper. It will not recompense you for the time and trouble. You should buy sensitised albumenised paper, which any photo material dealer will supply for about 1s. per sheet. This must be kept in a dark room or box, and may, in the absence of a

dark room, be cut to size, and kept in a box or book. To take an impression, all that is necessary is to take a small piece, a little larger than the leaf, say, place the leaf on it, and make a temporary printing frame by using two sheets of glass of the required size; between them place the sensitised paper, and on it the leaf. Now, having the second piece of glass on the top, slip a rubber band over each end, which will hold all firmly. Now expose to diffused light and examine from time to time, when by looking through the plates it will be seen when the details of the leaf are well defined. Rather overdo than otherwise. Now remove from the glass plates, and quickly slip into a box or book until the evening. Then by candle-light immerse the prints in a saturated solution of hyposulphite of soda in water. This will remove the unexposed silver, and make the print permanent. After soaking in the hypo solution, well wash in plain water for several hours. The print so fixed will be of a brick-red colour generally. This is no detriment for some purposes; but if you desire, I would tell you how to tone the print so that it might be the same colours as an ordinary photograph. I have seen some beautiful photographs in this way of leaves, especially skeleton ones.—**SUNLIGHT.**

[45686].—**Taking Leaf-Impressions.**—There are several methods of preparing the paper. The simplest for your purpose, though one of the oldest methods, is Mr. Talbot's first method, which I have myself used for the same purpose—viz., for taking the delineations of dried plants, particularly the ferns, sea-weeds, and the light grasses. Take superfine writing-paper and dip it into a weak solution of common salt, and wipe it dry, by which the salt is uniformly dispersed through its surface. Then spread a solution of nitrate of silver on one surface only, and dry it at the fire. The solution should not be saturated, but six or eight times diluted with water; when dry, the plate is fit for use. Mr. Talbot says "This paper, if properly made, is very useful for all ordinary photographic purposes. For example, nothing can be more perfect than the images it gives of leaves and flowers, especially with a summer sun, the light passing through the leaves delineates every ramification of their nerves." To render this paper more sensitive, it must be again washed with salt and water, and afterwards with the same solution of nitrate of silver, drying it between times. Mr. Golding Bird's method consists in using 200gr. (nearly 1oz.) of salt to a pint of water—soaking the paper in it—taking off superfluous moisture between folds of bibulous paper, or by a cloth; while still damp to be washed on one side with a solution of 20gr. of fused nitrate of silver (lunar caustic) in an ounce of water, and hung up in a dark room to dry. This, Mr. Bird observes, produces a rich mulberry tint. To take the images, place upon a flat surface a piece of the photographic paper, with the prepared side upwards, upon this the object to be delineated, and cover it with a piece of plate-glass; expose this to diffused daylight, or still better, to the direct rays of the sun, when that part of the paper not covered by the object will immediately become tinged with a violet colour, and if the paper be good, in a few minutes pass to a deep brown, or bronze-black colour. It must then be removed, as no good will be gained by keeping it longer exposed; on the contrary, the delicate parts yet uncoloured will become in some degree affected. The photographic paper will now show a more or less white and distinct representation of the object chosen. To fix the drawing, wash the photographic drawing with a solution of hyposulphite of soda, no matter as to the strength of the solution, and before using this preparation for fixing the drawing, it should be soaked for a minute or two in hot water, which of itself removes a large portion of the silver chloride that is to be got rid of.—**F. I. C.**

[45686].—**Taking Leaf-Impressions.**—Take two pieces of glass and four American spring page, get a piece of prepared paper and some blotting-paper, clean the glass, lay two thicknesses of blotting-paper on one of the glasses, the prepared paper on that, and your leaf on the top of all, then the other piece of glass on the top of the leaf; press them together, and put a peg at each corner. Let it remain in the light till the paper that can be seen round the leaf has turned very black, then remove it. The act of placing and removing the prepared paper must be done in a dull light, or by candle-light. Your best plan is to get your paper ready prepared. Till you are ready to finish the prints you should keep them in a dark place. Now take a tube of chloride of gold, 15gr., dissolve it in 15 drachms of water; now take a plate, see that it is clean, pour one drachm of gold into a jug, bicarbonate of soda 4gr., water (pure) 8oz.; wash your prints in two or three changes of water till they do not colour the water, then place your prints, face downward, in the gold. Let them stay till they are a deep chocolate colour, then remove them and place them in water again; wash them. Make a solution of hyposulphite of soda 2oz., water 8oz.; place the prints in this for 15

wash them well in fresh water. Dry for 12 hours. Dry, and starch.—E. A. B.

Testing Commercial Nitrates.—The value of a commercial nitrate as nitric acid, it is simply necessary to determine the percentage of nitric acid. There is a way by which this can be done. One depends on the discovery by Dr. Mr. Tribe, that a zinc plate covered with sulphuric acid, with the formation of hydrogen gas, and the liberation of hydrogen gas is the simpler, perhaps, and as a rule, to determine the percentage of sulphuric acid, except for greater description of the preparation of nitrate and potassium chromate is unnecessary. I shall, therefore, determine the percentage of nitric acid. A very gentle heat, a few grams of the mass is sufficiently liquid—it is taken to moderate the heat of sulphates, and particularly the sulphates, which are partially volatilised, which the result—pour the mass into a basin; powder it at once, and add it into a tube. Into a platinum crucible or three grams of quartz, in this to redness, and, when cool, weigh. Add about half a gram of the zinc. Intimately mix, with a little nitrate and silica, not allowing the powder to adhere to the glass. Heat the crucible till it attains a red heat. Keep it at this temperature for five minutes; then transfer it to the air when cold, weigh. The loss of weight gives the amount of nitric acid. Chromate and borax may be used to determine silica.—F. I. C.

Testing Commercial Nitrate of Potash.—This substance as a source of the vitriol manufacturer, the main thing is, of course, the percentage of nitrate in the sample. Perhaps the best way of doing this is the following, and the precautions it gives results sufficient for technical purposes, it may suit better than some of the more common ones. In the first place, determine the amount of moisture by gently heating a quantity (four or five grams) of the sample in a crucible, until the salt begins to melt, allow to cool in the air, weigh. The loss in weight gives the moisture in the sample. Now put in a crucible about three grams of fine nitrate, to redness, cool, and weigh. Add a little of the dried and powdered sample, to ascertain the exact amount of nitrate. Mix the contents of the crucible with a thin platinum-wire, and heat to redness in a Bunsen burner for about half an hour. Cool in the desiccator, weigh. The loss in weight indicates the quantity of nitrate in the sample, and knowing the moisture, it is easy to calculate the nitric acid present in the original sample.

In conducting the above process, be careful not to heat the crucible beyond red heat; otherwise the chlorides and nitrates are liable to be decomposed.

Model Loco.—It would give me a great deal of trouble to write you, but I am unable to refer to back-numbers of *Engineer* or *Engineering*. Some of the things I have, I know, been illustrated in those papers; but I cannot from the 7th. express engine has been. I refer back at the first opportunity.

Model Engines.—A drawing to G.W. express passenger engines is given on pages 202 and 224, and a page 208. If "E. A. M." is unable to find the dimensions, I will be very glad to help him.—METEOR.

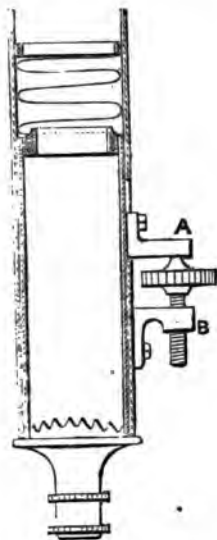
Pin Pegs.—The pegs must be made of glass-paper till they fit well in both ends with chalk, and work the holes.—C. P. T.

Pin Pegs.—I have made a few and bothered with the pegs until I tired pin and burnished the holes in.—TURNER.

Pin Pegs.—Don't push them in so hard as you can.—FIDDLER.

How Motion for Micro. Stand.—I am able to properly describe this, therefore I have sent same to you fully clear. As you will see, inside the tube slides truly another short tube, and the casting which carries the o.g.

The outer tube has a short slot cut in it, so that a brass bracket, A, just slides in it nicely. This bracket is screwed to the inner tube. To the outer tube is also screwed a somewhat similar bracket, B, whilst through the boss on it passes a very fine screw, forming part of the milled head. At the



upper end of the inner tube is soldered a ring, against which bears a spiral spring. Whilst the spring at its upper end bears against another ring soldered to the body-tube. The spring is, therefore, always in compression, and thrusts against the milled-head screw through the bracket A. If the screw be run up, the inner tube is raised, and the spring further compressed, whilst the reverse action lowers the tube by the spring forcing it down. Do not forget that the screw-thread must be a very fine one on the milled head. This is the usual form of fine adjustment. But where the body tube is carried on an arm, I prefer the adjustment differently arranged.—SUNLIGHT.

[45698].—**Leclanche Battery.**—Some months back, our friend, Mr. Lancaster sent a sketch of a similar battery to the one you now ask an opinion on; but his was in the shape of an inverted cone, with the zinc cast to correspond. I presume he selected that shape so as to expose the largest amount of surface possible; but he did not have any blotting-paper between as you suggest. If you think of making cells of this pattern, I should say a thin sheet of blotting-paper, much less than 1/16 in. thick would do, its purpose being only to prevent the impurities from the zinc and solution falling on the carbon and manganese. By the way, do not bother with coke—it is false economy, for I was in conversation with the manager of a gasworks the other day, and he says he has quantities that he cannot give away. "B. F." says he thinks this form of cell easily made, and I fail to see any advantage over the ordinary upright form. Also, he has a very great difficulty to contend with before he can make one, that is the connection to the carbon (not a plate of coke), in the bottom. I must say, after many years' practical experience, I do not know any plan that would be likely to last buried underneath: the connection would soon corrode through or become loose, and be very difficult to repair.—AN ASSOCIATE OF THE SOCIETY OF TELEGRAPH ENGINEERS.

[45700].—**Tools for Bending Iron.**—You do not say the form you wish the iron to take, but merely mention hooks and flat iron. If you will say, I will endeavour to send a sketch for them.—LORIDE.

[45704].—**Case-hardening.**—A cheap and clean way is to get a pennyworth of prussiate of potash, heat the bearings to bright red, well rub with the potash, let cool to dull red, then dip in water, put in endways and quickly. Use a charcoal fire, or heat in a sheet-iron cylinder over a forge—not in the open fire.—WORKING TOM.

[45704].—**Case-hardening Bicycle Bearings.**—There are several ways of hardening bicycle bearings. The best and most effective is to put them in an iron pot, covering them with fine bone-dust, and subjecting them to a gentle red heat for, say, from one to three hours. This will carbonise the iron according to the time allowed in the fire. When taken out they should be turned into cold water. Another way is to pound prussiate of potassium, and when you have heated the bearings in the fire, cover the parts intended to be hardened with the powder. This will liquify; and when you have spread it well over and allowed it to run

then immerse them in the water. You may also use cyanide of potassium, which is stronger, for a like purpose.—LORIDE.

[45705].—**Master and Apprentice.**—Let "R. S." Ipswich, read the terms of the indenture, and if the apprentice was only bound to his dead master and not also to his (the dead master's) heirs, &c., &c., the apprentice is free.—WORKING TOM.

[45705].—**Master and Apprentice.**—A great deal depends on what is said in the indenture, for apprenticeships are now vastly different to what they were in the old time. Technically, the London custom is for an apprentice to remain bound to the widow so long as she carries on the business, or the executor may find him another master—in fact, the apprentice may demand that: for obviously, if a premium had been paid, and the master died soon afterwards, the apprentice would be at a loss. So far as the law stands, however, the death of the master terminates the indenture, which is in the nature of a personal agreement; but I believe that if a premium has been paid, the executor must either find a new master, or refund a proportionate part of the premium. The matter is one for arrangement, or for settlement by the custom of the town; but if the apprentice so desires, he is clearly free, as the master being dead can obviously no longer fulfil his part of the contract. Only then, no portion of the premium can be claimed.—NUN. DOR.

[45705].—**Master and Apprentice.**—As a general rule, upon the death of either the master or the apprentice, the indentures are dissolved. In the case put by "R. S., Ipswich," unless the indentures especially provide otherwise, they are at an end upon the death of the master, and the apprentice cannot be legally compelled to serve his time with the widow, although as executrix she carries on the same business. A contract of apprenticeship is, of course, a personal matter; and so, upon the death of either party, it determines. If the apprentice wishes to serve under the new proprietor, he must enter into fresh indentures.—FRED. WITHERFIELD, 2, Gresham Buildings, Guildhall, London, Solicitor.

[45706].—**Piano-Strings.**—See reply to a precisely similar query on p. 144 (No. 864) of this volume.—W. H. DAVIES.

[45708].—**Removing Burnt Clay from Castings.**—If "Founder" will state the kind of castings he wishes to make, I will endeavour to assist him. Prevention is better than cure.—CAST IRON.

[45709].—**Gilding Solution.**—Designs or ornaments of any kind can be produced on glass or ivory, by painting, with a very fine camel-hair pencil, nitro-muriate of gold over the designs. Hold the glass or ivory thus painted over a bottle, in which hydrogen is being generated; in a short time, the design will shine with considerable brilliancy, and will not tarnish upon exposure to the air. The thickness of the coating of gold is not more than the 10 millionth part of an inch. Another method, in which the use of hydrogen is dispensed with, is to mix gold powder with borax and water; then paint the lines and ornaments with it. When quite dry, the glass is to be put into a stove, heated to a high temperature. The borax is vitrified and cements the gold with great firmness to the glass. To make gold powder, put into an earthenware mortar some gold leaf, with a little honey or thick gum-water, and grind the mixture till the gold is reduced to extremely minute particles; when this is done, a little warm water will wash out the honey or gum, leaving the gold behind in a pulverulent state.—F. I. C.

[45715].—**Valves.**—How do you know that it is not the piston that is leaking, and what tests have you applied? By "valves," I presume you refer to the slide-valves, and not the pump-valves. If the slides are leaking, if not much, it might be rectified by filing and rescraping. It grooved at all, it will need to be replanned. If the leakage is trifling, then scraping would perhaps put it to rights. But if you are not well up in scraping a surface, do not attempt it, but employ a competent mechanic. If the pump-valves only, it would not be so difficult a job, especially if the valves are not of the "ball" class. But take my advice and do not attempt to meddle with the slides, unless you are well up in that class of work. You may easily do mischief that would cost you pounds a year in steam wasted.—SUNLIGHT.

[45716].—**Old G. W. R. Engines.**—The "Thunderer" was an engine built by Brunel, and constructed by Messrs. Hawthorn in 1837, the patent being that of Mr. T. E. Harrison, who later on became chief engineer to the North Eastern Railway. The boiler was on a separate six-wheeled frame, the engine proper running in front with four-coupled 6ft. wheels. The cylinders were 16ft. by 20ft., and the shaft spur-gear 3 to 1 on the driving axle, thus making the driving-wheels revolve as rapidly as if they had been 18ft. in diameter. Boiler, 44in. diam.; 135 tubes, 1 1/2 in.

ince recent statutes this is not at all a
er. But even as matters stand there is
for upon the death of the trustee, the
descend as trust property to his legal
ive. There is no way of showing that
stock stands to a trust account, as the
England will not notice an equitable
trustee might make a declaration by
held the stock upon trust, but an affi-
l be useless. To appoint a new trustee
plan; and there should always be two
least, so that, on the death of one, the
ake as survivor.—FRED. WETHERFIELD,
Buildings, Guildhall, London, Solici-

Trusteeship.—The proper course is
a new trustee. The surviving trustee
control over all the funds, and cases
seems rare where a sole trustee has ap-
trust money, and the defalcation has
covered for years, he having paid the
ut of his own pocket. The deed of ap-
eeed not cost much, as it could be en-
sement, and the expense could be
ng a portion of the stock. If a new
ot appointed, a memorandum of the
the investments might be endorsed on
nt and signed by the trustee; but this
security against his dealing with the
—G. J. M.

AND SCIENTIFIC NOTES.

Bicycles.—With the New Year, says
manufacturers will be re-issuing their
for the ensuing season, and riders in
be on the look-out for the good things
any intending purchasers will doubt-
be wondering "what they're going to
id there are many expectant ones, we
fully anticipate a general reduction in
882. In this, however, they are mis-
ough we often see writers in the
and cycling papers very sagely urging
n that machines of the very best quality
made and sold for £10, and then yield
d profit to the manufacturer. This
unds very well to those who have never
ug to do with "the trade" or with any
ing concern, and is certainly plausible
he casual observer, who begins to calcu-
r pound of steel and rubber, and hav-
this to his own satisfaction, he sets
ice upon the cost of labour and the
to produce a machine, and having
figure on this point, sets the two to-
imagines he is "well over" the nett
ines to the manufacturer. The cost
ine thus reckoned out is necessarily
ow—say £6 to £8—and the scientific
once thinks he knows everything, and
rites about the enormous profit manu-
ust make on good machines, bringing
bening argument very often the pro-
em, "If a machine can be made and
as they are in Wolverhampton, how
should a good machine cost of double
?"

as Food.—When cream is added to
and the mixture is curdled, it forms
eese as double Gloucester and Stilton.
milk alone is used, the cheese is less
called Cheddar. We then get inferior
single Gloucester, Cheshire, and
At first every variety of cheese is soft,
tasteful, but by keeping it undergoes
d is said to be ripe. The change is
upon the growth of fungi and the for-
atty acids. Practically, it amounts to
agulate the nutritious part of milk,
ake this fluid as the highest type of
it is, as animals will sustain life for an
riod upon it, we shall find by reason-
ed out how valuable it is as food. Sir
mer said some months ago that a pint
s equivalent in nutritive power to an
itton chop; and as a pint of milk will
oz. of cheese, we have a highly con-
nd cheap food. Celsius wrote 1,600
favour of a peculiar compound which
ade, and which consisted of a mixture
rd, honey, and cheese, and which he
g food; and in some interesting letters
red in the *Times* a short time ago, we
an old Wykehamist that the boys 70
ad for their breakfast bread and cheese
id again at nine o'clock they were fed
manner. The Italians live to a great
eese and Indian corn. In fact, around
Como, these two foods, with a little
ric, form the staple food of the people.
he common people eat enormously of
h you can buy in the form of a goat,
ted milk being fanned into the skin.

UNANSWERED QUERIES.

The numbers and titles of queries which remain un-
answered for five weeks are inserted in this list, and if still
unanswered are repeated four weeks afterwards. We trust
our readers will look over the list and send what information
they can for the benefit of their fellow contributors.

- 45174. Atlantic Cable of 1865-66, p. 218.
- 45181. Recovering Metal from Founder's Ashes, 218.
- 45182. Leather Rollers, 218.
- 45184. Multipurpose Lathe, 218.
- 45186. Jewel Pin, 218.
- 45188. Glazing Ornamental Pottery, 219.
- 45194. White Marble to Stain Black, 219.
- 45200. Old Coin, 219.
- 45203. Dynamo-Machine, 219.
- 45212. Lathe, 219.

- 45411. Bending over Edges of Tin, p. 312
- 45415. Cement for Bicycle Tires, 312.
- 45419. To Produce Smoke and Soot, 312.
- 45431. Phosphorus in Iron Ores, 312.
- 45430. Driving Clock for 4in Cooke Equatorial, 313.
- 45452. To "Clerkenwell Clockmaker," 318.
- 45465. Double Star, 313.

QUERIES.

[45737].—**Woolen Manufacture.**—Can any reader tell me of any work on the above?—D. C.

[45738].—**Thermometer.**—Will any kind reader inform me how to renew the marks of degrees and figures on a boxwood thermometer that are nearly worn off from exposure to the weather, and oblige!—TERRANT FARMER.

[45739].—**Cattle Barking Trees.**—Is there any composition for rubbing trees with to prevent horses, or other animals, from barking them? Any effectual prevention will much oblige.—ARNOX.

[45740].—**Organ Stop.**—In Clarke's work on the Organ, a stop called "Pedal Check" occurs in each of the specifications. Would Mr. Warman, or Mr. Dresser, kindly say what the effect of this is, as I have not seen it in any instrument?—AMATEUR.

[45741].—**Civil Service Strictures.**—Will some of the readers of the *ENGLISH MECHANIC*, who are conversant with the above, please inform me if the Civil Service Commissioners are very severe as regards the nomination of candidates who, supposing them to have passed the necessary examinations, are short-sighted? I should like to receive a definite answer.—IMPAIRED OPTIC.

[45742].—**Grinding Model Taps.**—Would "Sunlight," or any other efficient reader, kindly say the best mode of grinding very small model taps? Have tried emery, but cannot get them steamtight.—STAN-LIGHT.

[45743].—**Hydraulic Organ Blower.**—I have partly succeeded in making one of these, but when I attached it to organ found that it made too much noise. This seems to be the water thumping in the pipes; and, when the water is nearly out off, there is a very loud hissing through the pipes. How can this be stopped?—AMATEUR ORGAN GRINDER.

[45744].—**Curious Method of Suction.**—A friend of mine states that he has thrown a length of 3in. indiarubber piping over stern of vessel going full speed, dropping the other end into bilges, and, by these means reduced the water arising from a leak. He asserts that a vacuum is formed; I regard the idea as absurd. Am I right? Taking 10ft. as the exact height the water has to be raised.—P. F. O., Liverpool.

[45745].—**Artificial Limbs.**—I should like very much, and I have no doubt that several others would be highly, and I am sure, instructively interested, if any of your accomplished correspondents would give a paper, or papers, on the above subject for application for "Symos" operations. This branch of art, I think, requires and calls out loudly for great development in many respects, especially in the natural imitation of the "Tendo Achilles," and joints, &c. I, as a regular reader, and I am sure others, would be highly pleased to see a series of most useful and instructive information on this subject for different applications. The best so called makers are behind time greatly, and, I think, should be a step in science that requires more attention.—F. H. R.

[45746].—**Oxalate of Iron.**—Can any reader oblige me by telling me how to make oxalate of iron from sulphate of iron?—J. H. C.

[45747].—**Platinum Amalgam.**—How is the platinum amalgam used in the contact-breakers of large induction coils made?—ETA.

[45748].—**Mounting Engravings.**—Wanted, a few hints how to do this properly. When I place them on the mount dry they bulge in the engraving. If I damp the engraving, when dry it bulges the mount and pulls it into all shapes.—J. W.

[45749].—**Gases.**—Will "Sunlight," or others, answer the following?—What in detail is the nature of the chemical change in the gases during respiration on an average in men and horses? Also, what is the result of the combustion of 1lb. of ordinary gunpowder?—LEO.

[45750].—**Expansion.**—What will be the effect of a reduction of pressure from 30in. to 29in. of the barometer on a mass of gas of 1,000ft. (cubic) capacity? Kindly give a formulae for calculating the increase in volume of a mass of gas under a reduction of pressure.—R. D.

[45751].—**Preserving Amalgamation on Zinc Battery Plates.**—Can any correspondents inform me by what means I can preserve the mercury amalgamation on zinc plates? About a week after amalgamation, although not used, my battery plates become dark in colour and partly covered with a white crystalline substance. What is the probable cause and remedy of this?—J. W. B.

[45752].—**Softening Hard Iron.**—Wanted, a practical and efficient means of softening hard iron so that the iron retains no magnetism after being placed in a strong magnetic field.—J. W. B.

[45753].—**Taking Out Piston.**—Will some of "ours" tell me the correct way of taking out and unlacing a piston 24in. diam.? It is one of Mather and Platts' make.—ALPHA.

[45754].—**Polishing Covers of Cylinders.**—What is the best for polishing and keeping bright the covers of high-pressure cylinders?—ALPHA.

[45755].—**Improved Gaslight—Carbon Substitute.**—Will Albert Smith please give me the process for the preparation of chloro-chromic acid? And, also, how it is used so as to get the perfectly white light of wonderful power!—GAS-WORKS MANAGER.

[45756].—**Stays v. Corpulence.**—Some few years back there was a correspondence in the *ENGLISH MECHANIC* as to wearing stays for corpulence and indigestion. The majority then recommended gentlemen to wear stays or a wide leather belt with a broad steel busk. I should be obliged if some gentlemen who have worn stays for that purpose, would say what their opinion now is? I am getting much too corpulent—it is not want of exercise or too much eating. I have drunk no malt liquor or wine for the last seven years. I should be glad to ascertain what kind of stays or belt, if any, is the most suitable.—OLD SUBSCRIBER.

[45757].—**Bridge.**—Can any of your readers give me some information as to the most suitable kind of bridge under following circumstances?—The river is 50 yards across with high steep banks, it is subject to floods, and at such times carries down large trees, &c., which, accumulating against the supports in the middle of the stream of the usual kind of bridge, causes them continually to give way, and for this reason I think a suspension bridge would be best. The bridge must be capable of bearing a loaded waggon, and be moderate in cost. Good timber can be had at a low price, and unskilled labour is also cheap. My farm being divided by the river is the cause of my requiring a bridge. Would a Puntoon bridge be difficult to put up?—M. I. E.

[45758].—**Hay-Press.**—Can anyone give me plain instructions how to make a portable hay-press to press 100lb. of hay into bales of following dimensions?—Length 3ft. 6in., breadth 1ft. 2in., depth 10in. The hay must be wired under pressure, and adequate provision must be provided for so doing with convenience, to be worked by man or horse-power.—M. I. E.

[45759].—**Noisy Fan.**—Would some of your correspondents inform me the reason of my fan, which is a new one, making such a terrible noise? It is one of Clarke's improved Schiele fan. It is what they call a 10in. It revolves a little over 4,000 per minute, and is required to blow two smith's fires.—A. SMITH.

[45760].—**Motor for Dynamo—Electric Machine.**—Would "Sunlight," or anyone of your subscribers, kindly advise the cheapest motor for the above? A gas-engine, so far as I have yet seen, would be too expensive. I have both water and gas at my disposal. The power of what I want should be about 1 h.p.—ELECTRICIAN.

[45761].—**Concrete Pigsties.**—I wish to build some pigsties, and should be much obliged if any of your readers will give me information on the following points:—1st, Is concrete cheaper than brick for the walls and floors? Also, the exact cost of concrete per foot? 2nd, Can I make concrete myself? And, how? 3rd, Where can I get the materials? 4th, Give full directions for building the walls and laying down the floor. Or, refer me to some book which gives detailed instructions on these points.—W. D.

[45762].—**Boat—Tabernacle.**—I am just finishing a small half-decked sailing-boat to carry a 12ft. mast pivoted in a tabernacle at a point about 3in. above the deck, but I want to arrange the tabernacle so that, when desired, it can be lifted out of the boat through the deck, mast and all, and yet be sufficiently firm when in place to support the mast without shrouds or forestay. Depth from top of deck to top of keel, 2ft. 2in. Any hints will much oblige.—P. B. H.

[45763].—**Steam Tricycle.**—Can any reader inform me if it is practicable, having only one engine for this purpose, to use a flywheel and transmit the power from same to driving axle? By doing this, can perfect control be kept over machine? Could it be speeded to ten miles an hour? A sketch, showing the best position of having the flywheel and engine, will oblige.—STAN-ROVER.

[45764].—**Clarinet Tuning.**—I have a Clarinet nearly finished as regards the making, and then I come to (as I suppose) the most difficult point—viz., the tuning of the instrument. That which appears to me the most difficult is to find a standard instrument to tune by. I have a good B flat clarinet, and I might get it nearly correct by getting someone to blow the B flat while I tried each note on the new one; but it is a known fact that some men blow sharper or flatter than others on the same instrument. I might also tune it to a friend's harmonium, but I have doubts as to its correctness. Will some "brother-worker" please pass an opinion on the following?—Is it possible to make a pitch-pipe after the manner of an organ pipe, about 1ft. long, to speak an octave by semitones by means of a sliding stopper, and to be blown by means of a harmonium bellows? If practicable, I shall be very thankful for the diameter of the pipe and the correct distance (from block to stopper) for each semitone from C to C. If impracticable, any other method for arriving at the desired end will greatly oblige.—OLD BLOW HARD.

[45765].—**Watch—Jobbing.**—Will any watch-

making subcylinder inform me how to tighten barrel-holes that have become worn?—**CRABTOL.**

[45765].—**Watch Fusee Chain.**—Will some of "ours" tell me the best way to mend watch fusee chain? What kind of tools to use to hold it? And, whether a needle is best for a rivet?—**BASIL AMO.**

[45767].—**Comparative Light of the Moon and Planets.**—Will any of our astronomical readers be good enough to inform me, if possible with references to authorities, 1) What is the comparative quantities of light given to us by the Moon, Jupiter, Saturn, and Uranus when seen under the same conditions with the naked eye? 2) What is the comparative light given by the Moon and the planets named when the latter are raised by the telescope to the apparent size of the Moon—say, half a degree? 3) What allowance in the second case has been made for loss of light in the telescope?—**S. H.**

[45768].—**L. and N. W. Engines.**—Will some of "ours" favour me with the numbers of Atlas, Ousecliff, Elwy, Wyre; the dates of Baltic, Cambrian, Caractacus, Commodore, Centaur, Cathness, Canning, Crane, Delmore, Dalton, Duke, Gazelle, Hercules, Heate, Hush, Kestrel, Langdale, Mammoth, Medea, Mastodon, Magnet, Maberly, Monk, Pegasus, Salopian, Typhon, Talisman, Trafalgar, Tubal; the sheds of Atlas, Alaric, Burmah, Caractacus, Commodore, Councillor, Canning, Gabelle, Herald, Hardwiche, Hush, Latona, Londale, Mammoth, Marlborough, Magnet, Petrel, Pegasus 1840, Sir Alexander Cockburn, Sedgewick, Trafalgar, Zygia?—**PIONEER.**

[45769].—**Medical Coil.**—To **MR. LANCASTER.**—On May 27, 1891, you gave a drawing of a medical coil, but not particulars. I want to make a good one. Would you please give me the following particulars?—Length of coil? Size of reel ends? What gauge core and diameter? How many times should brown paper be wound for making core? Primary No.? And, how many times wound on core? What numbers of the different wires? And, how much of each to make six or eight powers? I shall put a draw-tube in, and would contact-breaker be better separate? Or, would it do at the core end, the wires projecting a little? The wires want all joining from each stud, but how are they and the terminals connected for the handles to be fixed? I doubt not many readers would appreciate a full and easily understood reply. I shall.—**INQUIRER.**

[45770].—**Lead Wire.**—Will any brother reader of "E.M." kindly inform me the best way of making lead wire of about $\frac{1}{16}$ in. or 3-16 in. diameter?—**COLUMBIA.**

[45771].—**Air-Pump.**—To "SUNLIGHT," or OTHERS.—The bucket of the air-pump of my condenser is worn so bad that by putting water in front of bucket it runs past it. I am quite unused to condensers, so I hope "Sunlight," or some other reader, will tell me what to do to it. It is driven from lock end of piston. I replaced the valves of engine during the holidays, and should have done the pump, but had not time to do so. I got 25 in. vacuum, but very unsteady. I had just 20 in. before I did the valves, but I hope to have 28 in. when the pump is done. Will it require to go to the workshop? Or, can I do it myself? I have got a good lathe if that is of any use. Can it be done on a Saturday afternoon? What is the best thing to pack it with?—**M. C.**

[45772].—**G. E. Engine.**—Would some correspondent kindly give particulars of No. 251 Great Eastern passenger engine? And, say where stationed?—**H. W.**

[45773].—**Traction Force of Locomotive.**—I should be glad if some one would inform me of the best means of calculating the traction force of a locomotive?—**H. W.**

[45774].—**G. W. R. Engines.**—Wanted, the dates to the following engines:—163, 670, 682, 710, 713, 914, 935, 943, 1118, and 1126.—**C. H.**

[45775].—**Glueing Steel to Wood.**—Would any correspondent give me a recipe for making glue for putting in shuttle tips?—**LOOM JOKER.**

[45776].—**Screw-Cutting.**—Would the ingenious contrivance for screw-cutting described by R. Hindley 19391, page 425 be applicable for cutting female threads? If so, would he kindly give particulars?—**S. M.**

[45777].—**Paraffin Lamp Reservoirs.**—I find a good deal of annoyance from paraffin oil creeping over the outer surface of lamp reservoirs, &c., and dripping. Is there any varnish or material repellent to the liquid, or other means of preventing this?—**X.**

[45778].—**Old Chisel.**—Will any reader kindly inform me the best method of hardening and tempering a cast steel cold chisel for sledge-hammer use, as I have great difficulty in getting them to stand?—**J. S. G.**

[45779].—**Largest Wheel of G. W. Engines.**—Can anyone give me the diameter of the largest wheel on any G.W.R. engine?—**J. S. G.**

[45780].—**Engine for Launch.**—Will "Sunlight," or any reader, please inform me if an engine with single cylinder 34 in. stroke by 2 in. bore would do to drive launch 18 ft. long by 6 ft. wide by using boiler proportionally large?—**AMATEUR BOATBUILDERS.**

[45781].—**Engine-Whistle.**—An engine on Bow and Fenchurch line sounds two notes when it whistles. Are these produced from one or two bells? And, what is the advantage?—**HARMONIC.**

[45782].—**Oxy-Hydrogen Dissolving View Lantern.**—Will "Sunlight" be kind enough to inform me whether my lantern, which has 4 in. condensers, can be fitted with the electric light? If so, will he also be good enough to state the cost and give details of apparatus?—**B. J. PINKNEY.**

[45783].—**Faint Photograph.**—I have an old photo. on glass; the likeness is excellent, but very faint. Could it be copied by photography or any other means? Any suggestion would be kindly received.—**H. T.**

[45784].—**Erecting Equatorial.**—Will "F.R.A.S." tell me what angle to set polar axis is to of an equatorial at Liverpool?—**A MECHANIC.**

[45785].—**Sp. Gr. of Glycerine in Jordan's Barometer.**—Will some reader kindly inform me what is the specific gravity of the glycerine as used in Jordan's barometer? And, where it may be obtained?—**J. M. S.**

[45786].—**To Mr. L. Wright.**—Would that gentleman add to his already numerous favours by giving the details of Mitscherlich's experiment, especially with reference to thickness of selenite and method of applying heat?—**L. V.**

[45787].—**"D. H. G.'s" Overhead.**—Being very desirous of having one of these fitted to a lathe, I have made one from the instructions in the "E.M." with the exception of the supplementary rocking-frame, which part of the apparatus I cannot quite make out. Will "D. H. G." give further explanations, or allow me to address him through the post? I advertise my address in the "Address Column."—**W. L.**

[45788].—**Wind-Power.**—Will any kind reader give me some idea how to make a wind-wheel to pump water from a well for a small country-house? And, how, after having raised the water to a tank say, 20 ft. above ground, some of the water may be used to work small domestic machinery?—**VULCAN.**

[45789].—**Sulphurous Anhydride from Vitriol Chambers.**—Will one of our kind contributors kindly give me full particulars of the method employed by the Government Board for the estimation of the sulphurous anhydride escaping from vitriol chambers? Also, I should like to know how the nitrous fumes may be estimated?—**GRACIAN.**

[45790].—**To Mr. W. H. Davies.**—I have a cottage pianoforte of 6 $\frac{1}{2}$ octaves, the low note beginning with C and going to B with lapped wire. Now, that octave I wish to leave, but I wish to re-wire the next five higher octaves. But what I wish to know is the number of wire to procure? And, how many notes in one octave will one thickness of wire do for, before I must begin with a smaller wire. The 6 $\frac{1}{2}$ octave at the top end I wish to leave.—**ONE IN A FIX.**

[45791].—**Galvanic Action on Screw-Propellers.**—I have just seen a cast iron propeller that has been on a steam launch for a few months. The launch was copper bottomed, and was kept in salt (sea) water. The propeller (or, rather, the remains of it) can be cut with a knife like chalk, and has something the appearance of plumage. Will some reader kindly tell me what it is? And, explain the chemical action of an iron-copper Voltaic couple immersed in sea-water? What precautions should be taken when having a new propeller? Would not a gun-metal propeller be the best?—**MORFUS.**

ANSWERS TO CORRESPONDENTS.

* * All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 31, Tavistock-street, Covent Garden, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

* * Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 11, and unacknowledged elsewhere:—

Rev. J. H. COLW.—R. McCowen and Co.—H. A. Ivatt.—Rev. W. Haslam.—Rev. W. H. Wright.—R. Smith.—E. F. Johnson.—L. R. W. H. Brown.—P. Digges.—H. Ash.—E. R. Dale.—H. C. Brett.—R. Martyn.—A. J. Compton.—W. H. Neill.—J. Hagger.—J. Wood.—Dr. Wilkins.—Phosphor Bronze Co.—R. Mills.—G. Highway.—Rev. T. Colquhoun.—R. E. Quinn.—W. Ersk.—Vulcan.—Vital Spark.—Clerical Bicyclist.—Larn r.—E. T. Scott.—J. Hofer Mincer.—Mersey.—M. C. H.—W. H. M. reer.—Ignoramus.—A. Fellow Workman.—J. H. P. Beveridge.—Traction.—R. C. Johnson.—J. Mordred.—G. B. J.—E. Thompson.—Geo. Bevis.—J. Bull.—E. B. F.—Pegandreduff.—Plasterer.—S. Roswell.—E. B. Rincer.—C. Aliquando.—L. L. B. A.—Omega.—G. Schfield.—66 Inch.—W. J. Lancaster.—Sigmund.—Orderic Vital.—E. P.—Bend Or.—Rudimentary.—M.I.C.E. Major Arnstrang.

TOM BROWN. (We do not think that any subject has been more fully treated in our columns from Vol. X. to the present time than that which forms the subject of your query. See the last No., recent back numbers, and the volumes referred to.)—**W. H. A.** (The questions about marine engines were answered over for all on p. 100, Vol. XXXIII. It is No. 836.)—**INQUIRER.** (Sold at most toolshops; but see a note on p. 435 last week.)—**BOOKS.** (You will find a useful article on home-bound books on p. 377, Vol. XXX. It is No. 770.)—**SPARK.** (If you were to give us "some idea" of the kind of electric machine you want, we might be able to refer you to a back number wherein you would find "some

idea how to commence.") We do not wish to discourage you, but really querists ought to have "some idea" of what they want.—**E. A. B.** (We suppose by your reference to a 1 h.p. engine that you desire to use it for creating current to be stored up for use at night. For that purpose you will need a small dynamo-machine, and a number of Faure batteries. You will find much information on the point in back volumes.)—**INQUIRER.** (The process is known as whitening, and consists simply in removing oxide and the base alloy from the surface. The simplest is to heat to a red, and then boil in sulphuric acid and water (1 to 40). If the silver is of low quality, no whitening process is available, for that depends on producing a coat of pure silver by removal of alloy. The method pursued is to electroplate with a thin film of silver.)—**BOOKS.** (Several in back volumes; but see p. 33, Vol. XXXIII.)—**AMATEUR.** (See recent back numbers and previous volumes.)—**H. H.** (See p. 216, last volume, and don't spoil a good servant to make an instrument of doubtful utility.)—**BLACK-BLOCK.** (We believe not on the North London. The Midland have some so fitted. The gauge belongs to the Westinghouse brake. The L. and N.W. have some of Smith's brakes. You can see full particulars of the numbers in the report issued by the Board of Trade. See p. 43, present volume.)—**DOWN JOINT.** (The position is to be obtained only by applying to the Boiler Insurance Companies, and they need men of experience.)—**H. D.** (Clean the rust off, or use new wires. Keep it dry. Dip good thin paper (bank post) in melted paraffin wax.)—**H. B. B.** (Any of the ordinary sizes supplied for battery use will do—say, 3 to 8 mm. About 4 to 6 in., according to size, and also according to current. No definite reply can be given.)—**W. W.** (We do not know how port wine is made. It is supposed to be the product of certain kinds of grapes grown in Spain and Portugal. See a cyclopaedia. Gin is made from alcohol, obtained by distilling saccharine and starchy matters; the spirit is rectified, flavoured, and reduced to taste and price. Properly it is corn-spirit flavoured with juniper berries or oil of turpentine. Rum is made from the waste syrup and molasses of the sugar-makers. It is made only where sugar is grown. 2. You mess steel, not iron. See indices. 3. Consult a handbook of British birds.)—**A MECHANIC.** (The last instalment appeared on p. 39, present volume.)—**N. K. S.** (Come and Blackwell, Castell and Brown, or some of the other large makers might take it up. You will find their addresses in the Directory.)—**AKAKIA.** (We fail to find the sentence in which you wish the intermission to be introduced. We think the other matter has been sufficiently replied to.)—**J. SMITH.** (Your informant is wrong, as you will very soon find out if you begin, and it gets to the ears of the Excise authorities.)—**SIMPLICITY.** (In every way desirable, but we are unable to name a shipowner or manufacturer who would take the matter up.)—**A. N.** (Write to the Secretary of the Civil Service Commission, Lord n, S.W.)—**JAWELLER.** (Your windows are too air-tight. You must get ventilation somehow, and then the unpleasantness complained of will cease.)—**PHILIP.** (The annual license costs £3 6s. or £5 15s., according to quantity sold, and is, we believe, renewable at the beginning of each year.)—**LAWYER.** (1. Riddan's; your other queries next week.)—**J. BROWN.** (Your letter on Patent Law in type.)

W. H. HARRIS.—Your query can only appear in the "Sixpenny Sale Column."

S. FAURE.—Young Turner.—Akakia, and others have replied to queries similarly or adequately answered.

USEFUL AND SCIENTIFIC NOTES

Legal Queries.—Mr. F. Manley Wetherfield has kindly consented to answer any legal queries put by our readers, and has commenced this week. Mr. Wetherfield is the editor of the *Commercial Law Annual* (London: William Cate), just issued for the 13th time, and which is a most useful volume. The book contains an almanac for the year, with the usual information and the legal fixtures, together with an analysis of the practical statutes of 1881; hints on evidence for plaintiff and defendant; practical points and recent cases in bankruptcy, liquidation, and composition with creditors; the new practice in probate and administration, with hints for executors and administrators; useful hints on County Court business, with forms of particulars, &c.; the Customs and Inland Revenue Act, 1881; the Alkali Act and the Conveyancing and Law of Property Act, complete; the Bills of Sale Act, 1878, complete, with notes, forms, and recent decisions; the Employers' Liability Act, 1880, complete, with rules of procedure, forms, notes, and cases; the Married Women's Property Acts, 1870 and 1874, complete, with notes and cases on wife's separate estate, and husband's liability for wife's debts; contracts with infants; imprisonment for debt; recent important commercial cases; solicitor's costs and charges; tables of stamp and Excise duties, and a copious collection of useful forms.

HOLD a cold chisel firmly to its cut without removing it at every blow. This will increase the effectiveness of the tool, and there will be less danger of breaking by a foul blow.

To clean grease from bolts, moisten them in benzine; roll in sawdust, and brush off.

To fit a key, smoke the blank over a candle. Insert it into the keyhole, and press it hard against the wards of the lock. The indentations in the smoked portions will show where to file.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, JANUARY 20, 1882.

LAWSON'S BOILER-EXPLOSION EXPERIMENTS.

WITH the view of discovering some of the more recondite causes of boiler-explosions, experiments have occasionally been made in this country and in the United States, which have helped to explain a few of the most puzzling incidents of these constantly-recurring accidents, and possibly those conducted by Mr. Lawson at Pittsburg, during the last summer, may not be the least valuable of them. We have previously briefly recorded the results of his experiments, the main feature of which was the fact that a boiler was made to explode by suddenly releasing the pressure—that is, by simply opening a valve admitting the steam to a closed cylinder. Before the well-known experiments at Sandy Hook were made, it was held by many that the sudden opening of a large valve in connection with a boiler containing highly pressed steam was sufficient to cause an explosion, but the commissioners of the United States Government applied this test ten or twelve times and failed to produce any effect whatever—the steam simply rushing out without affecting the boiler in any way. So long as the flow of steam is continuous, the rapidity of the escape is not dangerous; but it is contended that given a boiler the water contents of which are ready to flash into steam the instant the pressure is removed, a concussive effect is produced, if the flow of steam is as suddenly checked as it is started. In other words, the sudden stoppage of the flow acts as a blow given on every square inch of the boiler surface covered with water, and this blow is assumed to be irresistible. This view is met by the fact that water, however highly heated, does not all flash into steam at once, when a valve of limited area is opened, and that, no matter how suddenly the flow of steam is checked, it still acts as an elastic cushion, though it may have a pressure of 300 and more pounds per square inch. Another contention is that if cold water be injected into a boiler so as to come into contact with the steam, the latter is instantly condensed, the pressure is removed from the water in the boiler, and an explosion follows. The supposition in this case is that the steam is so instantaneously condensed that a sort of vacuum is formed, which is filled as instantaneously by a portion of the water flashing into steam; but there is no evidence that water flowing into the steam-space of a boiler can condense steam under pressure, and there is no reason to suppose that if it does condense the steam it can rob it of its elastic properties. Mr. Lawson, however, contends that many explosions have been caused by the water striking hot steam instead of hot iron, and that many attendants have been unjustly censured for negligence. In this connection it is not impossible that he thinks explosions caused by shortness of water have been brought about by the feed suddenly turned on coming in contact with red-hot iron—a very common idea, but one that is not supported by proof. So far as all experience teaches, steam is not generated suddenly and with explosive force when water touches red-hot iron in a closed vessel, and though boilers are burst and sometimes exploded through shortness of water, it is not so much

because the feed has been incautiously turned on, as because the crown-plate of the furnace, having become hot, is weakened, and coming down rests at one of the seams. Where the plates are of good tough iron they are forced down without rupturing, as the records of our boiler-inspecting societies testify in hundreds of cases; but there is no reason to suppose that the pumping of cold water on to the red-hot plates does anything more than damage the iron and rapidly develop steam—unless we are to assume that the water coming into contact with red-hot iron is decomposed and is subsequently re-composed with explosive violence, a favourite hypothesis which, however, scarcely holds together, because in the event of decomposition of water in the presence of red-hot iron the latter immediately commences to combine with the oxygen. Still, boiler explosions do take place, and the simple explanation that the boiler was not strong enough is satisfactory only so far as it goes; the question that has to be solved is, why the boiler should yield all at once, instead of giving way gradually at some seam or weak place, and so establishing a leak that would relieve the pressure. The usual answer is that a boiler always fails at its weakest part, and that a rupture having once been effected, it proceeds so rapidly that an explosion is the result, as distinguished from a simple burst. Where one part of a boiler is so weak as to fail, while the surrounding parts are strong enough to withstand the strain, we have a simple burst—a magnified leak—the steam escaping without doing any injury, as in the case of a tube giving way, to take the simplest instance. It is, however, no very difficult matter to find in the records of the boiler-inspection companies, accounts of boiler-explosions which are inexplicable, except on the simple hypothesis that they were not strong enough; but the fact remains that the experiments made at Sandy Hook, and those carried out under the direction of the Manchester Steam Users' Association, served to show that it is not an easy matter to explode a boiler even when the pressure is excessive. Leaks, flaws, and ruptures can be made, but an explosion cannot be caused. Mr. Lawson's experiments, which did result in the explosion he was trying to produce, were carried on in the grounds used by the U.S. Commissioners a few years ago, the bomb-proof huts being still in good condition. So far as they go, these experiments prove either that Mr. Lawson's boiler was equally strong at every part, or that there is something about steam-boilers which is not yet fully understood. The boiler on which the test was made was a simple shell with flanged ends, the latter being $\frac{1}{2}$ in. thick, while the shell plates were of 3-16 in. iron, all of the best quality. The heads were tied together by a one-inch rod firmly bolted, and care was taken to keep the fire-line considerably below the water-line, so as to avoid any chance of over-heating the plates. The length of the boiler was 6 ft., the diameter 30 in., and it was filled with water to within 6 in. of the top, so that there was very little room for steam. We have no data as to the riveting, but supposing it to have been only single riveted, by the formula $P = T \times c / D$, the bursting pressure would be 329 lb., T being thickness of shell, c a constant taken as 1097 for wrought iron single-riveted, and D the diameter in quarter-feet. Mr. Lawson says he calculated that a force of from 400 to 500 lb. would rend the boiler, but the U.S. Government rule made the bursting pressure 625 lb., and putting the iron at the tensile strength which some experts allow, it would be 712 lb. to the square inch. The results of the experiments may possibly have convinced the experts that their estimate of the strength of the iron of which the boiler was made is

rather high, but it shows at any rate that the older rule adopted in this country is much nearer the truth than even that which gives 625 lb. as the bursting pressure of such a boiler as we have described. Theoretically, we know that a boiler strained to its bursting point should give way at all parts around its circumference at the same instant; in fact, be blown to atoms; but in practice, as the experiments above mentioned showed, there are invariably lines of less resistance along which the fractures go, leaving large portions of the shell often intact and apparently uninjured. It is said that Mr. Lawson's boiler was blown into a number of small pieces: it was "rent in twain four times transversely," though one of the heads was found with a portion of the entire circumference of the shell still remaining, and not a rivet loosened. That latter fact would seem to show that the boiler gave way all at once from weakness; but we must finish the description of the conditions. The shell, 6 ft. by 30 in. was built up in the ordinary way, and petroleum was allowed to flow into the furnace by gravity. The connection between the boiler and the cylinder was a 2 in. pipe, which, about 30 ft. from the boiler contained a quick-lifting valve operated by cord and pulley from the bomb-proof. This valve must have been very close to the cylinder, which was closed at both ends, and had only a small cock for letting out steam and water. A government steam-gauge connected by a $\frac{1}{2}$ in. pipe was fitted in the bomb-proof, about 40 ft. from the boiler. At the first test, pressure 65 lb., the index of the gauge vibrated to an extent of 15 or 30 lb., which continued at each trial made when the pressure had risen 10 or 15 lb. When a pressure of 165 lb. was reached, the bolts of the cylinder head stripped the threads, and the experiments were brought to a close. The vibration of the gauge-needle varying from 20 to 30 lb., although the gauge was separated from the boiler by 40 ft. of $\frac{1}{2}$ in. pipe, proved that a great commotion took place in the boiler every time the valve was opened; but there is no ground for Mr. Lawson's supposition that the gauge represented only one-tenth of the effect produced in the boiler, or that that effect was in the nature of a concussion. However, having repaired the damage and satisfied himself that the boiler would not explode until a pressure of about 400 lb. was reached, the experiments were resumed, and tests made at pressures of 260, 300, 335, and 365 lb., the "boiler remaining perfectly steam-tight, not a joint leaking." When the gauge indicated 380 lb. the valve was suddenly opened, and a report similar to that of a large cannon was heard, followed by the rattling of falling debris: the boiler had exploded. No water could be seen on examining the spot immediately afterwards, and the boiler itself was in fragments. A pressure of 380 lb. is equivalent to a temperature of about 440° Fahr., so that we can readily understand why no water was found; but it is not so easy to understand why Mr. Lawson should assert that the boiler was exploded by the concussive effect produced by opening a valve in a 2 in. pipe, the steam having only a few feet to travel before it was stopped. The boiler in question was no doubt well made of the best materials, and it exploded just as theory says it might be expected to do, when a pressure exceeding the calculated amount was reached. The formula gives the bursting pressure as about 330 lb.; this boiler failed, and failed all over, at 380 lb.; the experiments consequently prove nothing more than that when a boiler is already strained to its fullest extent, a very little commotion amongst the steam suffices to cause an explosion. It will be seen that the question turns on the strength of the boiler; by our formula it was very much less than by the Government

method of estimating sanctioned in the United States, and we suspect that the majority of engineers will regard Mr. Lawson's experiments as supporting the conclusions arrived at in the textbooks rather than the idea of a concussive effect which is irresistible. For such an experiment to support the views of Mr. Lawson, it will be necessary for him to show that a boiler which could stand the hydraulic test up to, say, 500lb., can be exploded by merely opening the valve leading to a closed cylinder, when the gauge shows a pressure of only 380lb. He will then have made an experiment which will deserve the attention of boiler-makers and steam-users.

THE TOTAL SOLAR ECLIPSE OF JULY 29th, 1878.*

SLOWLY, but perhaps not the less surely, is our knowledge of Solar Physics being extended by successive observations of those grand and impressive phenomena, Total Eclipses of the Sun. Nor does the Eclipse of which the records lie before us appear to yield much to any of its predecessors in the interest of the observations which were made, or in that of the deductions which have been derived from them.

From the noble quarto volume of 426 pages issued by the American Government, we learn that the preparations made for the study of this Eclipse in those parts of the United States lying in or near the line of totality were most extensive and complete; no less than twelve separate expeditions having taken part in the observations, and reports of various importance, together with a large number of sketches appearing from no less than ninety-three observers, some of them ladies. As is pretty well known, several of our own countrymen, including Messrs. Haskins, Lockyer, Loder, Penrose, Ranyard, and Schuster, crossed the Atlantic for the purpose of observing the Eclipse of 1878. Mr. Penrose, however, is the only one of these who contributes to the Volume of the U.S. Naval Observatory: Dr. Schuster having given an account of his observations in the *Monthly Notices of the Royal Astronomical Society* (as did, in fact, Mr. Penrose too), and Mr. Ranyard's observations having only just been issued in a separate form by the Society. The first thing which will strike the reader who possesses any familiarity with Eclipse literature, is the curious difference between the drawings of the Solar Corona of 1878 and that of 1870. Its most marked feature in the more recent eclipse is its enormous extension in the equatorial regions of the Sun, and its comparative absence in his Polar regions. There is a practical consensus of testimony that the outer corona terminated on the western side of the Sun, in a kind of fish-tail bifurcation; a structure existing, according to a few of the numerous drawings, in the eastern part of the equatorial Corona too. Curiously radiated thin streaks of light are shown by some of the observers as issuing from the Sun's polar regions. As we remarked, however, in reviewing Mr. Ranyard's admirable Eclipse Volume (XLI.) in the *Memoirs of the Royal Astronomical Society* (ENGLISH MECHANIC, Vol. XXXI., page 223), there is nothing more curious than to note, under what a totally different aspect, two persons, even drawing side by side, may delineate the same object. In the American Volume facsimiles of the original sketches are given, and while some observers appear to have noted accu-

ately the difference of intensity between that part of the Corona immediately circumjacent to the sun, and the fainter outer one to which the projections of which we have just been speaking belong; others seem to have seen little or nothing beyond the bright and narrow Coronal Ring, which nearly followed the Sun's outline. It may, though, now, we think, be held to be an established fact that this extension of Coronal matter in the direction of the Sun's Equator is a characteristic of periods when there are few sunspots; the wonderfully curved and complicated structure, and the more equable distribution round the Sun indicated in the 1870 photographs and sketches pertaining particularly to periods when sunspots are numerous. We may remark that Professor Newcomb ingeniously shaded that part of the sky in which the Sun and Moon were situated at the time of totality, by means of a disc mounted on a pole, and by thus hiding the central and more brilliant part of the Corona was enabled to trace a narrow ray of faint light some 6° on each side of the sun. "They struck me," says Professor Newcomb, speaking of these rays, "as having a great resemblance to a representation of the Zodiacal light on a reduced scale."

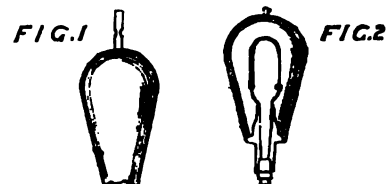
There can be now no doubt that the Coronal polarisation is radial, and upon the present occasion it appears to have extended without diminution down to the very limb of the Moon itself. In 1870, some of our readers may possibly remember that it distinctly became weaker as it approached the lunar limb. Polariscopic photographs, taken at La Junta, Colorado, seem to indicate that in 1878 polarisation decreased sensibly from the Moon's limb outwards.

The spectroscopic observations appear to point to the conclusion that the major part of the light of the Corona was reflected light. Mr. Ranyard succeeded in taking a photograph of the Eclipse with what he calls a "slitless spectroscopic camera," consisting, in effect, of a flint-glass prism of 45° placed in front of a very short-focussed object-glass. He had made elaborate preparations for photographing the Corona in a camera of 13in. aperture and 74in. focal length, belonging to Mr. J. Kennedy-Esdale; but after one plate had been properly exposed, the thoughtless mischief of a boy-assistant caused the camera to be moved off the Sun, and the remaining plates were, of course, failures. That Mr. Ranyard did not immoderate this youth upon the spot, would seem to speak volumes for his Christian forbearance and control of temper. It is curious and interesting to add that the very accidental shifting of the Sun's image on the plate, while taking the Spectroscopic photograph, has supplied us with most valuable evidence of the nature of the Coronal light. It is evident, from a study of this photograph, that the light by which the Coronal image was impressed came from the region of the H line in the Solar spectrum: in other words, that it was light of the same refrangibility as that by which ordinary terrestrial photographs are produced on the sensitive material. Hence the inference is obvious that the Corona must consist of discrete particles reflecting common sunlight; and not of glowing or incandescent gas at all.

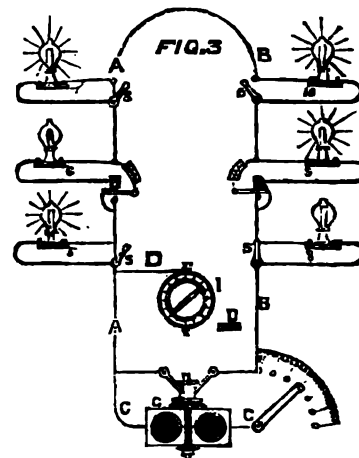
We commenced by saying that the study of the phenomena of successive Eclipses has added, and is adding, to our knowledge of the physical constitution of the Sun. It does so directly in a way which must be at once apprehensible. It does so indirectly by furnishing hints to future observers exactly what to look out for. Let us hope that the lessons thus taught will not be lost upon those upon whom the pleasant and important task of observing the Total Eclipse of May 17th will devolve.

EDISON'S NEW ELECTRIC LAMPS.

FURTHER improvements in his incandescent lamps have been lately made by Mr. Edison, the main features of which will be understood by the following diagrams and description, which latter also includes an account of his new arc lamp. The object of that part of the invention shown by Figs. 1 and 2 is to secure increased



economy in the manufacture of the lamps by simplifying the blowing of the glass globes, and secondly, to clamp the leading wires more easily and cheaply to the carbon filaments or bridges as they are termed. The blower takes the glass from the melting-pot, and shapes it as seen in Fig. 1, leaving an opening large enough to allow the carbon to be passed into the globe. The leading wires are laid through a glass tube, seen in position in Fig. 2, which has a swelled part to fill up the orifice left in Fig. 1. The wires at one end are firmly sealed by melting the glass around them. Where this sealing takes place the leading wires are of platinum, but on either side they are of copper, taking the form of copper ribbon where the connection is made with the carbon filament, in order that they may be wrapped around the bridge and have abundance of surface contact. The wires being sealed in the tube and connected to the bridge, the latter is passed into the globe and the two parts are firmly attached by melting the glass around the bulb or enlargement of the tube. Another feature of this improved lamp is a modification in the carbon filament itself, which is so made as to have a less resistance at one terminal than at the other. When carbon filaments are used for lighting by incandescence, it is found that the carbon is carried from the negative to the positive end—a phenomenon which has been described as "electrical carrying." The amount depends, it appears, on the resistance of the filaments, the degree of incandescence, the E. M. F. between the clamping-wires or electrodes, and the condition of the vacuum. To obviate this difficulty, as far as is possible at present, Edison makes one end of the carbon, the negative, thicker than the other, so as to reduce the resistance at that end of the bridge; but he says, definitely, that in the present state of the art, it is impossible to manufacture a carbon which will not eventually be destroyed. The tube seen at the top of Fig. 1 is for attaching to the vacuum apparatus, and when the globe has been exhausted or otherwise completed, it is melted off and sealed, as seen in Fig. 2. To prevent any serious inconvenience from failure of lamps, arrangements have been made by which two can be placed



close together, and on the failure of one the current will be automatically switched to the other. There are several ways of carrying out this part of the invention; but Fig. 3 will pre-

* Reports of the Total Solar Eclipse of July 29, 1878, issued by the U.S. Naval Observatory, Washington, 1880. Observations of the Total Solar Eclipse of the 29th July, 1878. By A. COWPER RANYARD, Esq., M.A., F.R.A.S. Published by the R.A.S. London: 1881.

bably serve to explain that and some other features of the system, as it shows how one lamp may be put out without extinguishing others in the series. A B is the main circuit, C the field-magnet circuit with the resistance, and D is a derived circuit with the electro-dynamometer I inserted, G is the generator, and ss are switches which can be used to short circuit the branches 5, 7, 8, 10, and in the case of 8, the lamp is shown short-circuited and extinguished. In 6 and 9 are illustrated the means provided for avoiding any difficulty from a lamp breaking. Here there will be seen a small magnet with a pivoted armature, and a resistance shunt-circuit. In the ordinary condition, when the lamps are at work the magnet is excited and keeps the armature up, thus breaking the resistance-circuit, but should a lamp fail, the circuit is momentarily broken, the armature drops on to the lower stop, and the current passes through the resistance shunt instead of through the lamp branch circuit. To prevent the blackening of the glass globes by the deposition of carbon, Mr. Edison attaches to each lamp a short magnet or a coil of wire which attracts the highly electrified carbon vapour downwards towards the the clamps.

Mr. Edison has also patented some improvements in arc lamps, the chief feature of which is rotating one or both carbons around their longitudinal axes at a high speed—some two or three thousand revolutions a minute—the object of which is “to secure a steady light.” As a motor he uses a Pacinotti ring or clockwork. Such an arrangement appears to unnecessarily complicate an already complicated device, and it is doubtful whether the advantages to be gained compensate for the extra cost and liability to derangement.

POCKET MICROSCOPES:—(1) SALT'S. (2) SWIFT-BROWN'S.

FIG. 1. shows a small pocket-microscope devised by Salt and Son, of Birmingham,

FIG. 1.



for the examination of urinary deposits, blood, &c. The microscope is of the compound achromatic form, provided with a $\frac{1}{2}$ in. objective, giving a magnifying power of 120 diameters, focussing by a short sliding tube, and is intended to be held in the hand as figured. A condensing lens is applied at the lower end directed upon a white reflecting surface (e.g., white paper). The object slide is put into a slot, and is held firmly by an inner cylindrical tube pressed down by a spiral spring; it can be released by raising the knobs at either side.

Figs. 2 and 3 show a more convenient form of instrument, made by Swift and Son, at the suggestion of Professor G. T. Brown. It is provided with a mirror, G, which can be removed when desired, and the piece which is seen projecting on the right enables full-sized slides to be used. It has also an achromatic condenser, with diaphragm and central stops. A is the main outer tube; D an inner tube carrying the

objective, and sliding within A for the coarse adjustment; E a third tube which supplies a fine adjustment. Within B is a spring tube

FIG. 2.

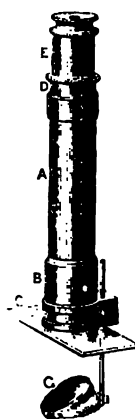


FIG. 3.



which holds the slide C in position. It is stated in the *Journal* of the Royal Microscopical Society that this “hardly leaves anything to be desired, where an instrument is necessary which has to be in reality, and not in name only, a ‘pocket microscope.’”

[We are indebted to the editor of the *Journal* R.M.S., Mr. Frank Crisp, for the use of the above figures, thus enabling us to answer “B’s” query, No. 45375, p. 290.—ED.]

THE ELECTRICAL STORAGE OF ENERGY.

IN a lecture delivered before the Newcastle Literary and Philosophical Society, last week, Mr. Swan, after describing what was meant by the storage of electricity, said:—

What they wanted was to have energy so stored that the electric current might be actually waiting to pass, ready to flow at any moment when the channel in which it had to circulate was completed. Happily, there was a way of obtaining an electric current in a very direct manner by means of stored chemical energy. This chemical energy might be dormant for any length of time and give no outward sign of power, and yet in an instant, as by the touch of a magician’s wand, it sprang into powerful action. Sir William Thomson had made careful measurements of the energy stored in the Faure cells, and found that one weighing 1½ cwt. could store energy of one horse-power for one hour. If they supposed that store cells were applied to produce electric light, at this rate one ton of cells would supply sufficient current for ten Swan lamps during six hours. Two things were clear from this—first, that unless the price at which such cells were sold was much higher than the intrinsic value of the material of which they were made and their simple construction suggested, their cost need not be prohibitory of their use; second, that the bulk and weight of a set of cells to do any considerable amount of work would be too great to admit of the idea that it would be practicable to move them for the purpose of charging. In some exceptional cases the cells might be carried from place to place, just as gas was occasionally carried in bags. It was much more easy to carry the electric current from a fixed and distant dynamo-electric machine to the store cells by means of wires than to carry the cells to where the dynamo was, just as it was easier to carry gas to a distant place in pipes than in a metal gas holder. There were, however, special cases where store cells might with advantage be carried to a distance to be charged, and one such case was that of coal mines, where it might be found convenient to employ small store cells in portable cases, and to send them to a safe and central part of the pit, where a dynamo might be fixed for charging. A portable case of store cells and lamp of this kind were exhibited, the cells being some belonging to Professor Herschel. The case was carried by a leather handle, and the lamp, which consisted of a clear double glass globe, entirely closed, and guarded by strong wire, was attached to it by means of a wire-conductor of considerable length, so that a miner might hang up the lamp where he was working, and place the charge cells a little distance away. The light emitted by the lamp was clear and much superior in quality to the light of an ordinary safety lamp, and the lecturer remarked, as air was not required for it, and as the globe was air-tight, it was a safety lamp in the strictest sense of the word. He thought also it would have the advantage of being an economical lamp. For

lighting railway carriages he thought the most feasible arrangement would be to have a small dynamo and set of store cells for each carriage. The arrangement for working the dynamo might be extremely simple. The armature might be attached to one of the axles of the carriage. Whenever the carriage moved there would be a current of electricity generated if the circuit was closed through the lamp and store cells. When the cells were full they could be thrown out of action automatically. The same dynamo could easily be applied to store current in another set of cells, to be used for the working of an electro-magnetic brake, which might be of great power, with very small abstraction of the motive power of the engine, for the principle of accumulation here came into play most advantageously. Whether railway carriages and tramcars were to be in future driven by electricity was not yet a settled question, but it was certain that whenever (if ever) they were so driven, electric storage of energy would play an important part in bringing it about. Some people had the idea that by means of store cells they should have portable electricity extensively employed—a daily supply of electrically stored energy delivered at their doors like milk, the empty cells to be taken away when the full ones were brought. It was not likely that this idea would be realised. There was no form of energy so easily conveyed to a distance as the energy of electricity, and to think of carrying it about in boxes instead of sending it on its distant journey through wires was to ignore one of its most valuable properties. The probability was that in every house lighted by electricity, there would be a fixed set of cells occupying a place, and perhaps also a space not unlike that which a water cistern occupied in a house. These cells would be in a communication through insulated and hidden wires, with a main central electric supply, and would either be kept charged by continual connection with the main, as their water cisterns were, and with a regulating appliance equivalent to the automatic feed of a water cistern; or the current would be turned on for a few hours each day until the cells of one district were fully charged, and then the current would be turned on to another district to charge cells of that district. With reference to the application of electricity to the production of motive power, at present they depended on motive power for the production of electricity. It was, therefore, a roundabout process to reproduce motive power from motive-power-produced electricity. Still, there were cases in which the economy of producing motive power on a very large scale, and the facility with which this power might be sub-divided and distributed by means of electricity would make the reproduction of motive power in this roundabout way both economical and convenient, notably in cases where at no great distance from a town or populous district, requiring motive power for industrial purposes, there was some great stream or waterfall, and in connection with electrical storage it was within the scope of probability that the still power of wind and the intermittent power of tides might be made more practically serviceable in the development of motive power. It was quite a common anticipation—perhaps most strongly entertained by those who had least knowledge of the question—that electricity would one day supersede steam. The possibility of this could not be denied, but at the same time it was equally undeniable that they were a long way from such a revolutionary change. They did not even see the road by which it was likely to come. They merely saw that the steam-engine, admirable as it was as a piece of mechanical ingenuity and skill, was yet wasteful of energy to the last degree. Sir William Armstrong had put down the waste of heat in a steam-engine of the best construction at 90 per cent. Only 10 per cent. of the heat stored in coal and actually evolved was utilised in the resulting motive power. This enormous waste of heat energy in the steam-engine certainly left room for hope that some even more economical means of producing electricity than that possessed by the dynamo-electric machine might be discovered.

ON SILVERING LARGE MIRRORS.*

By A. A. COMBON, F.R.A.S.

THE anticipated difficulty of silvering large mirrors face downwards in the ordinary way, caused me to adopt the plan of silvering the mirror of my three-foot reflector face upwards, in the cell in which it had been made. At first a fairly good film of silver was got in this way, and a source of some anxiety was thought to be got over, as the removal of the silver at intervals of about one year was always contemplated; but subsequent attempts were not so successful, and I determined to try the other way.

As the plan I have designed and used for holding the mirror was quite successful, and is, I think,

* From the Monthly Notices, R.A.S.

Fig. 3; the difference between this hub and the other one referred to is, that the thread has one straight side corresponding with the radial side of the tooth. The blank from which the saw is made is placed on a stud projecting from a handle made specially for the purpose, and having a rounded end which supports the edge of the blank, as the teeth are formed by the cutters on the hub.

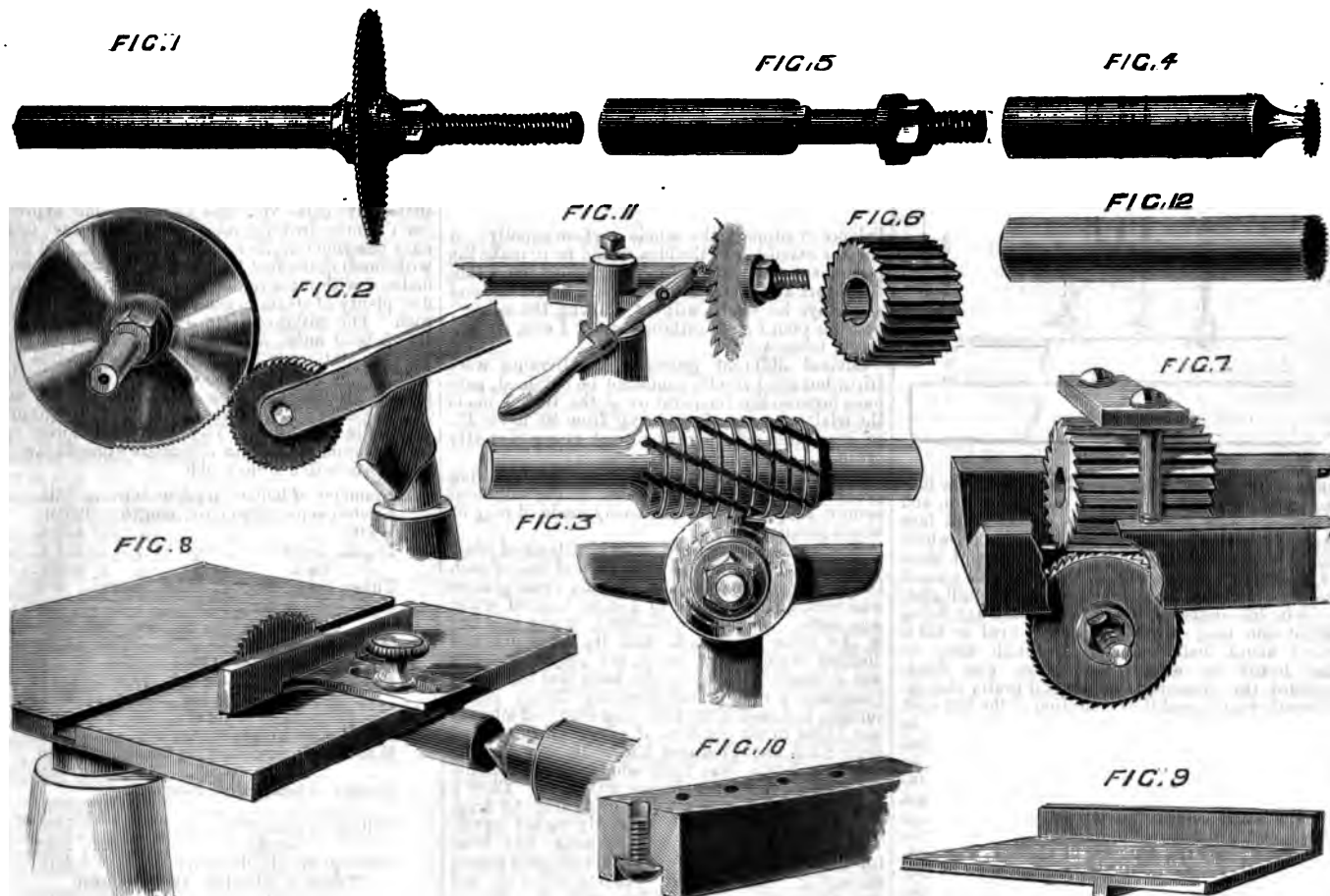
The saw, after the teeth are formed, may be hardened and tempered by heating it slowly until it attains a cherry red, and plunging it straight down edgewise into cool, clean water. On removing it from the water it should be dried, and cleaned with a piece of emery-paper, and its temper drawn to a purple, over a Bunsen gas-flame, over the flame of an alcohol lamp, or over a hot plate of iron. The small saw shown in Fig. 4 is easily made

holder may be split longitudinally and hinged together. Another method of nicking screws is illustrated by Fig. 11. A simple lever, fulcrumed on a bar held by the tool-post, is drilled and tapped in the end to receive the screw. After adjusting the tool, all that is required is to insert the screw and press down the handle, so as to bring the screw-head into contact with the saw.

Where the lathe is provided with an engine-rest, the cutter shown in Fig. 6, mounted on a mandril, shown in Fig. 5, is very useful; it is used by clamping the work to the slide-rest, and moving it under the cutter by working the slide-rest screw. To make a cutter of this kind is more difficult than to make a saw, and to do it readily a milling-machine would be required. It may be done, however, on a plain foot lathe, by employing a

ported in a vertical position, and arranged at right angles with the cutter mandril. The mandril is of the same diameter as the cutter, and serves as a guide to the pattern which carries the work to be operated upon. The principal use of this contrivance is to shape the edges of curved or irregular metal work. The casting to be finished is fastened—by cement if small, and by clamps if large—to a pattern having exactly the shape required in the finished work.

By moving the pattern in contact with the table and the mandril, while the latter revolves, the edges of the work will be shaped and finished at the same time. By substituting a conical cutter for a cylindrical one, the work may be bevelled; by using both, the edge may be made smooth and square, while the corner is bevelled.



ROTARY CUTTERS.

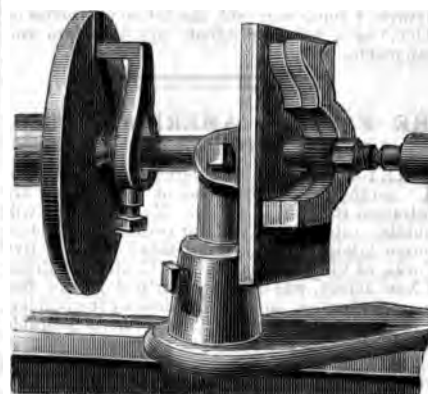
from a rod of fine steel. It is very useful for slitting sheet-brass and tubes, slotting small shafts, nicking screws, &c. Being quite small, it has the advantage of having few teeth to keep in order, and it may be made harder than those of larger diameter. A series of them, varying in diameter from one-eighth to three-eighths of an inch, and varying considerably in thickness will be found very convenient.

These cutters or saws, with the exception of the smaller one, may be used to the best advantage in connection with a saw-table, like that shown in Fig. 8. This is a plane iron table, having a longitudinal groove in its face to receive the guiding-rib of the carriage shown in Fig. 9, and a transverse groove running half-way across, to receive a slitting gauge, as shown in Fig. 8. The table is supported by a standard or shank, which fits into the tool-rest socket. The saw mandril is supported between the centres of the lathe, and the saw projects more or less through a slot formed in the table. The gauge serves to guide the work to be slotted, and other kinds of work may be placed on or against the carriage, shown in Fig. 9.

It is a very simple matter to arrange guiding pieces for cutting at any angle, and the saw table may be used for either metal or wood. The saws for wood differ from those used for metal; the latter are filed straight, the former diagonally or fleaming. Among the many uses to which metal saws may be applied we mention the slitting of sheet metals, splitting wires and rods, slotting and grooving, nicking screws, &c. Fig. 10 shows a holder for receiving screws to be nicked. It is used in connection with the saw table, and is moved over the saw against the gauge.

To facilitate the removal of the screws the

V-shaped cutter and using a holder (Fig. 7) having an angular groove for receiving the cylinder on which the cutting edges are formed. The blank can be spaced with sufficient accuracy, by means of a fine pair of dividers, and after the first groove is cut there will be no difficulty in getting the rest



METAL SHAPING.

sufficiently accurate, as a nib inserted in the side of the guide enters the first groove and all of the others in succession, and regulates the spacing.

One of the best applications of this tool is shown in the small engraving. In this case, a table similar to the saw-table before described is sup-

The tool shown in Fig. 12 might properly be called a barrel saw. It is made by drilling in the end of a steel rod and forming the teeth with a file. To avoid cracking in tempering a small hole should be drilled through the side near the bottom of the larger hole. To insure the free working of the tool it should be turned so that its cutting edge will be rather thicker than the portion behind it. This tool should be made in various sizes. Tools for gear cutting and also cutters for wood have not been mentioned in this paper; as they are proper subjects for separate treatment.

SOME OF THE INDUSTRIAL USES OF THE CALCIUM COMPOUNDS.—II.*

By THOMAS BOLAS, F.C.S.

THE composition of the ordinary carbonate of lime, as represented by chalk, is expressed by the formula:—



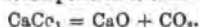
Ca stands for 40 parts of calcium by weight, C for 12 parts of carbon by weight, and O, for three times sixteen, or 48 parts of oxygen. Thus we have.

Calcium.....	40
Carbon	12
Oxygen	48
	100

These figures, when added together, make just

* Being an Abstract of the Cantor Lectures delivered before the Society of Arts.

100; so that chalk contains 40 per cent. of calcium. When carbonate of lime is heated to redness under favourable circumstances, the whole of the carbon flies off in company with two-thirds of the oxygen; the gaseous product thus constituted being called carbon dioxide. The whole of the calcium remains behind, united with one-third of the oxygen, this compound being ordinary lime. In symbolic language the decomposition is thus represented:—



These symbols imply that 100 parts by weight of calcium carbonate split up into 56 parts of lime and 44 parts of carbon dioxide. Although the diminution of weight which a limestone undergoes when burned is 44 per cent. or more, as moisture and organic matters are often present, the reduction as regards volume is much less—say some 14 to 25 per cent.

Here is a small fragment of carbonate of lime in the form of marble. You see that the heat of this blowpipe is directed on it for a few seconds only; but this suffices to effect the decomposition of a considerable proportion of the carbonate, so that, when it is placed on a sheet of damp and strongly coloured red litmus-paper, a vigorous blue colouration is immediately formed round the material. Although the carbonate of lime is so readily decomposed by heat under these circumstances, it is quite possible to expose it to an equally high temperature without decomposition occurring to a notable extent. If carbonate of lime is heated to redness in a closed iron tube, it simply fuses, and on cooling, it solidifies to a semi-crystalline mass, like marble. If it is heated under the ordinary atmospheric pressure, the decomposition is extremely slow, unless the carbon dioxide first liberated is removed by some means. This last fact is very well illustrated by an experiment which it will be easy to show you. Here is an iron tube which passes through one of Mr. Fletcher's new gas furnaces for heating tubes, and this tube is packed tolerably full of fragments of marble. In a few minutes the tube will be heated to bright redness, and you will notice that the evolution of carbon dioxide, as measured by the occasional bubbles which pass into the gas jar, is extremely slow. Notice the effect now of passing steam over the heated carbonate of lime. A rapid evolution of carbon dioxide takes place, and the receiving jar is almost immediately filled with the gas. A stream of air, or other gaseous matter, will produce a similar effect; but steam is most notably effective in expediting the decomposition of heated carbonate of lime into lime and carbon dioxide. In a similar way, the decomposition may be facilitated by a reduction of the pressure; as, for example, when the liberated carbon dioxide is continually removed by means of an air-pump.

A very high temperature is not by any means necessary for effecting the thorough decomposition of carbonate of lime; a moderate red heat being quite sufficient, if other conditions are favourable. A moderately rapid current of steam may be considered to reduce the time necessary for the decomposition to one-eighth, and a knowledge of this fact has led some to suppose that a notable advantage is gained by the burning of damp limestone. This supposition seems, however, to be unfounded, as one may readily believe when it is borne in mind that the greater part, if not the whole, of the water must be driven off long before the heat required for effecting the decomposition of the carbonate is reached. It appears, however, an advantage to place water-troughs in the air-ways of the furnaces in which lime is burnt. In connection with this point, it must not be forgotten that such fuels as wood and coal contain a notable portion of hydrogen, and when this burns, water is formed.

Your attention will next be called to some diagrams of the various classes of lime furnace in use. The drawing which is now projected on the screen, represents one of the most primitive lime furnaces, but a form still in actual use. It consists merely of a dome-shaped heap, which is 15 or 18 ft. across, and is built up of alternate layers of fuel and limestone, and covered with loam, excepting the extreme top and an opening at the bottom, which leads into a tunnel-shaped channel, leading across the bottom of the heap. Although this primitive lime furnace is very wasteful as regard fuel, there are occasions when it is the most convenient arrangement for burning lime.

The next lantern slide represents a rudimentary shaft furnace, and, in most cases, such a furnace is excavated out of the limestone rock itself. It consists of a cylindrical shaft, about 1 ft. in diameter and about one and a half times as deep, a small horizontal channel serving to admit air; and a dome of limestone is generally built round about the place where the horizontal channel opens into the shaft, so as to allow an approximately equal distribution of the heat. This form of furnace works very satisfactorily, if carefully managed, and very many of them are in regular use all over the country. Those of you who travel on the South Eastern Railway towards Woolwich may see one by looking out of the right-hand window

of the train, just after it has passed Westcombe-park Station. The next slides represent improvements on the simple shaft furnace, a firebrick lining being introduced, the mouth being somewhat contracted; while methods of inserting sticks of wood, so as to lead the draught equally through the various parts of the mass, are shown. The diagram now before you shows another step in advance, a grate of fire-bars being introduced, and a permanent arch of firestone, or other refractory material, instead of the temporary arch built up out of the limestone itself. Many forms of interest must be passed over without consideration, in order that you may be enabled to study those furnaces which are continuous in their action—that is to say, are kept constantly burning, fuel and fresh limestone being added at the top, and the burned lime removed at the lower part, without extinguishing the fire. In the case of the furnace now represented on the screen, you will notice the damping arrangement for stopping the draught at the time of extracting the burned lime, the hot lime being raked into the cooling chambers, which are provided with ventilating shafts, in order to facilitate the operation.

It is probable that a notable future in the process of burning lime by means of gaseous fuel, generated by such an apparatus as that of Siemens, especially when this method is carried out in conjunction with the principle of the ring-furnace, or annular kiln. In kilns of this description the fire-chamber may be regarded as a ring or closed circuit placed in a horizontal position; but this ring need not be round, it being more usually formed like an oblong with rounded corners. The fire-channel or ring may be regarded as being built up of a number of segments, and a cut-off or damper may be inserted between any two of these segments. Each segment has a direct connection with the main chimney; which can, however, be cut off by means of a metal bell, which dips into a ring-shaped vessel containing sand—a form of joint which is extremely useful in furnace work. Each segment can also be opened so as to admit the external air or limestone; and fuel is added through small holes in the top of the ring-system. Now, imagine that one of the dampers or diaphragms is inserted between two of the segments so as to block the ring at that point, and that the segment on one side of the damper, say the right-hand, is open to the air, while that at the other side is connected with the chimney. If the fire is now lighted at the open segment, the flame or heated air will have to circulate round the ring until it reaches the adjacent segment, or that on the other side of the damper, before it can reach the chimney. Things being allowed to go on, a period is arrived at when the maximum of combustion is seated at a point midway in the circuit, or opposite the damper. When this is the case, the segment where the fire first began is emptied of its lime, and fresh limestone put in; while at the same time, the damper is shifted, so as to add this segment to the unburned end of the series, the chimney being then connected with it, and the air-way of the next segment on the right is opened. By proceeding in this way, the point of maximum combustion can be kept nearly opposite the diaphragm or damper, and that air which actuates the furnace becomes considerably heated in its passage over that lime which is already burned, while the waste gases impart a considerable proportion of their waste heat to that material which has not yet commenced to burn.

The waste of heat is so small in a well-constructed annular kiln, that in some cases as little as seven per cent. of fuel is used; and, moreover, the labour involved in working the furnace is not very considerable. Several thousand furnaces are in use at the present time, and whenever the operation of lime or cement burning is performed on a large scale, it is likely that this system will come into use, either with solid or with gaseous fuel. It is not at all necessary that the shaft or chimney should be built in the middle of the ring system, as represented in the diagram now on the screen; only when it is outside, some of the chimney channels must be a little longer. If one wishes to increase the turn-out of a ring-furnace, it is merely necessary to use two dampers, and keep each half of the furnace in independent action; but in such a case the air passes over a less length of finished lime, and the products of combustion are less perfectly denuded of their surplus heat by reason of the shorter length of unburned material over which they pass; there is, therefore, less economy of fuel than when one fire is kept burning in each furnace. If the ring or annular channel is made long enough, there is no reason why several fires should not be kept in circulation.

Well, now, lime is a compound of oxygen and calcium; but besides this normal oxide of calcium there is another oxide which contains double the proportion of oxygen. This is, however, a very unstable body, which is of no particular interest out of the laboratory. One of the most notable properties of lime is its extreme power of resisting the

fusing action of fire, the intense heat of the electric arc only serving slightly to soften it. This infusibility is taken advantage of in the lime furnace of Deville; this apparatus being used for melting platinum and other highly infusible metals. Here is a small one which will serve for melting half an ounce of platinum. The metal is placed in the hollow of the lower block, and the flame of a powerful oxy-hydrogen blowpipe is made to enter at the top, as you now see. You notice how the incandescent lime glows, this glow being the well-known limelight. Here is one of the usual arrangements for producing this light. A jet of coal-gas is crossed by a fine stream of oxygen, and the sharp and bluish flame is allowed to impinge on a small cylinder of quick-lime; this becoming incandescent almost immediately, and giving out the brilliant light which you now see. The limelight is being used in this magic-lantern for projecting the photographic reductions of diagrams on the screen; and as the light in question is highly actinic, it is of frequent use in many photographic operations, and notably in making enlargements. It is very probable that, before long, the limelight may compete with the electric light for the illumination of large buildings and open places.

Iron and steel may be satisfactorily cast in lime moulds. The Gilchrist-Thomas process for the dephosphorisation of iron is well-known to you; the converter being lined with lime bricks, which take up the phosphorus during the operation of "blowing." One of the bricks used is on the table, and you can examine it for yourselves. It is coated externally with pitch as a protection against the atmosphere.

When lime is brought into contact with water, combination soon ensues, and heat is evolved; a white powder containing CaH_2O_2 , and commonly known as slaked lime, being the result. The heat evolved by the slaking of lime has been known to cause fires, and one occasionally sees workmen cooking breakfast or dinner by the heat of a heap of slaking lime. When lime is freely exposed to the air, it soon absorbs enough water to become slaked, but at the same time it absorbs carbonic anhydride, and is partially converted into ortho-carbonate, $\text{Ca}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$, a substance which it excellently well adapted for making mortar.

Lime dissolves in about 800 parts of cold water, but is somewhat less soluble in hot water, so that when this clear lime-water is boiled, it will deposit a portion of its lime. The principal use of lime is for making mortar, and in this case sand is used, not only to prevent the cracking which would happen if a mere paste of lime and water were used, but also to unite chemically with a portion of the lime, a layer of true silicate of lime being formed round each grain of sand. The conversion of the lime into carbonate takes place with extreme slowness, and appears to play a secondary part in relation to the hardening process, as samples of mortar taken from the great pyramid in Egypt were found to contain free lime.

The presence in lime of certain foreign bodies, as clay, oxide of iron, silica, or manganese oxide, exercises a remarkable influence on the properties of mortar made with it, such mortar possessing, in a degree depending on many circumstances, the property of setting under water. Such a lime is ordinarily called hydraulic lime.

At Puzzuoli, in Italy, a remarkable volcanic product called puzzolana is found, this material consisting principally of silicates of calcium, aluminium, and sodium. When this puzzolana is intimately mixed with an ordinary or "fat" lime, hydraulic mortar or cement is obtained, which possesses most valuable qualities, and has satisfactorily resisted the destructive tendencies of two thousand years.

The mineral known as trass, and which not only is found abundantly on the banks of the Rhine, but also occurs in Ireland, is an analogous substance, and it is largely used in some parts of Germany and in Holland for making hydraulic mortar. Finely powdered silica, glass, or lightly-burned clay, in a state of minute division, possesses similar properties; but in the present day hydraulic cements are mostly obtained either by the careful calcination of impure limestones, as found in nature, or by the use of artificial mixtures—say of chalk and clay—made up to the required composition.

Enormous quantities of the so-called Portland cement are now manufactured in this and other countries by mixing chalk with river-mud; and, after the mass has dried, burning until incipient vitrification sets in. The mass, being now finely ground, forms an admirable hydraulic mortar, when mixed with water and sand.

The cement ordinarily called "Roman," is made from the nodules of highly ferruginous and very impure limestone, known as septaria, which are found in the Thames Valley, and it sets with great rapidity.

The dephosphorising properties of lime have been rendered available in obtaining compact masses of the refractory metal, iridium; the spc-ny metal being first fused with a moderate proportion of

phosphorus, after which the comparatively fusible phosphide is heated in powdered lime, until all the phosphorus becomes removed. As an indirect manure, lime possesses some value, decomposing silicates, disintegrating organic matter, and destroying insects. As an agent in various chemical industries, lime holds an important position; its uses in tanning, the preparation of the caustic alkalies, the liberation of ammonia, and other processes, being very considerable. With respect to its bearing on the iron industry, my remarks must be deferred until the utilisation of the furnace slag is considered. Some kinds of glass, as for example the hard Bohemian variety, contain a considerable proportion of lime; and powdered lime is often used in packing delicate articles of steel which it is undesirable to oil. In this case it most effectually prevents rusting.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE January meeting was held at the Society's Rooms at Burlington House on Friday, the 13th inst., J. R. Hind, Esq., president, in the chair.

Harry Escombe, Esq., Durban, Natal; Major E. S. Gordon, R.A., Royal Carriage Department, Royal Arsenal, Woolwich; T. Hands, Esq., B.A., 19, Castle-street, Carlisle; J. N. Harrison, Esq., Saling Grove, Braintree, Essex; Alfred Morris, Esq., C.E., Sydney, New South Wales; Samuel H. Parkes, Esq., King's Norton, near Birmingham; G. E. Rankin, Esq., B.A., 88, St. James's-street, S.W.; I. Roberts, Esq., Kennessee, Maghull, Liverpool; Captain M. Salt, 48, Clifton-hill, St. John's-wood; and the Rev. W. J. Wilby, B.A., H.M.S. *Champion*, Pacific station, were duly elected Fellows of the Society.

Mr. Christie read several papers giving accounts of observations of the transit of Mercury of the 7th of November, 1881. Mr. Ellery, who observed at Melbourne with an 18in. refractor, saw a white spot at the centre of the planet's disc during the whole time it was upon the sun. No distortion was observed at ingress or egress.

Mr. Tebbutt, who observed at Windsor, New South Wales, with a 4in. refractor and negative eyepiece, saw no black drop at egress, and observed a white spot towards the centre of the planet's disc, which at one-time appeared to lengthen out. He watched for a brighter halo around the planet, but was unable to detect any, or any trace of a satellite.

Mr. Nursinga Rao and several friends observed the transit at Vazingsapatam, but they do not mention any black drop or ligament as being visible.

Mr. Maunder was called upon to read a note on the employment of photography in observing the transit of Venus of 1882. He said, during the coming transit, the solar activity will be very near to its maximum, and there is, therefore, a high probability that a fair number of spots and faculae will be visible upon the sun's surface. The planet will cross the sun at about 42° south of heliographic latitude, and the limb of Venus will extend as far as 37° south latitude. This is not beyond the limit of the zone in which spots are occasionally seen; and though it is scarcely probable that Venus will pass over a spot, she may probably pass over faculae. The object of the note is to suggest that under-exposed photographs should be taken at the various stations by which the parallax of the planet, as observed upon such solar details, may be determined. The great difficulty in measuring the photographs taken during the Transit of 1874 was found to arise from the fact that the light of the sun's disc fades off very rapidly towards the limb; so that, in order to get a good impression of the limb it is necessary to give a long exposure, and the central portions of the disc are over-exposed. But for the method now proposed, it would only be necessary to give a slight exposure, and the parallax of the planet may be determined from any two stations, whether the place of the planet appears to shift towards the limb of the sun, or in any other direction, if there are suitable details in the immediate neighbourhood of the planet from which to measure.

Mr. Lockyer said: I think the paper that has been read is of very great value. We have had a good deal of experience lately of solar photography at South Kensington. It is clear that if you refer the position of Venus on the sun to a spot or facula, you are more likely to obtain a definite result than if you simply refer it to the limb, because we find that the limb of the solar disc depends upon the collodion employed. The absorption in the solar atmosphere seems to lie chiefly in the region of the spectrum between G and H, and consequently if any departure is made from the collodion ordinarily employed you get a considerable difference in the intensity of the

limb as compared with the centre of the sun's disc. Another reason why there will be an advantage in observing the position of Venus as compared with spots and faculae is that the boiling appearance of the image is most intense on the limb. In observing in London we are, as might be expected, very familiar with this dreadful boiling appearance, and frequently, when the limb is most distorted, the spots and faculae well within the disc are quite sharp and clear, and, therefore, the position of Venus will be better referred to them than to the limb of the sun. If it is intended to take photographs during the coming transit, I would suggest that they should be taken on a large scale, for the faculae, and the markings, frequently called willow-leaf markings, come out much better when the photographs are taken on a large scale, and with short exposure, as Janssen was the first to point out. We have been making experiments lately with one of the photo-heliographs employed during the transit of Venus of 1874. It was arranged so as to give a solar image of 4in. diameter, but we find that it gives a much better picture when the solar image is made 7in. diameter. It used to be thought that it was better to take a pretty dense photograph and develop it rapidly, but we find that most detail comes out with an under-exposed picture which does not come out immediately on being developed, but which needs to be intensified, and the details slowly brought out. Such details at some distance from the solar limb would, I think, make very good fiducial points, and for this reason I attach great importance to the paper which has been read. (Applause).

Mr. Christie: The suggestion of Mr. Maunder is of great value, and I, for one, should be sorry to see photography neglected altogether in the coming transit. If you can get a good spot pretty near to Venus, you will be able to rely upon the scale-value for measurement as determined by means of the long-focus method which the Americans adopted, and this will be a great advantage. I cannot quite endorse all that Mr. Lockyer has said about the necessity of having a large image. I think that good results may be got with a 4in. image, if sufficient attention is given to improving the mechanical means for getting short exposures; that is an essential point in the success of Janssen's method. He used the large image, and so diminished the light; but the same result may be obtained by using mechanical means which would give a shorter exposure.

Mr. Ranyard: With regard to the boiling appearance which Mr. Lockyer has referred to as especially existing at the sun's limb, it without doubt arises from inequalities in the Earth's atmosphere, and it cannot be supposed that there would be any great difference in the amount of such boiling in passing over a distance of a quarter of a degree from the limb of the sun to the centre of the disc; the heated currents, no doubt, exist there, and produce the same effect as at the limb; but we do not recognise the distortion they produce so easily, the eye recognises at once any inequality in the circular limb, but it does not so easily recognise distortion of the spots and faculae, because we do not know their exact shape. The effect of this distortion might, however, to a great extent, be got rid of, if several photographs of short exposure are taken at short intervals and afterwards compared. Unfortunately, the boiling appearance is most marked when the sun is near to the horizon; and this will be the case at stations which give the best parallax. Photographs taken by the method which M. Janssen employed will need to be given very rapid exposures, in which all the distortion of the moment of exposure is recorded, whereas the eye takes note of the mean position. The chief reason of the success of M. Janssen's photographs arises from the fact that the part of the solar spectrum near G is the first to impress itself upon the photographic plate; and to M. Prazmowski is due the credit of perceiving that this fact might be made use of. The idea was adopted by Janssen, and Prazmowski arranged for him a system of lenses, so as to throw an image which would be practically perfect for the G rays upon the plate. Looked at with the eye, the sun's image, as seen upon the plate in this Janssen instrument, is not optically good; but the photographic effect is so sharp, because the plate is accurately placed in the focal plane of the G rays. This would, of course, have to be attended to, and I have no doubt that the faculae and minute markings might become very good fiducial points for measurement.

Mr. Knobel said probably many of the Fellows have seen a paper by Prof. Harkness comparing the results of the different methods of determining the sun's distance. In it he deduces a very small probable error for the photographic results. I should like to ask the Astronomer Royal whether the photographic method will be adopted by the English expeditions?

Mr. Christie: I really cannot say whether photography will be adopted.

The President: As a member of the Venus com-

mittee of the Royal Society, I think I may say that there has been a general feeling that photography should not be employed again; but it would not, I believe, be too late now to make arrangements to use the photographic method partially.

The President: Perhaps I had better take this opportunity of mentioning two matters which occur in a letter I have received from Prof. Winnecke. It will be of some interest to Fellows of the Society to know that the bright comet which was seen in June and July is still well within the range of his large refractor of 20 English inches aperture; he examined it last Saturday and Sunday, and states that it is 30 seconds in diameter, and equal in brightness to a star of the 13th magnitude. Owing to the bad weather, he has not succeeded in getting recent observations of the interesting periodic comet of Denning. Sometimes these late observations are of great value in determining a satisfactory orbit.

Mr. Glaisher read a paper by Mr. Watson, giving an account of an observation of the two satellites of Mars, made with a 12in. refractor, on the 22nd December, 1881.

Mr. Common said it would be interesting to know whether Mr. Watson observed two stars, one on either side of the planet and in the neighbourhood of the satellites. Two such stars were visible on the 22nd of December, and they were decidedly brighter than the satellites, so that it was possible they might have been taken for them.

Mr. Glaisher read a paper by Mr. Lewis Swift on the "Merope Nebula." Mr. Swift considered this nebula was one of the greatest enigmas of observational astronomy. Here was an object which, to his eye, could be easily seen with a 3in. telescope, and which yet could not be detected by Mr. Burnham with his great instrument at Chicago. He wished to suggest a possible reason for the discrepancies. With a faint object, like a nebula of sensible magnitude, its visibility is not increased by magnifying it, while the brightness of stars in the neighbourhood would be increased by the larger aperture, so that the eye might be dazzled and rendered unfit for observing faint areas of light.

Mr. Common: I am very glad to find that an American has taken Americans to task for not seeing this nebula. I was certainly very surprised, on reading Mr. Hough's and Mr. Burnham's paper, to hear that they could not see it with their clear American air and large instrument. It is certainly very visible, and of considerable extent. There are some observers who have traced it as extending all around the Pleiades.

The President: I have found, from a pretty long experience, that those observers who are best able to distinguish faint points of light, such as Mr. Burnham observes, are not always able to distinguish faint nebulae. What the cause is, I don't know; but I have frequently observed that it is the case.

Mr. Ranyard: Mr. Swift's idea that faint nebulae may be less visible with large apertures on account of the eye being dazzled by the light collected from stars in the neighbourhood, seems to me to be a new one, and there is, no doubt, something in it. It may be easily shown that the light of a nebula of sensible area cannot be made brighter as compared with the sky, by using a telescope however large. Even when the whole pencil from the object-glass is used, there is some loss of brightness, owing to reflection and absorption of part of the light by the lenses of the instrument, and I, therefore, doubt all such observations as that referred to by Mr. Common, of the nebula extending round the Pleiades. If there were such a nebula, it would be more easily seen with the naked eye than with the telescope, and would be visible to everybody.

Mr. Christie: In order to use a power so low as Mr. Swift mentions, it would be necessary to contract the aperture of Mr. Burnham's reflector, and by using the centre of such an object-glass which is of great thickness, there would be considerable loss of light, owing to absorption.

Mr. Mattieu Williams: As to the possibility of distinguishing faint objects by means of a telescope, I can quite corroborate what Mr. Ranyard says. Once, when observing the cone of Etna, as seen from Malta, through the mists of the horizon, I tried to see it more distinctly by using a telescope, but found that it entirely vanished on being magnified. It stands to reason that there must always be some loss of light, owing to reflection and absorption by the lenses used.

The meeting adjourned at half-past nine o'clock.

ROYAL MICROSCOPICAL SOCIETY.

THE fourth meeting of the present session of the above society was held on the 11th inst., at King's College, Strand, W.C., the President (Professor P. Martin Duncan, F.R.S.) in the chair.

The list of Fellows to be recommended to the Society for election as members of the council is

the ensuing annual meeting in February was read, in accordance with the 4th bye-law.

The nominations are as follows:—President, Prof. P. M. Duncan; Vice-Presidents, Prof. F. M. Balfour, Dr. Braithwaite, R. Hudson, and J. W. Stephenson; Treasurer, Dr. Lionel Beale; Secretaries, C. Steward and Frank Crisp; Council, C. J. Fox, J. Glaisher, A. de S. Guimaraes, J. E. Inghen, J. Mayall, jun., A. D. Michael, F. H. Ward, T. C. White; and as new members, L. Dreyfus, J. W. Groves, Dr. Millar, and W. T. Suffolk.

The President gave notice that at the next meeting an alteration would be proposed in the bye-law relating to the payment of subscriptions, so that Fellows elected in any month after February would only be called upon to pay a proportionate part of the subscription.

Mr. Crisp exhibited Beck's miner's binocular microscope, intended for rough use in the field, and a photograph by Mr. Jennings of .001 grain of arsenic $\times 400$.

Mr. Beck exhibited and described a new achromatic condenser for dry and immersion objectives, with five different front lenses, set in a drum, capable of being rotated consecutively over the back combination, and giving apertures from 7° in air to 110° in glass (1.25 N.A.). Mr. Beck stated that the mode of setting the front lenses avoided the inconvenience of having the immersion medium drawn away by capillary attraction, as would be the case if the lenses were mounted on a flat surface, as in previous forms.

Mr. Stewart exhibited and described a specimen of Gonidia, from the vesicula seminalis of the earth-worm, and explained their mode of growth and development, calling attention to the spines frequently observed upon them, and which he inclined to believe were *bona-fide* outacular appendages, and not parasitic attachments, as had been sometimes supposed.

Mr. J. W. Stephenson read a paper "On mounting Objects in Phosphorus and in a Solution of Bismuthide of Mercury and Iodide of Potassium," in which he explained in detail the methods which he had found the most successful for the purpose.

Mr. Stewart thought that the bismuthide would prove of very great value as a mounting medium, on account of another of its qualities not alluded to in the paper, namely, its chemical properties as an antiseptic. He believed he was correct in saying that it possessed the valuable power of preserving the colours of many delicate vegetable tissues, and that chlorophyll was not changed by it; blues would be found to fade a little, but red was kept well, and he thought that the fluid promised to be of great value in mounting such organisms as Desmids, the beauty of which was so greatly increased by seeing them in their natural green colour.

The President said it occurred to him that these fluids might be also of great use in enabling anyone to see other difficult objects, such, for instance, as coccoliths. They were very difficult to see in the ordinary way, and he would suggest to Mr. Stephenson to try whether they might not be made out more easily by means of such media as he had described.

Mr. Crisp read a paper "On the Conditions for Utilising the Full Aperture of Wide-angled Immersion Objectives."

Mr. Forrest's Compressorium (received 31st October last, and accidentally mislaid), was exhibited and described. It is designed with a view to cheapness, and differs from the Wenham Compressorium in the action of the spring and screw being reversed, so that, instead of the spring putting on the pressure and the screw releasing it, the screw puts the pressure on and the spring releases it. It is claimed that this in practice will be found an advantage, as it enables the observer to feel what pressure is put on.

Mr. Crisp referred to the erroneous statements that had been made as to the supposed advantages of Mauler's blue-glass slides in "shortening the wave-lengths, and so giving increased resolving power." The fact was that they were intended to be used with objectives affected with chromatic aberration, the performance of which was thereby greatly improved. A letter from Mr. Mauler was read to the meeting, in which he mentioned that the blue mounts would be found useful in the case of delicate histological preparations. They also agreeably modified the ordinary yellow light of gas and oil lamps.

Mr. Kitton's note on the use of gum-juniper for mounting diatoms was read. It has an intermediate between water and balsam, and is soluble in methylated spirit. Preparations may be at once transferred from the spirit to the dissolved gum.

Dr. Anthony's paper "On the Threads of Spider's Webs" was read by Mr. Stewart, enlarged copies of the illustrations being drawn upon the blackboard.

The President said that Dr. Anthony had certainly exercised great ingenuity in his methods of procedure. He believed that the nature

of the thread depended upon the spinnerets which were used, and that when a large number of them were used the thread was non-glutinous.

Mr. James Smith said that, in watching the process of an attack by a spider upon a fly, he observed that, at the commencement, only two or three spinnerets were used to spin the web round the fly. The first portion of the web was like a quantity of floss silk, and then, as the web converged towards the fly it became more like a gut-line. After a while the fly began to struggle, and then the spider used some more web, and finally used all five spinnerets. He thought, from what he had seen, that the quantity or quality of the web depended upon what the spider wanted to use it for, and, according to this, he used more or less of the spinnerets.

The President inquired whether Dr. Anthony should not have used the word "she" in speaking of the spider. Was it not the female spider who spun the web?

Mr. Stewart said he had often seen the male spider in the middle of a web waiting for his prey, and always thought it was his own web, for he certainly would not venture into the web of a female, knowing very well what his fate would be. He believed that the explanation given was quite correct, and that not only were the different tests different in form, but the glands inside them were different in structure, so as to be able to produce different kinds of threads. The cross threads, it might be observed, contained an axis of comparatively hard, dry thread, which was exceedingly elastic, and the outside portion was glutinous, like birdlime, and remained so for years. If the thread was stretched this would be seen to be the case; the glutinous portion would break up into beads, and would rearrange itself when the tension was relaxed.

Mr. Beck said that it was quite easy to examine the different kinds of webs which were spun by a spider, and if they allowed the spider to run out one of the glutinous threads, they could observe the formation of the web and the globules. He had had frequently to use spiders' webs for the cross-lines of transit instruments, for instance, and the kind they used were not at all adhesive. Anyone who had watched a spider encasing his prey would have noticed how entirely the web seemed to be under command, and that there appeared to be a remarkable power of changing the character of the web at will. The spinning-organs were very highly developed, and would form a very good subject for a monograph.

Mr. Crisp referred to the researches of the Rev. H. C. M'Cook on spiders' webs. (See *Journal R.M.S. II.*, 1879), p. 559, and *Proc. Acad. Nat. Sc. Phila.*, 1881.)

Dr. Matthews inquired how it was that the spider dropped or divided his web without using his jaws, and how it was that he climbed up his web, if it was composed of glutinous threads?

Mr. Beck said that a spider did not always use glutinous threads. The radial lines of the web were not glutinous; neither were those which were used to tie the web fast to neighbouring objects; but only the transverse lines.

Mr. Michael said that anyone who watched a spider, would see that he took great care not to put his foot on the transverse lines of his web; but that in running across it he always walked on the radial lines only.

Mr. Crisp said that in a letter to Mr. Mayall, Dr. Anthony had anticipated Dr. Matthew's query as to the division of the web, and proposed to show in a further communication on the spinnerets, that the spider did not use his jaws for the purpose; but that there was a special apparatus at the end of the spinnerets. The diagram accompanying the letter illustrating this apparatus was enlarged upon the blackboard by Mr. Stewart.

Mr. Badcock said he had brought some specimens of *Lophopus crystallinus* to show what might be found in the depth of winter. A pond in Epping Forest a few days ago had what looked like a mass of fungi in the middle of it, and on examination it turned out to be an immense quantity of *Polyzoa*. He thought that naturalists often failed to find things because they did not look for them in the winter. The pond in question contained nothing of any consequence in the summer.

Mr. Stewart said that the specimen exhibited by Mr. Badcock was the finest he had ever seen.

The President then adjourned the meeting to February 8.

Dermatine.—Under the name of "dermatine," The Morris Patents Engineering Co., of High-street, Birmingham, have introduced a cement for joining leather, indiarubber, &c., which has met with much favour in factories and workshops in Austria. The cement is melted and applied in the same manner as glue, and a belt thus joined is ready for work in about twenty minutes. It is certainly the best cement for leather we have found.

SCIENTIFIC NEWS.

THE satellites of Mars have apparently escaped nearly all the telescopes. Prof. Asaph Hall succeeded in picking up Deimos on Nov. 15, and Mr. Common also saw the outer satellite on December 1. Prof. Hall thought he obtained a glimpse of Phobos in November, but could not be certain. As the planet is favourably situated for observations of the satellites nearly to the end of the month, it is probable that sufficient observations have been, or will be, made to determine their places. Prof. Hall has found that the place he computed for Deimos was near the actual position.

Herr Hornstein has communicated to the Vienna Academy the result of his recent researches in connection with the asteroids. He thinks that the number of those with a diameter of over 25 geographical miles is extremely small, and that probably all such were discovered before 1859. The number of asteroids with a diameter less than five miles seems also to be very small, at least in the parts of the asteroid zone next Mars; in the outer regions next Jupiter there may be a more considerable number of these very small bodies. Most asteroids seem to have a diameter between five and 15 miles. The average number of asteroids with a diameter of five to ten miles discovered annually within the last 20 years is about three; the number of those of 10 to 15 miles diameter about 1.6. Thus, should no telescopes greatly more powerful than the present ones be used in future in search for those bodies, we may expect but a moderate "find" of asteroids with diameters under five or over 15 geographical miles, while a considerable increase of those with diameters of five to 15 miles may be looked for.

The specification for the dome of the Paris Observatory, to be erected in the new grounds for the large telescope, has been issued. The diameter is to be 65ft., a complete turn is to be made in ten minutes, and the mechanism is also to move a seat carrying two observers. The motive power may be a falling weight or a gas-engine.

Amongst recent appointments to the Normal School of Science and Royal School of Mines are—J. F. Main, M.A., D.Sc., to be assistant professor of mechanics and mathematics; F. O. Bower, B.A., to be lecturer on botany; F. Rutley, F.G.S., lecturer on mineralogy; and J. R. Smith to be instructor in mechanical drawing.

The Royal Society has received a supplementary note from Mr. Sutton, of Ballarat, in which he describes an improved form of his storage battery. He uses a copper case shaped like a Grove cell. A lid of paraffined wood supports a plate of lead amalgamated by mercury. The liquid is a solution of sulphate of copper to which one-twelfth of sulphuric acid is added. The presence of this free acid improves the cell at once.

In Jurgensen and Lorenz's magneto-electric machine, the field magnet is of horseshoe form with an annular armature of wire coil sections. The novelty consists in the employment of a central stationary electro-magnet, acting as an inner field magnet, inside the annular armature, and formed as two bar magnets placed cross-wise, and having their north poles and south poles respectively united by pole-pieces. This interior magnet is carried on, or is united to, a stud projecting from a bracket on the frame, and has its poles opposite to like poles of the outer field magnet.

An ingenious resident of Pennsylvania has conceived the idea of utilising what is known as the "pulse-glass" for obtaining motive power. A wheel is made up of a number of bulbs each connected to the one opposite by a tube, which forms two spokes of the wheel. The alcohol in the bulbs is vaporised as the wheel revolves, and rising into the upper bulbs the top part of the wheel is made heavier than the rest, and so it revolves by gravitation!

Prof. Nordenskjöld purposes making another Arctic expedition during the coming summer, the main object being to prove the possibility of regular communication with the coast of Siberia.

Sir C. M. Lampson has taken out a patent for a method of utilising electricity in preparing sealskins. The skin is fed over a knife-edge bar, above which are the guard combs. A wire stretched over the bar meets the bristles or long hairs, and, being raised to incandescence by an electric current, burns them off.

With regard to the past year's history of the Paris Academy of Sciences, we note that three members have died—viz: M. Delesse, and M. Sainte-Claire Deville (both in the section of mineralogy), and M. Bouillaud (in medicine); also two correspondents, viz: M. Kuhlmann, of Lille, and M. Pierre of Caen (both in rural economy). MM. Jordan and Fouqué have been elected new members, and M. Gould, of Cordoba, a correspondent. M. Blanchard has been elected vice-president for 1882. The *Annuaire du Bureau des Longitudes* for 1882 contains an account of all comets observed during the last decade, important data in thermochemistry, a résumé of what is known about intra-Mercurial planets, a *fac-simile* of M. Janssen's photograph of the comet of last summer, &c.

In St. Louis arrangements have lately been made for distribution of hydrogen gas for heating and power purposes (according to the Low process already applied in Yonkers and Winchester, N.Y.) The works are the largest in the country, and when completed, will have a capacity of 300,000 feet a day. The gas is not adapted for illumination. The cost will be 1.50 dollar per 1,000 cubic feet. Anthracite coal is fed to an upright generator, where it is worked up to a white heat by means of a powerful blower. Superheated steam is then driven through the furnace and thence through superheating chambers and carburetters. In its passage the generated gas is washed, and, after passing through a series of tile-pipes, it reaches the condenser and is ready for distribution. The surplus is conducted to a gasholder, having a capacity of 30,000 cubic feet. Connection will be made with manufacturing through ordinary 15in. iron pipes, laid underground like ordinary gas-pipes; for private houses, smaller mains will be used. The condensation is so small that it is not thought necessary to encase the pipes in asphaltum, cement, or other non-conductor. Applications for supplies are already in excess of the power of the company to meet.

A hen's egg subjected to artificial incubation in a small vessel hermetically closed, became covered in six days (M. Dareste lately found) with green spots of fungus-growth. On opening the egg a few days later, there was also found a thickish growth of mycelia (fungus-tubes) on the membrane next the shell; and no trace of embryo. With sixty other eggs of the same source, similarly treated, the result was much the same; sometimes the fungus permeated the whole interior. Whence came this vegetation? From spores in the air of the vessel or on the interior surface of the latter? Or spores deposited on the egg between laying and incubation? Or spores imprisoned in the egg while it was being formed in the oviduct (egg-passage) of the hen? From numerous experiments M. Dareste is led to adopt the last of these views. Foreign bodies have often been found in the interior of eggs. M. Dareste has himself noticed unmistakable particles of bran, 1mm. diameter, in the albumen; and the spores would be only about a thousandth of that size. They might quite easily enter from the cloaca (or common cavity at the end of the digestive and other apparatus). These facts recommend cleanliness (M. Dareste points out) in poultry yards.

Some curious results in electrolysis have been lately obtained by Signori Bartoli and Papasogli. Using electrodes of retort carbon (or of wood purified in heat by chlorine) in an apparatus for decomposition of water, they found the carbons attacked and the liquid become black. With 1,200 Daniells acting for a month without interruption, the liquid acquired an acid reaction, and compounds of the benzo-carbonic series were formed; mellitic acid, with its derivatives, and a dark substance, composed of carbon, hydrogen, and oxygen, little soluble in water and insoluble in alcohol and chloroform. The same results were had with several acid or alkaline solutions. When graphite is used, the liquid is not coloured.

For photography, especially of the kind called instantaneous, it is very desirable to have a

means of regulating with precision the time of exposure. An ingenious apparatus for this purpose has been recently described by Colonel Sétert to the Société d'Encouragement. It is in a small box which can be easily adapted to any camera. There are two shields, one above the other, controlled by springs which tend to lower one and raise the other. A chronometric counter is in the front part of the box, and presents its disc below the objective. The act of bringing the index to the time of exposure required, applies two catches, one of which holds the first shield raised and closing the camera, and the other holds the second shield down, but ready to rise at the right moment after the first has gone down. The index of the counter is liberated by squeezing a caoutchouc capsule at the end of a tube. As it moves round the disc, it at once liberates the upper shield, without shock, so opening the camera; and when it reaches zero it liberates the other shield, which closes the camera. With this "chronometric obturator," as Colonel Sébert names it, the time of exposure can be regulated to a fraction of the hundredth of a second. The apparatus is figured in *La Nature*.

A good imitation of various organic elements, such as cells and tubes, clear or partitioned, or with granulated contents, &c., is obtained by MM. Monnier and Vogt, in suitable liquids, through double decomposition of two salts brought together. The liquid may be organic, as succate of lime, or inorganic, as silicate of soda. One salt should be dissolved in it, the other present in solid form. The form of the products is constant in relation to crystalline salts (as much so as any crystalline form of minerals) and it is a means of very delicate analysis, enabling one to detect minute quantities of certain substances. Sulphates and phosphates, as a rule, give tubes, and carbonates, cells. With exception of sulphates of copper, of cadmium, of zinc and of nickel, the pseudo-organic forms are only produced by concurrence of substances met with in real organisms; thus, while succate of lime gives these forms, succates of strontian or baryta do not. The products have true membranes dialysing in a high degree.

A French scientific expedition to the coasts of Lapland commenced, it is known, last spring. M. Pouchet has lately published the results of some measurements of sea temperature that were made. The heating of the sea in the roadstead of Vadso, in June and July, was found to be about 9° in fifty days, or nearly 0.2° a day. Soundings off Vadso, and in the Varangerfjord verified, for that advanced time of the year, what M. Mohn had proved for winter, viz.—a cooling influence of the coast. This was perceived as far as one and a half miles, and to a depth of about 340ft. at Vadso; it appeared in a difference of about 1° at depths of 65 to 100ft. In the open sea, as well as at the coast, a very regular decrease of temperature with the depth was observed; and M. Mohn's observation was not confirmed, that at the coast in summer the temperature sinks, down to a certain depth, thereafter rising till the bottom is reached.

Of Sir William Thomson's compass, M. Faye spoke the other day, in terms of high praise, in the French Academy. "The new compass, the deflector, and the system of magnets and compensating soft-iron spheres of our illustrious associate," he said, "have everywhere been received with a sort of enthusiasm. The nautical men whom I have consulted on the subject, are unanimous. It is, they say, the last word on the question; it is the definitive solution of the problem, even on our ships of war, where the deviations of the compass threatened to put that precious instrument out of use." M. Faye commended to navigators a treatise by Lieut Collet, on the regulation and compensation of compasses, which deals fully with this important matter and expounds the new methods.

The petroleum industry in the Transcaucasus, south of Russia, has now attained colossal dimensions, and at Novorossusk telegraph and electric-light apparatus has been set up—the latter to light up the bay, so that operations of loading, &c., may go on by night as well as by day. A special telegraph wire for Bourse matters has been fixed between Paris and Bordeaux. At the Berlin Opera, telephonic experiments similar to those in Paris are being made,

the telephone used being the Bell-Blake. A hall in the Leipzig-street post-office is the place of hearing. The system works very well. The microphone, however, becomes completely useless when trumpets or cymbals are sounded in the music; all other sounds are then masked. In the town of Sydney 100 telephones are now worked by the telegraph department. In the case of a recent destructive fire in Lyons, the telephone was the means of bringing fire-engines to the spot with remarkable promptitude.

From recent observations by M. Lalané of Toulouse, it appears that something very like tuberculosis is produced in the lungs of dogs by a nematoid worm called *Strongylus vasorum*. This creature is developed in the vessels, and each egg deposited in one of the small branching arteries produces about itself an accumulation of matter, the minute structure of which is exactly that of tuberculosis properly so called.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

* * * In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physics: a vice from whence great inconveniences derive their origin." —Montaigne's Essays.

COMES OF ϵ DRACONIS.

[19631.]—MAY I call the attention of some of your numerous correspondents—who are working at double stars, to the question of the magnitude of ϵ Draconis.

This star has been continually observed from 1780 to the present time, and the diversity in the estimates of its magnitudes is certainly very striking. Herschel, in his manuscript notes in 1780, writes: "Small star, extremely small;" and in 1781, "hardly perceptible." Herschel and South, in 1823, with instruments 3fin. and 5in. apertures, with "Measures are of the utmost difficulty, &c." yet rate it at 10th magnitude; while in the autumn of the same year Struve, with the Reichenbach Circle calls it 6.9 mag.; the same observer's estimates in the "Mens. Microm.," between 1830 and 1833, vary from 8.5 to 7.5 (on one occasion by daylight 7.0); Smyth, in 1833, calls it 9.5; Dawes, in 1843 and 1848, makes it 8.0; in 1856 Dembowsky, 7.0, and Secchi, 8.0; in 1859, Morton, 9.0; Dunér, in 1867 and 1869, makes it 8.0, but he has 2 estimations in 1871 on the same day of 8.0 and 6.5, and on the same day in 1872 of 7.5 by night and 7.0 by day. Wilson and Seabroke, in 1873 and 1874, call it 9.0. Cincinnati observers in 1877 and 1878, 7.0 and 7.5; finally, my attention was specially drawn to it because I find a record of my having observed its visibility in sunshine at 8.30 a.m., on the 5th March in 1878, with a 9in. aperture silver mirror.

I am not able to make further observations at present, but think it would be worth while ascertaining whether this *comes* may be a variable of short period.

There also appears to be some difference of opinion as to the magnitude of the principal star, and it is altogether omitted from Lalande's catalogue.

I have to acknowledge my indebtedness to Mr. Herbert Sadler for some of the references above quoted. R. C. JOHNSON.

COLLISIONS AMONG THE PLANETOIDS.

[19632.]—LE VERRIER has shown that it is probable that the total mass of the planetoids is less than, I believe, $\frac{1}{2}$ that of the earth. Whence there may be 2,000 million planetoids each five miles in diameter, and half as dense as the earth. Now, their average density is probably very much less than this, and the diameter of an enormous number of them also is probably less than five miles, so that the above number is a very reasonable assumption.

No planetoid can in general come into collision with another unless the orbits, the one projected upon the plane of the other, intersect.

The greatest number of planetoids is no doubt collected about the central portions of the ring.

Let us ascertain the probability that any one of the large asteroids now known (about 220 in number), may come into collision with some one or other of the smaller fragments during a year.

This may happen owing to secular movements of node and perihelion to all those pairs whose orbits have not one entirely outside the other.

Taking into account the congestion above mentioned in the central portions, it will not be an unfair assumption that a collision will be possible upon the average some time or another, between any one of the larger planetoids, and one-fifth of the rest. Proceeding in a similar manner to that adopted in letter 19464, in solving a somewhat similar question—namely, the probability of the earth and some comet colliding in a given time, and supposing the average planetoid period to be 5 years and average mutual inclination to be 15°. We find that a collision may be expected for any one of the larger 220 planetoids once in about 100 years, provided that a collision takes place when the centres of the two planetoids are distant not more than 30 miles one from the other. So that among the whole 220 large planetoids two collisions per annum upon the average would take place, adopting the above assumptions. Upon examination of a table of the magnitudes of the planetoids, it appears that in the densest portions of the ring their average magnitudes is markedly the largest, which would seem to be a consequence of such collisions. Such frequent collisions may appear rather remarkable; but they would no doubt, be much more frequent in the central portions than as regards those planetoids which come nearest the earth, and whose observation is appropriate for determining the solar parallax. But even in these cases the possibility of such collisions introducing an unknown though probably small perturbation in the position of the planetoid must give rise to some uncertainty.

W. C. H.

CHEAP MICROSCOPES.

[19633].—THE microscopes of which you have been good enough to supply cuts in recent volumes are only available to the select few, the cost being considerably more than the great majority of your readers who take an interest in matters microscopical can afford. Probably even the Society's £3 3s. instrument is beyond the means of many readers. There seems, however, to be no reason why such readers need be deterred from securing much of the pleasure that falls to the lot of owners of expensive instruments. There are in the market, I believe, instruments costing less than 20s., and which have a body made to incline at any angle, are supplied with powers (in combination) of about 1½, 1, and ½ in., a condenser fitted to body or stage, and are inclosed in wood case. The powers, of course, are not achromatic, and are, in consequence, looked upon by microscopists as mere toys. Such an instrument, however, will show a large majority of the objects figured in any of the microscopical manuals, and would be found useful, as a collecting microscope, if the owner should afterwards purchase a more expensive instrument. I wish some reader who is practically acquainted with the cheap instruments to which I refer would describe the best of them. I don't mean any of those with a non-inclining body. Probably few opticians keep such microscopes; but I have seen them in fancy shops. It seems to me that a good increase in the number of microscopists might be secured by encouraging the purchase and display of such microscopes. They might be brought into notice by use at the soirées of the various societies. Few of the objects shown at such soirées could not be displayed by such means. The present tendency is to "go for" expensive instruments; and from what I have seen at soirées, I should say that for one microscope costing under £3 3s., there have been 20 costing at least £15; and I don't remember seeing one which would have cost less than £2 10s.

C.

JUPITER—MARS.

[19634].—THE motion of the great reddish spot of Jupiter continues to slacken, so that the longitude of the spot in reference to the assumed First Meridian gradually increases; but any attempts to determine the rate of this increase and other variations of the motion must remain, for the present, merely preliminary attempts. The following list of observed passages of the spot across the middle of Jupiter's illuminated disc is a continuation of that on page 279, and contains the results of observations contributed by D. = W. F. Denning, Ashley Down, Bristol; 10in. refl., power 450. Gw. = G. T. Gwilliam, 35, Lansdown-crescent, Bayswater; 6½in. reflector, power 200. W. = A. S. Williams, 1, Medina-terrace, West Brighton; 5½in. refl. also one passage observed by Mr. T. G. Elger, Bedford, 8½in. refl.

		Observed Passages.			Obs.	Corresp. Long.		
		Pr. E.	Middle.	Foll. E.		Pr. E.	Middle.	Foll. E.
		h. m.	h. m.	h. m.		°	°	°
1881.	November 7	—	—	16 31	W.	—	—	34.1
	14	—	6 48	—	D.	—	15 5	—
	15	—	12 38	—	D.	—	17 7	—
	15	—	—	13 8.5	W.	—	—	36.1
	17	13 48	14 14	14 41	W.	1.1	16.8	33.1
	22	12 50.5	—	13 55	W.	359.0	—	38.0
	23	8 39.5	9 10.5	9 40.5	W.	357.8	16.5	34.7
	25	—	10 50	—	D.	—	17.7	—
	28	7 51	8 16	8 42	D.	1.1	16.2	31.9
	28	7 54	—	8 41	Elg.	2.0	—	31.3
	28	—	8 20.5	8 49.5	W.	—	18.9	36.4
	28	7 53	8 21.5	8 50	Gw.	2.3	19.5	36.7
December	1	—	5 47	6 15	D.	—	17.6	34.4
	3	6 58	7 25	7 53	D.	1.5	17.9	34.8
	3	—	7 29.5	7 52.5	W.	—	20.6	34.5
	5	8 33	9 4.5	9 33	W.	359.9	19.0	35.2
	5	8 37	9 5	9 31	D.	2.4	19.3	35.0
	5	8 38	9 6	9 34	Gw.	3.0	19.9	36.8
	7	10 15	10 40	11 9	D.	2.6	17.7	35.2
	7	10 19	—	—	Gw.	5.0	—	—
	7	—	10 45	11 10	W.	—	20.7	35.6
	8	—	—	6 52.5	W.	—	—	30.6
	8	6 3	6 30	6 58	D.	0.7	17.0	33.9
	10	7 46	8 12	8 40	D.	3.9	19.6	36.5
	13	5 11	5 40	6 6	D.	1.6	19.1	34.8
	18	4 17	4 47	—	D.	1.2	19.3	—
	19	—	10 37	—	D.	—	21.3	—
	21	11 48	12 18	12 44	W.	5.1	23.2	38.9
	22	7 38	8 2	8 30	D.	4.4	18.9	35.8
	22	—	—	8 33	W.	—	—	37.6
	22	—	8 6	8 34	Gw.	—	21.3	38.2
	23	—	3 55	—	D.	—	20.0	—
	23	13 25	13 49.5	14 17.5	W.	4.5	19.3	36.2
	24	9 12.5	9 40.5	—	W.	2.3	19.2	—
	24	—	9 43	—	D.	—	20.7	—
	29	—	—	9 20	W.	—	—	38.8
1882.	January	1	5 50	6 15	D.	3.0	18.1	35.1
		3	7 28	7 57	D.	3.0	20.5	37.4
		3	7 32	7 59	Gw.	5.4	21.7	38.6
		3	7 38	8 3	W.	9.0	24.1	42.9
		5	9 11	9 35	D.	6.0	20.5	—
		6	5 2	5 30	D.	5.8	22.7	—
		7	10 49	11 19	D.	5.9	24.0	38.5
		9	—	2 58	D.	—	21.9	43.1
		9	12 25	12 52	D.	4.6	20.9	36.6

Of the white equatorial spot the following additional observations have been communicated by Mr. Denning and Mr. Williams. The "corresponding longitudes," under the heading 870° 42', are those of the system with which the observations of the great reddish spot are compared; while the longitudes under the heading 878° 48' are directly comparable with those given in the last column of the two lists previously published in the ENGLISH MECHANIC of Feb. 18, p. 564, and Nov. 25, p. 279; so that a comparison will show at once how far the motion of the white spot accords with the assumed daily rate 878° 48', corresponding to a period of 9h. 50m. 6s. The fluctuations in the brightness of the spot require circumspect attention. *b* bright, *f* faint, *v* very.

		Passages of White Spot.		Corr. Long. 870° 42' 878° 48'	
		h. m.	h. m.	°	°
1881.	Oct. 5	12 3	Williams	303.9	25.8
	Nov. 7	16 37	"	37.7	27.2
	14	5 56	Denning	344.1	26.4
	15	11 32	<i>rb</i>	337.8	30.0
	(17	13 11	Williams	338.7	47.6
	22	10 44	<i>f</i>	282.5	30.9
	22	10 47.5	Williams	284.6	33.1
	23	6 25	<i>rb</i>	276.5	31.5
	23	6 26	<i>rb</i>	277.1	32.1
	23	16 16	<i>rb</i>	273.7	32.1
	27	8 45	<i>b</i>	243.2	31.2
	27	8 55	Corder	249.2	37.3
	28	4 27	<i>rb</i>	237.7	32.4
	28	14 18	<i>b</i>	235.0	33.0
	29	9 52	<i>rb</i>	244.7	29.3
	29	9 54.5	Williams	226.2	30.8
Dec.	1	11 55	<i>b</i>	210.2	31.6
	2	6 44	<i>rb</i>	202.7	32.4
	3	12 14	<i>rb</i>	192.6	30.1
	7	4 41	<i>rb</i>	160.7	28.0
	7	4 45	Corder	163.1	30.4
	7	14 33	<i>rb</i>	158.5	29.1
	8	10 20	Corder	156.1	33.3
	10	11 26	<i>rb</i>	138.9	30.6
	12	12 30	Williams	116.5	26.7
	13	8 12	<i>rb</i>	111.0	27.8
	13	8 12	<i>rb</i>	111.0	27.8
	18	6 12	<i>b</i>	70.7	27.1
	20	7 26	<i>b</i>	56.3	29.3
	21	12 54	<i>b</i>	45.0	27.8
	22	8 33	<i>rb</i>	37.6	27.1
	22	8 40.5	Williams	42.1	31.7
	23	4 11	<i>rb</i>	29.6	25.7
	24	9 43	<i>rb</i>	20.7	26.7
	24	9 44	<i>rb</i>	21.3	27.3
	29	7 50	Corder	344.4	30.1

		Passages of White spot.		Corr. Long. 870° 42' 878° 48'	
		h. m.	h. m.	°	°
1882.	Jan. 3	5 44	<i>rb</i>	Denning	300.1 25.5
	5	7 5	<i>rb</i>	"	289.8 31.6
	6	12 34	<i>rb</i>	"	279.0 30.8
	7	8 13	<i>f</i>	"	271.6 30.0
	9	9 27	<i>b</i>	"	257.0 31.9
	10	5 8	<i>rb</i>	"	250.8 32.3

The following is a continuation of the list, on page 351, of the times when the assumed First Meridian of Jupiter passes the middle of the illuminated disc:—

		h. m.		h. m.		h. m.	
		Feb. 1	Feb. 10	Feb. 10	Feb. 20	Feb. 20	Feb. 20
Feb.	1	6 18.5	11 4 35.1	11 4 35.1	7 6.6	16 56.3	16 56.3
	2	2 9.8	14 30.8	14 30.8	21 2 52.0	22 43.5	22 43.5
	12	5.5	12 0 26.5	12 0 26.5	22 47.8	22 47.8	22 47.8
	22	1.2	10 22.2	10 22.2	22 43.5	22 43.5	22 43.5
	3	7 56.9	20 17.9	20 17.9	22 8 30.2	22 8 30.2	22 8 30.2
	17	52.6	13 6 13.6	13 6 13.6	18 34.9	18 34.9	18 34.9
	4	3 48.3	16 9.3	16 9.3	27 4 30.6	27 4 30.6	27 4 30.6
	13	44.0	14 2 5.0	14 2 5.0	14 20.3	14 20.3	14 20.3
	23	39.7	12 0.7	12 0.7	24 0 23.1	24 0 23.1	24 0 23.1
	5	9 35.3	21 56.4	21 56.4	10 17.4	10 17.4	10 17.4
	19	31.0	15 7 52.1	15 7 52.1	20 13.5	20 13.5	20 13.5
	6	5 26.7	17 47.8	17 47.8	25 6 9.2	25 6 9.2	25 6 9.2
	15	22.4	16 3 43.5	16 3 43.5	16 4.9	16 4.9	16 4.9
	7	1 18.1	13 39.2	13 39.2	26 2 0.7	26 2 0.7	26 2 0.7
	11	13.8	23 34.9	23 34.9	11 56.4	11 56.4	11 56.4
	21	9.5	17 9 30.6	17 9 30.6	21 53.1	21 53.1	21 53.1
	8	7 5.2	19 26.4	19 26.4	27 7 47.0	27 7 47.0	27 7 47.0
	17	0.9	18 5 22.1	18 5 22.1	17 43.5	17 43.5	17 43.5
	9	2 56.6	15 17.8	15 17.8	23 3 39.3	23 3 39.3	23 3 39.3
	12	52.3	19 1 13.5	19 1 13.5	13 35.0	13 35.0	13 35.0
	22	48.0	11 9.2	11 9.2	23 30.7	23 30.7	23 30.7
	10	8 43.7	21 4.9	21 4.9			

MARS.—The position-angle *P* of the axis of Mars, the areographical latitude of the centre of the disc, the diameter of the disc, and the amount *q*, and position-angle *Q* of the greatest defect of illumination, will be:—

		P.	Lat.	Diam.	q.	Q.
1882.	Feb. 3	332.5	2.0	11.8	0.6	92
	13	332.8	1.5	10.7	0.7	91
	23	333.7	0.6	9.7	0.8	91
Mar.	5	335.0	0.7	8.8	0.8	92

Approximate times, when some of the most marked spots of Mars will be near the central meridian. *vide p. 61.*

Feb.	h.	h.	Feb.	h.	h.
1	f	7.8 a 12.9	15	r	9.0 f 16.5
2	f	8.4 a 13.5	16	r	9.6 f 17.1
3	f	9.0 a 14.1	17	d	4.6 r 10.2
4	f	9.6 a 14.7	18	d	5.2 r 10.9
5	f	10.3 a 15.3	19	d	5.8 r 11.5
6	f	10.9 a 16.0	20	d	6.4 r 12.1
7	r	4.0 f 11.5	21	d	7.1 r 12.8
8	r	4.6 f 12.2	22	d	7.7 r 13.4
9	r	5.3 f 12.8	23	d	8.3 r 14.1
10	r	5.9 f 13.4	24	d	8.9 r 14.8
11	r	6.5 f 14.1	25	d	9.6 r 15.4
12	r	7.2 f 14.8	26	d	10.2 r 16.0
13	r	7.8 f 15.3	27	a	4.7 d 10.8
14	r	8.4 f 15.9	28	a	5.3 d 11.5

A. Marth.

66, Lambeth-road, S.E., Jan. 14.

DOUBLE-EARED MICROPHONES—PHOTOGRAPHIC—THE LANTERN—LANTERN SLIDE-HOLDER—BAD MANGANESE, GOOD WISHES, &c.

[19635].—I MADE, two or three years ago, a box telephonic receiver, with not only two vibrating-plates, but with one on every square, six in all; but after repeated trials and alterations, I gave it up as a bad job. Instead of getting clearer articulation, it gave a more confused sound. I would, therefore, advise "L. B. B." to give up the idea of a double-eared microphone.

In answer to "Pyro" (19198), I may tell him I am now working out a new form of tripod, that will be compact, and at the same time quite steady. I will give full particulars the moment it is ready, and also of the improvements I have made to "Le Merveilleux." Pyro must gauge exposure from experience. When I wrote the instructions in the summer time, the light was very different indeed, and in new instructions there will be a method of timing exposures to a part of a second; this I will communicate when written out and printed. I have made all kinds of umbrella stands. In fact my father was the first to make an umbrella stand, and since his death I have made a number of different forms of umbrella and walking-stick stands, but, at present, nothing that pleases me so much as I would like a stand to please me before sending it out to the public. The new stand for Le Merveilleux, &c., has the front leg adjustable, and the other legs clamp firmly on to a new form of triangle, thus holding the camera very firmly indeed; this can be in part applied to the older form of stand. I would not recommend a ball-and-socket joint: we used to put them on all the stands, but found them to be a nuisance in more ways than one. In working with dry plates for the first time, amateurs should not think that they can put a plate into slide and run away and take a good photo in five minutes without any previous experience. I have known of numerous cases where an amateur has gone and taken a splendid photo right away, but he had first mastered all the instructions; then knowing what to expect and when to expect, they have worked methodically and produced good pictures, while a non-methodical amateur runs his legs off, and looks at the instructions after he has developed, or rather tried to develop, the plate. "Make haste slowly," then you will succeed, and above all, be clean; use plenty of water, especially after the plate is fixed, and allow it to dry slowly, not by a fire.

The lantern is being improved year by year. We are, of course, devoting ourselves to the obtaining of the greatest amount of light in the smallest possible compass. We do not require a great mass of flame, making everything too hot to touch; but the smallest possible light, with perfect combustion and ventilation. This I have endeavoured to obtain in my latest lamp; it is a three-wick, with perfect ventilation, and the combustion is as perfect as I can get it up to now. It seems to me to be worse than a farce to state that a lamp gives so many candles, when in all probability rush-lights would be nearer the mark. A gentleman who introduced a lantern sometime ago, and advertised as so many candles, told me he did not know what a Parliamentary candle was. I am of opinion there are a few others in the world who don't know any better. This ought not to be in our age of supposed scientific accuracy; but as long as people must have something big, I suppose they will be able to get it.

As to my lantern-slide, if anyone would like to make one, I will give instructions and drawings how to make it. I have been satisfied with the results of sale, and will now be pleased to give working drawings bound in slide and dissolve for a single lantern. The latter can be made by any one with a fair knowledge of tools.

I am more than surprised at the letter of G. G. Blackwell, 19586, re Manganese. I can tell him that I have had adulterated samples from three of

the largest houses in the trade (wholesale chemists). One sample caused a terrific explosion, tearing out of the wall a thick iron casting put up to withstand the force of an explosion if it ever occurred, and the other side opened outside. The force of the explosion tore this 2wt. of iron out, and drove it into the wall on the opposite side of the room, two persons narrowly escaping. A sample of this manganese gave 20 per cent. carbon from analysis. Another sample from a large manufacturing chemist was being used out of doors, fortunately; the retort burst—one half was found four gardens away. I could give several more accounts of similar explosions. Now I have given over and over again the only simple and satisfactory method of testing the manganese; the test-tube method given by A. H. Soward is not satisfactory. With pure manganese it sometimes occurs that the evolution of gas at the bottom of the tube is great enough to blow the whole or nearly the whole of the compound out. All that is necessary is to put a spoonful of manganese on to an iron shovel, heat it over the fire until the shovel is nearly red hot, then sprinkle a few crystals of chlorate of potash on to the manganese; if the chlorate simply fuses, then manganese is safe; but if there is any blaze the sample is dangerous and must not be used. By mixing a little soot with some good manganese, the chlorate will at once fire. Test every sample. I would not believe anybody's word about manganese. Test! Test! Test!!! Then it will be your own fault if you have an explosion.

One word as to the New Year. I can assure "Sunlight" I have no wish to be anything but a sincere friend to him and every reader and writer to our pages. I would repeat what I said at a lecture I gave the other day on "How we Think": "I want you to go away with one idea, and if that one idea is all that you can gain from my lecture, I shall be satisfied. Remember that there is something stored in every brain before me that is in no other brain, and I want you to give of that store to others less fortunate, and receive from them some knowledge you do not now possess. In giving we gain, and in this year just ushere in may we each endeavour to help others as much as may be in our power; and when 1882 is becoming a thing of the past, the world will be the better because we have lived in it, and have become better ourselves in helping those around us." I do not think I need add one word to commend this to every reader and contributor of our valuable paper.

W. J. Lancaster.

NUTRITIVE VALUE OF FOOD.

[19636].—I AM glad to find "Nun. Dor." has set the ball moving on the above subject, and I hope others will keep it going. The food of humanity is becoming daily of more importance, especially in these closely-packed islands of Great Britain and Ireland. Already England is at the mercy of other countries for the necessary supply of many of her ordinary articles of food; this will be seen by England's bread and butter bill that she pays yearly for such articles as wheat, maize, rice, &c., and also butter, bacon, cheese, and butcher's meat, and unless a little of the same care is bestowed on the economy of the human fuel, as necessity compels in sea-going steamers, the day may come when we shall have to pay heavily for our waste. The real truth is that, as a rule, we "live to eat, in the place of eating to live." This is good for the medical man but bad for the patient, and the patient's pocket. I do not hold with those who mortify the natural appetite to support one of the many "isms," be it teetotalism, vegetarianism, or any other of them. Asceticism is out of place. Nature never gave men appetites simply for them to be mortified. Reason requires the proper use, not the improper abuse. Chemists may lay down the law as to what man's requirements are, as to the quantity of carbon and nitrogen required for men going through ordinary labour and exercise. One may say that 40 grains of carbon and 1½ grains of nitrogen are required for each pound weight of man; another may give different quantities and proportions, but there is something more to be done. As "Nun. Dor." sensibly remarks, "we have to consider something more with regard to the value of food than how much carbon and nitrogen it contains: we must ascertain how much of the nutritive value the human economy can assimilate." Never were truer words spoken. I have made many experiments in feeding animals of all sorts, myself included, and have realised the truth of that remark. Chemists tell you of the value in carbonaceous matter of wheat or oat-straw; but try and feed young cattle in the strawyard with straw alone, and you will get nothing out of the straw, either into the cattle or out of the cattle in the shape of manure worth carting on to the field. So it is with man. Try and feed him either on maize, wheaten flour, or oatmeal alone. He may exist, but he does not realise the chemistry of his food; but give either the bullock or the man something in the shape of pickles (if I may use the term), that makes him

relish his food, and assimilate it, the whole aspect will be changed. Give the straw-fed bullock his pickles in the shape of a small quantity of turnips, mangold wurzel, or, better still, pea or bean meal, or give the oatmeal, maize, or wheaten-fed man his pickles in the shape of milk, cheese, butter, or animal food, the relish will be given and the food assimilated, and the digestive organs will do their work. As far as I can see, no tight and fast rule can be drawn as to man's diet; what fattens one may poison another. My experience has led me to the conclusion that man should eat whatever he likes, but in moderation; using moderation in quantity, he will soon find out the quality of food he can assimilate best, and he will not be long in discovering that the appetite is most pleasurably excited, and life rendered most enjoyable by substances which are commercially cheapest. Up to my fifty-eighth year I never studied the wholesomeness in any way, further than in always finishing with an appetite. I indulged rather too freely in wine and spirits, but never to feel uncomfortable. From my fifty-eighth year, and my retirement from my profession, I commenced the study of fuel and food, and I have, during the last eleven years, tried total abstinence of alcohol in liquor, and of animal matter in food, and I have found both of them unsuited. I found that I could not change a life's habit by rule and line. I found I required a moderate quantity of animal food to digest the cereal or vegetable food, which must ever be the mainstay, if a man wishes to preserve health. For years I have not averaged four ounces of cooked meat a day: on some days I take none. My main meal is oatmeal porridge; but the inducement to assimilation is milk, and my pickles, sometimes salt, sometimes marmalade, treacle, or sugar. I do not find it either heating or palling on the appetite. Again, I often and often make a meal of bread and cheese, and to my mind, a more appetising and satisfactory meal cannot be made than of good rich Cheddar and well-made bread, not too new. Good cheese, as Dr. Kitchener says, "makes the best bread sauce." Here, again, pickles, in the shape of onion, radish, salad, apple, or good grapes, add much to the zest. The secret in all is mixing your food, and changing your food, so that you always relish it, and not destroying your relish on a future day by taking too much, and also bearing in mind that *pièce de résistance* must be carbonaceous food, but that the carbonaceous will not assimilate without nitrogenous food in certain proportions, but that these proportions must not be exceeded. The nitrogenous foods, although the most appetising, must not be indulged in to excess; instinct teaches the rustic to eat beans and fat bacon, and the Egyptian-fellah to take oil when he can get it with his tick beans; and it would also tell the well-to-do over-fed Englishman that he cannot with impunity indulge in large quantities of animal food rich in nitrogen. Hypertrophy is quite as mischievous as atrophy; and the best friend to the doctor, and the worst enemy of the patient, is the indulgence in highly nitrogenised food. The cereals, in some shape or another, should form the base of human food. In point of value for money, they stand in this order:—Maize first, wheat second, and oatmeal third. The appetising adjuncts should be used as (and treated as) pickles—not for the purpose of making a man eat more, but as a means of exciting the salivary glands, and causing the food to assimilate. I have not seen the American work on the subjects referred to; but I have had by me for years the works of the late Dr. Edward Smith, and in one of his works, "Practical Dietary," will be found the money value compared with the nutritive value of almost every article of food. I trust others of your contributors besides "Nun. Dor." and Dr. Edmunds, will take this subject up, and give us their views and experiences.

Khoda Bux.

SCREW-CUTTING.

[19637].—HAVING read Mr. Hendley's method (19591) of cutting screws in an ordinary lathe, I think the following device, which I fitted up about two years ago, and which has answered very well, might interest some of your readers. The chief points in it are, that it will cut both right and left-handed inside screws as well as outside ones.

Herewith I send a sketch of it, drawn from memory. A is a parallel roller of oak or other hard wood about 3in. diameter, and almost the same length as lathe and perfectly parallel to same. The left-hand end is connected by a gut band, B, to one of the pulleys of mandril, which should be exactly the same diameter as the pulley on the roller, so that they may revolve at the same speed. C is a flat wooden pulley fixed to end of slide-rest screw, a flat band, D, connecting the same to the roller. Now the action is this: when the mandril-pulley revolves, it drives the roller A, which being connected with C, moves the slide-rest along; so that by using pulleys of certain diameters (which can be easily calculated) corresponding motions of the slide-rest are obtained.—i.e., &c.

large pulley is put on, a large thread will be cut, and if a small one, then a fine thread.

If it is required to cut a left-hand screw, all that has to be done is to cross the gut-band B, when the slide-rest will move in the opposite direction. To cut inside screws, first fix the work on face-plate, then move slide-rest and band D down to it, change the tool and proceed the same as before, always taking care in making a fresh cut to see that the tool drops in the one made previously. If the bands should slip, put a little resin on them and keep them tight.

When using small pulleys on slide-rest, the band D will be loose—this can be obviated by having a small running pulley which will take up the sag. The best kind of band for D which I have used is one made of common white tape, which stretches very little, is thin, and holds well. It will be seen that as C is almost under the roller A, the slide-rest

is cussed and written about, as it seems to me, *ad nauseam*, for who would "ever choose such a lathe?" Perhaps I should not have used these words; but it seems to me that he must be a very thin-skinned writer who would take offence at such a remark. The Gilray may be all that is said in its favour, and may, notwithstanding its 50wt. of metal, do ornamental scraping to perfection; but I repeat, Who would choose such a lathe? Certainly not I. Whereas, had I the choice, I would as certainly choose an Armstrong; and I almost venture to say "J. L." would himself give it the preference.

However, laying swords aside, I thank "J. L." for his contribution on this subject; and though I feel myself quite incompetent to write a paper, as suggested, I will show that my wish, as expressed in my letter, was real, by not refusing or delaying to help in the discussion. I can only say that, as

Therefore, it seems to me, the fault is reduced to its being a little slower to get up to speed, and unless a brake is used, a little harder to stop at a moment's notice—but other than these, I (recollecting I am not an ornamental turner) can think of no insuperable objection to the lathe on this head, for, of course, we suppose the mandril, &c., to be well fitted. But it seems to me that a good deal of ornamental turning is done from the overhead, and that as this is arranged so that by merely lowering the frame overhead, the band to the tool in slide-rest is slackened and thus the motion stopped on the instant. Hence in this class of work, the main objection is entirely removed, and there remains only the slight difficulty of getting up speed.

I humbly submit this for the opinion of experts: "J. L." says Gilray, even with many manifest defects, did reputable ornamental work. Could not Armstrong's do the same for those who might like it better than the Gilray?

That a heavy flywheel is unsuitable for wood-turning I cannot admit, and here I do not need to speak as a tyro. A lathe driving-wheel is supposed to run, and does run, with very little variation in speed, no matter what the work is. I have found wood-turning—unless it be some finikin thing, such as a knitting-needle or some other thing of small diameter—quite as heavy work as a very great part of the iron-turning an amateur has to do; in fact, I would sooner work a day at metal than at wood. To keep up the high speed necessary for wood, I maintain you require a good weight in your flywheel. A light wheel makes killing work.

But, leaving out ornamental work, to which "J. L.'s" objection may apply, will this lathe require a heavier driving-wheel than any screw-cutting lathe of the same height of centre? If it does not, is not it an advantage to have a lathe which is as good for metal-turning and screw-cutting as one only intended for those two purposes, and yet which can, if the amateur desires it, be fitted with an attachment which will, on an emergency, do a bit of work for which he cannot supply himself with a special tool, either from want of funds or space in which to place it if he had it?

If it does require a driver a little heavier, is it any disadvantage to a lathe of the kind—which, be it understood, is not for ornamental work, though it may do it, but for such work as anyone would buy which is ordinarily advertised as "a self-acting, screw-cutting lathe"? I have a small hand-planer myself, and yet I feel that there are some jobs in which it would be a great help and convenience to me to have the power, even at some little trouble, of converting my lathe into a shaping machine, and I suppose there are other amateurs, who have not a machinist's shop at their elbow, who have felt the same. Of course, most drilling can be done in the lathe, with work supported at right angles to the bed; but even in things that can be done in this way, I venture to say far more time is spent in arranging the work to the right height and at right angle, than would suffice to fit on the bed the Armstrong drilling attachment.

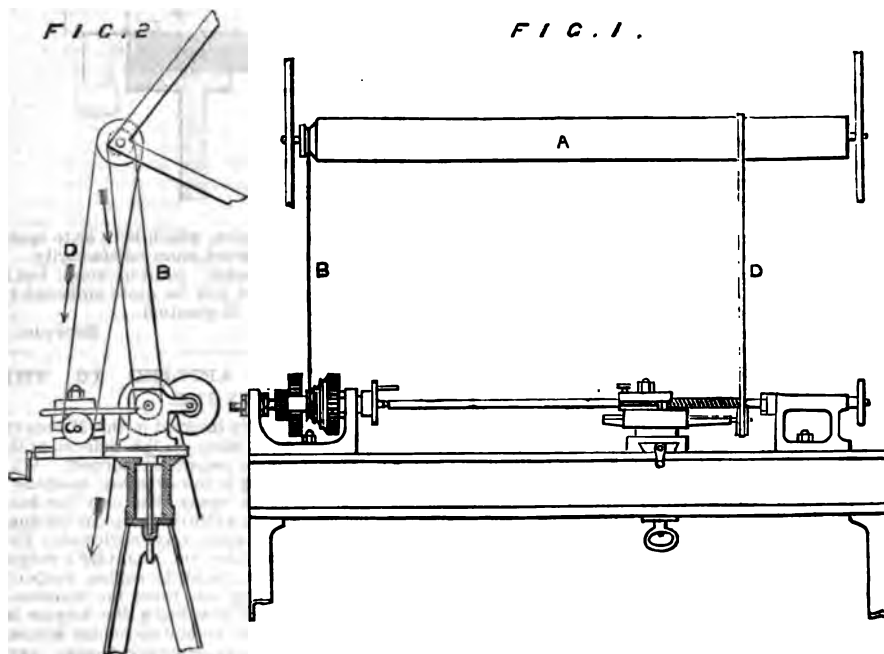
The head on which I am doubtful is, as to the amount of power absorbed by the three gear-wheels, as stated in my first letter. If I was satisfied that a little increase in the weight of driving-wheel would overcome this possible defect I think the others are not very serious, and far more than counterbalanced by the many advantages.

I know pretty well what "J. K. P.'s" opinions on combinations in general are. But I know this, that he does not condemn them absolutely; and, moreover, that he has himself supplied us with some most efficient ones. And what amateur is there, who is not a Crossus, but is ever plotting to make his lathe a combination one? and how many a one has been disappointed because, through bad design, some most useful and convenient attachment cannot be fixed to an otherwise good lathe.

The question now stands—Is there any combination lathe which effects the proposed ends in an apparently more successful way than the one under consideration? If there is, will someone be good enough to describe it?

Jan. 15.

Fredk. Carr.

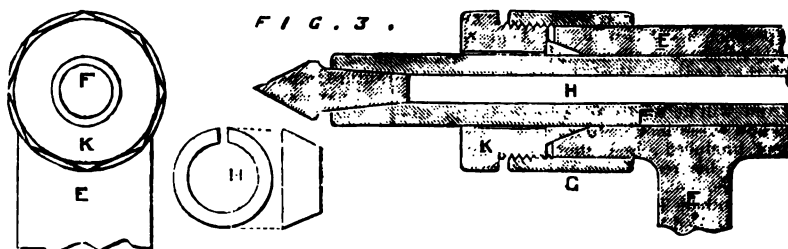


can be moved in or out some few inches without altering much the length of the band. By this plan I have cut outside screws with over 40 threads per inch, and inside screws $\frac{1}{16}$ in. diameter.

My lathe is a strong back-geared one, which I made about two years ago, and to which I applied something I believe quite new. When I had nearly finished the poppet-head, I found there was no way to clamp the poppet, which made me think of the following. Fig. 3 is a section of left-hand

"J. L." has had the drawings and MS., and already formed his opinion on the merits and faults of the latter, I wish he could have let us have had the benefit of it without further discussion.

To clear the subject, let me, then, at the outset state that we do not want a discussion on the defects of combination tools, which are fairly enough stated by "J. L." There must be some time spent in rigging up any addition—and it cannot be expected to do its work so perfectly or expeditiously



end of head, E is the casting in which F slides, G is a steel ring (part of the inside of which is screwed), shrunk on to the casting, H a cut steel cone, K an iron nut. When the nut is tightened it forces the cone H between the poppet and the casting, thereby fixing the poppet according to the pressure put upon the cone, which can be released by unscrewing the nut. This has the advantage over the ordinary set-screw in the poppet-head, of keeping the poppet quite central, however much it may be worn, thereby insuring true work.

Having seen nothing of the kind before, although it may not be new, I thought it might be interesting to some of your readers.

Jan. 11.

R. S. Milles.

THE ARMSTRONG LATHE.

[19638].—By way of answer to what I am stated to have "volunteered," I shall simply repeat what I did state—"We have had Gilray's lathe dis-

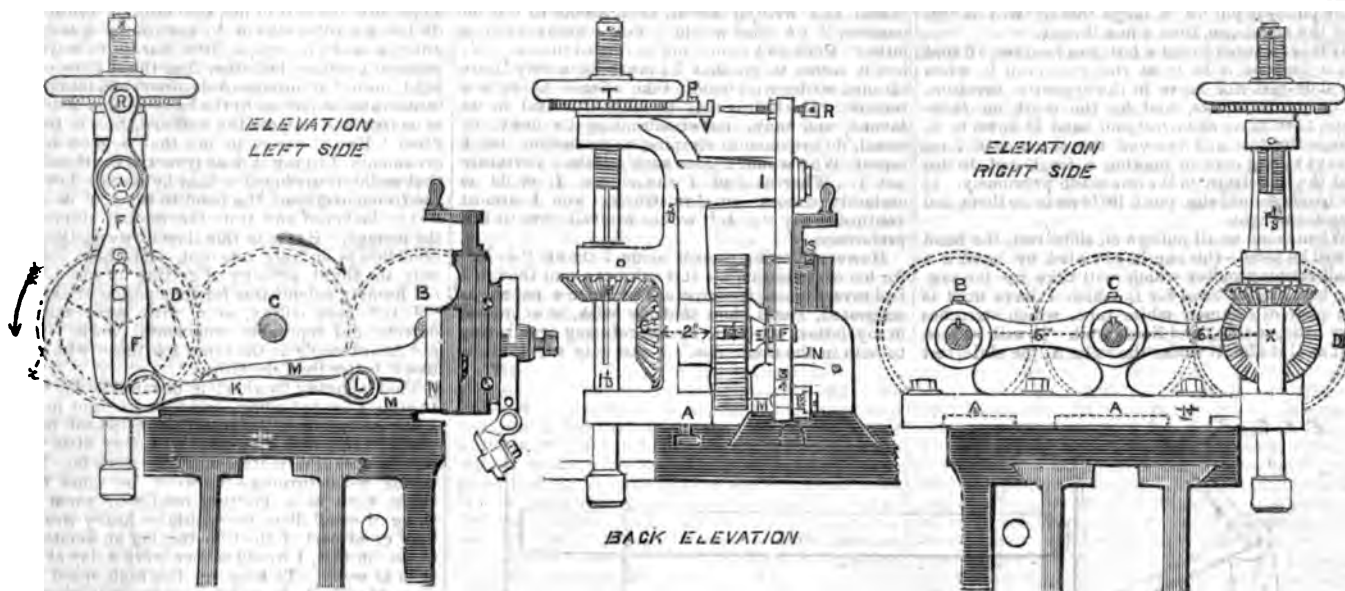
as a tool designed for one class of work only—but then this is all beside the mark. The man who proposes buying a combination tool has taken all this into consideration, and therefore he does not need to be told he must sacrifice something.

What we wish to discuss is the Armstrong combination lathe: What are its faults or deficiencies—as separate from those common to all combination tools? What are its merits?

The first objection, then, which seems to be brought against this lathe is that it is hardly possible to make it equally suitable for ornamental work and sober honest metal work. Is this so? I am not an ornamental worker, so I can say nothing worth listening to; but as "J. L.'s" objection seems to lie chiefly on its requiring heavy flywheel, I ask, Will this fault be sufficient to condemn the lathe as an ornamental one? If the wheel is not balanced, its weight can communicate no tremor to the bed or mandril when driven at a fast rate.

[19639].—In reply to "W. S." No. 45075, it is necessary to have complete plans with dimensions of his slide-rest and saddle, in order that I could supply working designs for the attachment; but as I have received many inquiries soliciting further detail, I send a type drawing of the attachment in a form which I think would be capable of use with most screw-cutting lathes. It is drawn to scale for a 5in. centre, and a few leading dimensions are given. I will presume that my descriptions in "Ours" of September 30th and October 14th, 1881, have been carefully read.

The bed-plate of the attachment, A A, is made deep and hollow, so that it can easily be cut away to suit saddles up to about 2in. thick. The gear wheels are 6in. diameter, say 60 teeth of 10 pitch,



and 1½ in. thick on the edge, with a boss on one side, 2 in. diameter and 2 in. long. B and C are bored and keyed to take a 1½ in. shaft provided with a key-way between the lathe-centres. All these geared wheels are fitted by the bosses to rotate on the left-hand side of the frame; when used for shaping, as shown in these drawings, the outer wheel, B, is idle—its use is to permit of the drill being run out a convenient distance from the lathe-bed when it is brought into position between the lathe-centres in place of the centre wheel C; the wheel D has a deep-bevelled groove, E, across its face, in which the crank-pin may be adjusted for length of stroke, or a bolt may be substituted, screwed into any one of a suitable series of tapped

means of gearing, why not do so at once, by employing a pinion on the mandril shaft? The intermediate and the driven wheel seem best of equal size; but I think the third standard should be adjustable, so that any sized wheel might be put on the driving shaft.

A less complicated way of giving motion to the slide would be to drive it direct from the adjustable crank-pin by means of a connecting rod. This however would not give a quick return motion.

With regard to the drilling apparatus, I do not like the gearing arrangement. Such a drill being intended for light work, and needing a very quick speed, the noise from so many toothed wheels would be very disagreeable. A pulley on the driving shaft connected with another on the horizontal bevel-wheel spindle would seem better adapted for a light drilling machine. The fret-saw motion is easily explained. The two horizontal bars of the saw-frame are rigidly connected to the rocker arm, the vibration of which causes the saw to have a vertical reciprocating motion.

The plan of making the lathe standard to support the platform or work-table is a very useful one, and could be advantageously applied to many lathes.

If the Britannia Company are going to bring out Major Armstrong's invention, I hope we shall have some practical particulars from our old friend "O. J. L." Orderic Vital.

ORNAMENTAL LATHE-THREADS.

[19641.]—In Mr. Evans' valuable articles upon ornamental lathe-work, references such as "J-thread," "N-thread," &c., frequently occur, and confuse amateurs. Will Mr. Evans kindly say what these designations are derived from, and give us a table showing—1. List of all screws now used by him in ornamental work. 2. Number of threads per inch to each screw. 3. Angle of point-tool with which such threads are cut. 4. Extent to which the tops and the bottoms of the threads are left flat, are rounded off, or otherwise modified? And will he kindly add one paragraph explaining how these modifications of the thread are accurately produced; and another paragraph of remarks upon his reasons for choosing these particular threads, and the advantages which they possess over others in vogue—say those of Whitworth or the United States? J. E., M.D.

LATHES AND LATHE-MAKING.

[19642.]—I HAD intended writing on this matter last week, but was prevented by the usual pressure of business at this time of year. Possibly my experience may help to explain the "apathy" referred to about combination tools. My ambition always is, not to lose time in rigging and unrigging attachments, but so to contrive it that they are practically independent one of the other, or even capable of simultaneous use, which may result in a gain of time instead of a loss. Thus, with a self-acting lathe I have rigged a pulley attachment for sliding, which is available without removing any of the change-wheels; half a minute is enough to arrange matters for screw-cutting. Again, I have a small (too small) hand-planing machine, which I have fixed behind the lathe-bed on the right-hand end of the table, with which I can do any work required and drive the lathe by foot at the same time. It seems to me that the cost in money and labour of planing and such like attachments to a lathe, would in most cases nearly or quite cover the

cost of a separate machine, which both as to speed and power will do the work more satisfactorily. I speak only from a "metal" point of view; but if others think as I do, it will be quite sufficient to account for the apathy in question.

Scorpio.

LEVER POWER APPLIED TO THE BICYCLE.

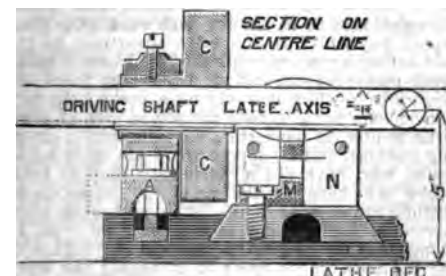
[19643.]—You kindly inserted in the *MECHANIC* (last July), a letter of mine on the defects of the bicycle. Permit me to reopen this subject. Why is the bicycle still only a fair-weather machine? Surely because, so to speak, the cart has been continuously improved, while the horse, or driving-power, has been as persistently neglected. The motive-power of a bicycle—viz., the rider's weight thrown on the treadles, ought to suffice, properly applied, for overcoming ten times the resistance offered by roads, which now bring the bicycle to a standstill, or cause it to be laid up for the winter. Whenever, and wherever, ordinary wheeled carriages run, bicycles ought to run, if only driven by good lever power.

Since writing my last letter, I have ridden the only lever-driven bicycle out, the "Facile," almost daily. A journey (among other travels) through twenty miles of Norfolk mud, enabled me to test the power and value of even a badly applied lever. The inventors of the "Facile" have thrown away a valuable principle by a bad application of it to their machine. Their wheel is too low. A higher one, 46 in. or more, would admit the use of a longer lever. Their excellent steady fulcrum, formed by the fork-end of the "Facile," by shortening, should be, though nearer resistance point, their connecting rod. Fulcrum and resistance being thus brought nearer the lever end at treadle, would, especially if curved up to saddle, gain a power of leverage. Whether, however, the "Facile" be improved or not, bicyclists must look to increased lever-power as the source of all future improvement of their machines.

I have avoided all reference to the lever-driven "Extraordinary," and "Devon Safety" bicycles, because their levers completely fail in obtaining any increase of driving power over the ordinary crank-action machines. Clerical Bicyclist.

TRICYCLES—DOUBLE DRIVING.

[19644.]—I AM sure the opinion of Mr. Scott is valuable, and in reference to traction engines still more so. But as we are in this paper devoted more especially to results and hard facts connected with scientific experiment, I can, without fear of treading upon anyone's toes, ask him, once more, the simple question: How is it that two wheels connected by differential gear, as in the tricycles spoken of, do not both equally climb and drive over any obstacle that comes in the way? My statement, I am confident, cannot be denied by any disinterested engineer who tests it in the way I have described. It is very easy to expatiate on the beauties and perfections of balance-gearing in the same manner as persons of undoubted experience testify to the superiority of gaslight versus electric, and declare it to be far superior. It is perfectly true that with the immense power (which may be multiplied to any extent) of a traction engine, differential gear may, as a rule, meet every requirement; but I contend that a tricycle, with its delicate limitation of power, deserves the fullest and most careful study, lest even an ounce of power at every



holes on its face, and so drive the vibrated slotted lever, FF; the wheel D also drives the drill by the lever gear, GH. The vibrating lever F works on the projecting arm, I, and most simply actuates the shaper by a toothed sector and rack (formerly shown in Fig. 5). For the short lathe-slides now so common, an L-shaped bracket casting, MN, will be suitable. The lower face is bolted to the slide, and the vertical face holds the sliding or simple adjusting-bolt, L, to the connecting-rod, K; the end face, N, of the bracket carries the upper slide of the slide-rest by its quadrant plate and screws. A hinged tool-holder, O (described Oct. 28), is shown in position. R is a long pin screwed through the end of F with a lock-nut; it is shown now out of gear with the arm V, which carries the pawl P, actuating the ratchet-wheel T of the drill feed. The screws, R and S, also serve for the attachment of the long arms of the fret-saw (Fig. 3, Sept. 30th). If a shaping-machine only be required, the drill and wheel B, with a part of the frame, may be omitted. It is not convenient to drive direct without the slotted lever, as the connecting-rod will not easily clear the driving shaft, and the advantages of a quick return are lost. There is no objection to the wheel D being larger, and at a higher level than C for plain work. As I am now serving in a distant part of India, and cannot quickly reply to inquiries, I may mention that I have placed my designs at the disposal of the Britannia Company, Colchester, who propose taking up the invention, should there be sufficient inquiry. J. A. Armstrong.

Kashmir, Dec. 15th, 1881.

[19640.]—THERE are many good points in Major Armstrong's novel and ingenious arrangement of lathe accessories; but I think his mode of applying the power will not be found altogether satisfactory. With three equal wheels the speed of the tool would be too fast, unless the back-gear was in action; and if it is necessary to reduce the speed by

stroke is wasted. I am sure the readers of the "E. M." are grateful for the space given them upon this subject, and it deserves the very fullest consideration.

Mr. Scott does not attempt to answer my argument, for I confess that the turning powers of the "Salvo," especially where the resistance from the ground is equal, to be very excellent; but I am sure that I would not sacrifice one ounce of driving power in a straightforward direction for one pound of superior power in turning. In turning, it is not speed nor power which is required—more frequently the brake has to be used; but I contend, in straightforward running, we require and thoroughly use up every ounce of pressure. Now, "170," who "still reiterates old fallacies with all the authority of proved facts," confesses a great deal of my argument. He states that such machines, when ridden *à la* "Otto," go ahead straightly, but only "when the resistance on the two sides of the machine is equal, but more or less wavy and erratic as the resistances vary with the state of the roads." So far, I could not state my case more plainly; indeed, I am surprised to hear that such a small difference as the state of the road should so far alter and spoil the double-driving powers of the machine as to compel it to make an erratic course. He then goes on to say, "the moment the steering-wheel touches the road, it equalises those resistances." So, if a brick is in front of the right-hand wheel, and it requires one hundred pounds pressure to cause the wheel to mount it, "the moment the steering-wheel touches the ground it will equalise the resistance." That is, either it will remove the brick or it will put a similar obstacle in front of the other wheel. "170" cannot mean this. It cannot equalise the resistance—hence his mistake. Unfortunately, it will not even equalise the power. All it will do is to put an immense strain on the steering-wheel, and in proportion to the amount of weight upon it and strain, so will the weakness of the wheel, which needs at least an equal amount of power, be felt, as in the "Meteor," or other single-driver under similar circumstances.

Now I have tested this, and what I state is that the wheel with the brick against it will not have any more power to mount that obstacle than the wheel of a "Meteor" machine, which is not driving under exactly similar circumstances. Any of your readers can test this: it is no small question, neither is it of small consequence, but the wheel which has the greatest resistance (apart from momentum) is as useless as a paralysed arm of a man who has to push a load. I do not ask for testimonials, nor mere opinions; let "170," who evidently understands my assertion, explain whether this is true or not. After an immense amount of riding and testing differential gear for some thousands of miles, I say it is the very weakest form of double-driving now in vogue.

56-Inch.

BALANCE OR DIFFERENTIAL GEAR.

[19615].—Some of the letters on this subject in the "E. M." maintain that in the "Salvo," in certain circumstances, one wheel ceases to be a driver, and acts in precisely the same manner as the free wheel in a single-driver machine.

Now, if this be so, there is, for the time, no pressure exerted by the pinion upon the corresponding bevel-wheel, and this bevel-wheel might be removed out of contact with the pinion, without producing any change in the mechanical effect; which is absurd, for, were this done, it is evident that the pinion would simply run round on the other bevel-wheel without driving anything.

The fact is, that in this gear the pinion is, at each instant, a lever of the third order with equal arms. The power is applied at the centre, viz., the stud which carries the pinion, and the resistances are applied at the ends of the equal arms, viz., the teeth in contact with the bevel-wheels; therefore, the pressures upon the teeth of these wheels are always (neglecting friction) equal to one another, and the driving forces exerted upon the two driving-wheels are likewise equal.

It follows from this that if the road resistances be unequal, there will be a strain upon the steering-wheel proportional to the difference of those resistances. The driving force transmitted to the more resisted wheel is not sufficient to overcome the resistance without some help, which help is supplied through the steerer. The force transmitted to the less-resisted wheel is in excess of the resistance, and the excess is neutralised by the steerer, and through its action is transmitted to the more resisted wheel. The strain thus thrown upon the steerer is equal to half the difference of the resistances multiplied by the distance between the driving-wheels, and divided by the distance between the driving-axle and the axle of the steerer. Expressed algebraically— $S = \frac{1}{2}(R - R')$ D · D.

This is very different from the result which we should have if the most resisted wheel were not driving at all, as maintained by "56in." in "E.M." of December 30.

Again, if the road resistance be equal, and the

helm be put over, there will be a strain upon the steerer, due to the tendency of the machine to run in a straight line.

In the foregoing cases I have neglected friction of the gearing. It is probably very slight; but whatever be its amount, its result is favourable to some extent in the first case, causing a slight additional power to be transmitted to the wheel which needs help; while in the second case it is unfavourable, causing the same to be transmitted to the inner wheel on the curve. All the phenomena in the performance of the "Salvo," which I have either observed myself, or heard of, are, I think, deducible from the principles which I have endeavoured to explain.

Similar considerations, *mutatis mutandis*, apply to the differential gear of Hillman and Co., and of the National, by both of which similar results are, no doubt, attained.

Now to change the subject. In "E. M." of Jan. 13, "Sunlight" expresses an unfavourable opinion of the central driving principle. Were he to see the performance of the tricycle I use, and upon which I have travelled many thousand miles over all sorts of roads, he might perhaps modify his opinion. It is a central-driver, the seat being in front of, and partly over the driving-wheel. It is driven, not with bell-crank, as in the "Singer" machine referred to by "Sunlight," but with connecting rods passing directly from the cranks to the pedals. It is the most easily-driven machine I have yet met with; though, being an old man and not a light weight, I am always on the look-out for one more easily driven.

Wm. Bindon Blood.

DYNAMO-MACHINES.

[19616].—THE several writers who have noticed my remarks on this subject have somewhat misunderstood me. I have no doubt that, here and there among our readers, there may be found a very few who might be able successfully to tackle the making of a working machine: such a one as "Anglo-Dane" is, however, a rare exception. What I meant to imply was, that such cases are so very rare that there is little inducement for the expenditure of great time and labour in order to assist them, with the certain result of inducing others to lose a great deal of money and work in attempting a task beyond their power.

I feel pretty sure that the exceptional cases can find better information for themselves in the examination of machines than can readily be furnished by writers, unless these are actually engaged themselves in the work; and I doubt if such a writer is to be found. They prefer to keep their acquired knowledge to themselves.

As to my own ideas on this matter, "Anglo-Dane" (19575, p. 405) exactly expresses my meaning. For myself, I prefer, and feel I can be most useful by turning from technicalities, useful to individuals, to the diffusion of scientific principles interesting to the multitude of thinking readers, and, I may add, much more in the line of my capacity.

I have had some thoughts of doing what "Anglo-Dane" suggests—writing a book on the dynamo-machine; but the task frightens me—it is so large; and, furthermore, I could not act in that matter as I like to do: that is to say, be perfectly sure of my ground because I had traversed it all myself. If no one better qualified for the task turns up in our pages, I may possibly undertake it when I feel more equal to it, as I am collecting every piece of information available on the subject.

Sigma.

[19617].—"EARNST ENQUIRER" asks for further particulars of Dynamos. Before answering these, I must correct his figures somewhat. 60lb. of No. 12 wire have a R. of about 1·5, not 2·5, as he calculates. The resistance of the No. 16 is correct; but as it is divided into two parts in the armature, its actual R. is only $\frac{1}{2}$ of the whole, or, say, 1½ ohm. The cost of the ironwork will vary with the form of construction adopted, and the speed required will depend on the same point, and on the care taken in working out the design, so as to use the wire to the best advantage or otherwise. With the Siemens armature, from 800 to 1,000 revolutions per minute would not be far out of the way.

With regard to the h.p., this can be approximately calculated from the R. and current. The lamp will have a R. of, say, 4·0 ohms; leading wires, say, .25 (if not very long); field magnets, 1·5; and armature, 1·25. Total, 7·0 ohms. This, with the normal current of 10 amperes, will require $10 \times 7 \times 10 \times 44 = 33,000 = 14 \frac{1}{2}$ h.p.; with, say, another $\frac{1}{2}$ horse-power for heating iron of armature and friction, gives 15 h.p., as actually required. It will be advisable, however, to provide rather more than this in starting; for in case of lamp working badly, a greater current will pass, and extra power will be required to overcome it. "E. E." will note that my machine gives a greater current and higher electromotive force

than the one I am now writing of, and requires more power; but in writing for amateurs I thought it best to give weights of wire for the smallest practical machine that would give an arc light, and my figures are, therefore, somewhat lower than the actual results I have obtained. If he is thinking of building a machine, and decides what form he is going to make, I may be able to give a hint or two which may be useful; but I have purposely written *generally*, as different forms required slightly altered proportions.

R. P.

ELECTRIC LIGHTING—ITS FIRE RISKS AND THEIR REMEDIES.

[19618].—IN the able article on this subject contributed by president Henry Morton to the *Sanitary Engineer*, and abstracted by you in your issue of Dec. 16th, are enumerated many of the dangers attending the use of electricity as a lighting agent; but one has, I think, been overlooked by him.

From Paris comes the report of an accident of a singular nature, which is stated to have occurred at a telephone station there. An attendant, having opened communication with another station, was awaiting a reply when an outrush of flame and smoke was observed from the tube containing the wires. The fire quickly spread to the walls of the room, and was not extinguished until considerable damage had been done. On investigation, it was found that a workman in a subway beneath the street had accidentally broken a gas-pipe. The out-rushing gas becoming ignited at his lamp, played upon the inflammable covering of the telephone-wires running alongside. The flames spread quickly, and soon reached the office.

In view of the possibility of other accidents of a like nature, I would suggest the advisability of covering gutta-percha coated wires, when in similar positions, with some such material as woven asbestos, which is at the same time a bad conductor of electricity and heat, and a substance both infusible and incombustible.

I do not know whether any experiments in this direction have been made; if they have, I think it would be of interest to your readers to learn what tests have been applied, and with what success.

Alfred W. Soward.

THE BLACKBURN ACCIDENT.

[19619].—COLONEL YOLLAND's long looked-for report upon the Blackburn collision, together with the minutes of the Board of Trade at the Council held on the 11th inst., before Mr. Chamberlain, M.P., president, have just been published. The opinions expressed by Col. Yolland have been received with surprise, owing to the fact that they are directly contrary to the verdict of the jury. If your readers will refer to last vol., p. 606, they will find full details of the experiments which were afterwards conducted to test the action of the brake, and in my letter, p. 68 of the present vol., the verdict of the jury is quoted as follows:—

"The collision was caused by the loose working of the signals, and the excessive speed at which the Manchester train was being driven into the station."

I may mention that I visited the scene of the disaster as soon as possible after it occurred, with a view to obtaining information to be used in case any of the railway servants were wrongly blamed or sent for trial upon a charge of manslaughter. However, after examining the situation and the wrecked vehicles, I could not help seeing that the two signalmen and the driver of the express had, to say the least, committed very serious errors of judgment. It will be remembered that the driver stated that the Westinghouse Brake did not act when required; but there is no proof whatever that this was correct, more especially when we refer to the fact that, when tested at the inquiry, the brakes were found in good order, and when every part was taken to pieces, no defect of any kind was found, as it most certainly must have been had any existed. Under these circumstances, therefore, surprise is expressed that Col. Yolland has accepted the driver's bare statement as correct. The minute of the Board of Trade is a most important document. It is there pointed out that Col. Yolland concludes that some mechanism of the brake had become out of order, but the President remarks:—

"This conclusion is not founded on such direct and positive evidence as to place it beyond doubt, but on inferences drawn from a variety of circumstances. On the other hand, there is evidence that the brake was in order, and had acted properly on this journey at the preceding stations at which the train had stopped."

This statement is very important, and your readers will at once see that there is not the least proof that the brake failed. The preceding statement at which the train stopped was Over Darwen; but there is evidence to prove that the brake acted properly. Now, the fact that the driver was able to take off the brake on his train, and start from that station, is most conclusive proof that the brake

was in good order at that time, and also that the couplings were properly connected, and that the main brake-pipe throughout the train (and consequently the auxiliary reservoirs) were charged with compressed air.

The distance from Over Darwen to Blackburn is only about three miles, and there is nothing to show that anything happened to the brake when running between those stations.

Suppose, for the sake of argument, that a hose-coupling had been pulled apart, or burst, or that any injury had been done to the brake, what would the result have been? Simply this: The pressure in the brake-pipe would be destroyed, causing all the pistons in the triple valves to instantly move down and open a direct passage from the auxiliary reservoirs to the brake-cylinders, and instantly apply the brake automatically. This fact is nowhere more clearly explained than in the official report of the Lancashire and Yorkshire Railway Company's own experiments, conducted at Garsburn on the 14th, 15th, and 16th July, 1880.

It is easy to say that the mechanism of a brake has become out of order, but we all know that when any apparatus is out of order, or does not act as usual, there must be some cause, and expert workmen can always, upon examination, find out where the failure is, and produce the defective part; now, in the Blackburn case, every part of the brake has been examined by most expert officials and workmen, and the result is, they find nothing wrong; therefore, it appears to me to be very unfair to conclude that a brake has failed to act when no defective part can be produced, or any proof given.

In the next session of Parliament, the advocates of brakes which are non-automatic and do not fulfil the Board of Trade conditions, intend to do all in their power to get the celebrated conditions withdrawn or modified.

The concluding sentence of Mr. Chamberlain's minute states clearly that "there is no reason to withdraw the opinions they (the Board of Trade) have previously expressed as to the conditions which should be observed in providing brake power for passenger trains."

This announcement will be received with satisfaction by all those who desire to see efficient brakes adopted and the number of railway accidents reduced.

Clement E. Stretton.
Saxe Coburg-street, Leicester, January 14th.

IMPURE MANGANESE DIOXIDE, AND THE DANGERS OF OXYGEN-MAKING.

[19650].—In reference to this matter, the letter of "Priam" (19613) in your last issue shows that the non-chemical public, who, like the country rector mentioned in the article from the *British Journal of Photography*, sometimes make oxygen gas for the purpose of magic-lantern displays, are open to a danger of which they should have the fullest knowledge. "Priam's" letter gives us one more out of thousands of instances of the manner in which human life is jeopardised by a want of the knowledge of the simplest principles of science. I do not mean to insinuate that the persons who ground the manganese in the mill in which coal had been previously ground, had any idea of the fearful consequences that might result, and which in this case actually did result from their ignorance, or that they were manufacturing a most explosive mixture; but it ought to be a warning to those who make oxygen for magic-lantern displays to be careful from whom they get their manganese. Where there is so great danger to the uninitiated as there is in the manufacture of oxygen, the materials ought to be obtained from responsible dealers. Make the dealers responsible, and there is little doubt a serious danger is removed. I feel sure that Mr. Blackwell would be ready to guarantee the purity of the manganese he supplied, and that he would sell it in very much smaller quantities than by the ton. Under these circumstances, a lanternist might go with high spirits to show the children and his friends, or the parishioners, "Jack and the Beanstalk," or "Little Bo Peep," without having the unpleasant suspicion that it was within the range of possibility that he might have to be brought home on a shutter. I must point out that there are other ingredients quite as dangerous as coal-dust—viz., charcoal, bits of straw, and chips of wood which, as a rule, get into the manganese when it has been carelessly kept after it has been bought from the chemist or manufacturer. I can well remember the only explosion I ever had when making oxygen. It occurred just seventeen years ago, shortly after I had been appointed to a large laboratory in the north of England. I was, among the first lectures, experimenting on oxygen, when suddenly the retort, which was fortunately a glass one, was shattered to atoms, not a particle of it, even to the stopper, ever being seen again. This caused me to examine the bottles from which the ingredients were taken, and I soon found that my predecessor, or someone else, had, no doubt inadvertently, been mistaking the

bottle containing the manganese and the bottle containing the bone-black; and that the bottles, although originally properly labelled, now contained mixtures of these two substances. Such things as this are not uncommon in laboratories where the students have access to the bottles. I have always found that ground glass is preferable to sand, because it can be got cleaner. When sand is used, it must always be thoroughly cleaned, or the danger is nearly as great as with impure manganese. The utility of the sand, which is used with advantage even when manganese is used, is to prevent the tumultuous rush of the gas, as sand is a bad conductor of heat. There should be just as much sand by bulk as of the other two constituents. As to the retort, I use a very simple contrivance when making oxygen in large quantity for the lantern, and it is perfectly safe. My retort is the shape of a truncated cone; the delivery tube is inserted laterally near the top. In the centre of the small circular plate, which screws on to the top of the truncated cone, and forms the lid, is inserted a short tube; on that is fitted tightly a piece of india-rubber tubing, not too thick, having a tightly-fitting cork fitted into its upper end. This is a perfectly safe oxygen retort, explosion or no explosion, and we should never hear of people being killed by the bursting of retorts, for the resistance of the india-rubber is so enormously less than that of the iron or copper, that cork and tube would be blown to atoms before the metal would be affected. I would advise experimenters not to sit on the retort, for really I have seen some that seemed so infatuated as to hang round the retort all the time the oxygen was being made. From 20ft. to 30ft. of tubing should be used between retort and gas-bag.

A Fellow of the Institute of Chemistry.

[19651].—In reference to Mr. A. B. Soward's further letter, 19614, in your *ENGLISH MECHANIC* of the 13th, pages 449 and 450: his warning to students of chemistry is perfectly clear, and I quite agree with him that they don't purchase by the ton, nor from wholesale dealers. My object was to inform such and other consumers that a thoroughly reliable oxide of manganese, specially prepared by me for oxygen gas, can be had from me direct in as small quantities as seven pound packets and upwards to any quantity. This paragraph in my last reads from "£7 per ton," and was an error in transcribing the notes of my shorthand clerk, for which I beg to apologise. Whilst I still maintain that manganese grinders whose trade is specifically so do not adulterate, it is quite possible that if, as some do, get manganese ground at a "jobbing mill" which grinds coal or anything else, accidental admixtures may thus arise, as in the case stated by your correspondent, "Priam" (19613); but it is clear that with suitable manganese, ground in mills specially set apart for the purpose, such accidents are next to impossible.

As previously stated, I am the largest importer, dealer, and grinder, by own mills, specially erected for and daily grinding manganese, which insures safety; but in addition thereto, I give special attention to the selection and preparation of ore suited to this and every other purpose to which manganese is adapted, and will guarantee, perfectly safe, my manganese for oxygen making. Sand and powdered glass are mentioned as substitutes for manganese, but they both require a great heat, and even then are of very slow action; besides, they do not discharge all the oxygen.

Geo. G. Blackwell,
Manganese Merchant.

26, Chapel-street, Liverpool.

[19652].—I HAVE read the various letters on the above subject with great interest. The idea of manganese being adulterated with coal-dust is, I believe, a popular delusion. I have had many years' experience as an analyst and teacher of chemistry, and have never met with a specimen so contaminated, nor have I ever yet had an accident in preparing this gas. I believe the cause of the majority of explosions in oxygen retorts is more mechanical than chemical. I have had opportunities of examining the remains of three explosions, and have found each to have been caused by the blocking-up of the leading tube. The mixture of manganese and chlorate froths—or rather spurts—very much, and if the temperature be high, the tube is almost bound to become choked at the end of the operation. If it were a rule to clean out this tube with wire before charging, I think we should hear of fewer accidents. I always use a large Bunsen burner, as a source of heat; and although the evolution of gas is not so rapid as when the retort is on the fire, it is safer, as the leading-tube is not so liable to become choked.

Another precaution should be taken—viz., to use a dry retort. The residue is often dissolved out with water, and the retort is used at the next operation with, perhaps, a few drops of water remaining. Let anyone fuse a little chlorate in a

test-tube, and then let fall into it a drop or two of water, and note the result. The same thing may happen in the retort, with more disastrous consequences.

Thos. W. Drinkwater,
Lecturer in Chemistry.
Chemical Laboratory, School of Medicine,
Edinburgh.

ETHOXO LIMELIGHT.

[19653].—In reply to the correspondent "Lanternist," 19606, asking for full particulars respecting the above light, I refer him to the *British Journal of Photography*, Feb. 25th, 1881, and the *ENGLISH MECHANIC* a week later, where he will find it fully described. J. Mercer.

THE BERLINER VIOLIN.

[19654].—NOTICING the interest which is manifested by your readers in my improved violin, I wish to tell you that I am preparing exact drawings and descriptions of my invention which will enable experimenters to avoid some errors in construction, and to make them familiar with the details of how to proceed in order to get the best results. For the present permit me to say that I can prove all the allegations made by me in the specification of my English patent—viz., that the tone of every violin made according to my invention exhibits all the elements of a first-class instrument, has a pure and sonorous tone, which is only modified in loudness if the wood of the violin is not well seasoned. At present I use the ordinary finger-board, which, however, is carved out up to within 2in. of the neck, and thinned off towards the free end. Underneath this, my new string-holder or resonator is fixed, and held to the body by a screw passing about 2in. from the neck, through the back, and through a hole in the belly about 3in. in diameter, so as not to touch the wood of the belly. The back of the violin is strengthened by a wooden rib extending from the neck to the middle of the violin, and scoping down in a curve. The resonator, before the strings raise the end upwards, lies flat on the belly, to which it is fitted, and a narrow strip of wood is preferably glued between the two blocks through the length of the violin and as high as possible so as to be near the belly. The resonator is about 7-16in. thick, thinning down to about 3in. towards the neck, and is well rounded on the upper surface.

E. Berliner.

Boston, U.S.A., Dec. 29.

INVENTION AND THE PATENT LAWS.

[19655].—ALTHOUGH fairly introduced by the editorial article on the first page of No. 876, I fear that the subject of the Patent Laws as a whole is far too wide for profitable discussion in "Our" pages. If, however, such discussion were confined to the one item of "Fees," I think it quite possible that some definite conclusion might be reached that could be turned to account when the Government redeem their pledge of bringing forward a Patent Bill; and I would therefore, with your permission, start a correspondence on the above particular. The article of last week had the Society of Arts' Patent Amendment Bill as its basis, and the Preamble of that Bill is referred to as an "excellent" one; and so it is. At the discussion in the Society of Arts' rooms it met with still higher commendation, for Admiral Selwyn (who is Chairman of the English Section of the Permanent Committee of the *Congrès de la Propriété Industrielle*) considered it "one of the finest ever drawn." Your article, however, does not mention that Sir Frederick Bramwell, the Chairman of the committee who prepared the Bill, in his reply on the third evening of the discussion, on the part of the very men who drew the preamble, disparaged it as "fine writing," and announced that the committee would "probably abandon it!" The reason given for this procedure was, that "when the Bill went forward it might be a matter of contest and of argument whether the preamble was proved or not." Had there then been any indication in the discussion that such contest and argument might ever arise? None whatever; not one single word had been uttered against the preamble. And as to its not being proved, why, all Patent Law rests upon its being "highly important for the good of the arts, manufactures, and commerce of this realm, that new and meritorious inventions should receive all possible assistance and encouragement!" (The words I quote are the words of the preamble.) So that, as whether there should or should not be a Patent Bill was not the question: the preamble of the Society of Arts' Bill stood already proved. We must then look further to discover the reason of the abandonment, and I think it is to be found here. One of the speakers had shown that the logical equivalent of the preamble was that the grant of patents should be free, and that therefore the preamble as it stood was not logically the preamble of a Bill that for the grant of a patent demanded £12 10s., but was a preamble proper to some other Bill not put forward. The right course

for the committee to have done under those circumstances would have been to retain the preamble, and make the Bill logically correspond with it by altering the provision as to fees, so that the grant of patents should be free. Afraid, however, of such recognition of the equality of men before the law, and equally afraid of being illogical, and, therefore, ridiculous, the committee would drop the preamble and retain the fees. Now, as even with that done, the Bill, by virtue of being a patent Bill, rests upon the basis of the expediency of protecting invention, the absurdity of drawing a money line between one invention new and meritorious and another answering exactly the same description, because the inventor of one is too poor to pay any fees, whilst the inventor of the other can pay these, is in no way got rid of. As one of the speakers said, referring to Dr. Siemens well-known remark as to its being in the public interest that an invention found in the gutter should become a personal property—if two men found each an invention in the gutter, and to one of them who could pay certain moneys protection was granted, whilst to the other who could not it was refused, that then a law which thus arbitrarily bestowed protection, though that law might professedly base its existence on the expediency of protecting invention as invention, really cared not for invention as such, but only for the payment of fees. How the Society of Arts will eventually word the preamble of their Bill remains to be seen; but, for my own part, examine the question in whatever way I can, I find no escape from the position that the grant of patents should be free.

PATENT LAW.

[19656].—If I find a diamond or a coal mine on my property, no one questions my right to it, and the law—so far from requiring the legal establishment of my claim to ownership—promptly interferes in my favour with any one who disputes that claim. This state of things has arisen from the recognition that a respect for the rights of property is in the end best for the general weal.

If I find an invention in my brain is it not also well to recognise it as my property, and why should I be compelled to employ legal aid at large expense, to establish my ownership in what is, by all laws of expediency and political economy, already mine?

In order that so-called "real property" may be put to the best use, it is found expedient to recognise it as belonging to some definite owner or owners; who, after expending capital and labour to make it productive, are legally and morally recognised as entitled to whatever profit their fellow mortals are willing to give them for their productions. Otherwise, who would expend labour or capital on anything further than his immediate "hand to mouth" wants.

The same idea has been aptly applied by Dr. Siemens to inventions, when he said that if a potentially valuable one lay in the gutter no one would pick it up.

The right of an inventor to the product of his labour (for inventions are not the results of any spontaneous generation process) should be strictly guarded. The communism which would make all inventions public property, strikes at the root of that strong recognition of individual right which is the basis of social progress. The idea that a new invention should be public property for the good of the nation, has just as much sense in it as that a new house should be public property for the benefit of all the tramps and vagabonds who have neither ability nor industry to build for themselves. Who would build houses or work out inventions if this were the law?

Calling a patent a monopoly, and therefore iniquitous, is only like giving a dog a bad name—to hang him. A monopoly is the restriction to one person, or a few persons, of what fairly belongs to all, or would produce a greater total of good if left open to all. A patent is the legal recognition of ownership already fairly existing.

To descend, however, from generalities to details, I would suggest that, instead of the elaborate and costly methods at present necessary to legally establish this ownership, the mere fact of having first invented anything should legally constitute ownership in it, and the sole right to all profits derivable from it. It may be objected that there would be a difficulty in proving priority of invention. I think there would be much less difficulty than appears at first sight, and what there was would be balanced by the freedom from the vexations and non-productive expenditure of legal energy at present going on. But granting the objection, then let priority of publication constitute ownership, providing the publisher cannot be proved a plagiarist from the real inventor. Let a journal be specially provided for descriptions of new inventions, to have a carefully-compiled subject-index. Such a publication would have a large circulation; but a charge per line for each insertion could be made, so as to prevent communications of unreasonable length or of no real value.

The inventor, having thus by one simple process

established his claim and advertised his invention, might either work it, sell it, or, if he pleased to do neither with it, might shut it up in a glass case and play "dog in the manger" with it, with just as much right as some of our large landowners (who "do what they like with their own") have to make deer-parks, &c., of their property, instead of potato-fields for the general good. However, the inventor being a worker, and therefore more or less to be sat upon by respectable idleness, he would probably have to forego this right, and either work his patent or sell it within reasonable time—no great hardship, after all.

To sum up, why do inventions differ from other manufactured articles in that the manufacturer must purchase the right to possess what he makes himself?

Let not England any longer class under one head whisky and inventions as fit commodities for a prohibitory tax.

Belfast, Jan. 4.

J. BROWN.

REPLIES TO QUERIES.

* * In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[45049].—**Carmine Paste (U.Q.)**—This can be made by throwing one pound of cochineal, previously ground to powder, into ten gallons of water and boiling it for about three hours; after which three ounces of carbonate of soda and half an ounce of alum are added, and the whole well stirred. Having remained at rest for some time, the clear liquid is drawn off, and mixed with the white of two eggs and again boiled. A coagulum is formed, which when the ebullition ceases soon falls to the bottom. The clear liquid (from which red lake is prepared) is poured off, the residue thrown on a filter, well washed and dried.—F. BARKER COOKE.

[45075].—**Armstrong's Combination Lathes.** A reply to this query will be found among the letters.—ED.

[45151].—**Glass (U.Q.)**—When the mixture of the ingredients for making glass is thrown into the furnace, the moisture is expelled, part of the carbonic acid driven off, and the inflammable substance consumed; at the same time, an action takes place between the silica (sand) and the alkaline matter. Great care is taken not to apply too much heat, otherwise a considerable part of the alkali is driven off in vapour; and the mixture is also constantly stirred, to allow the whole of the carbonaceous matter to be consumed by its coming in contact with the air. All the carbon being driven off, the remainder (glass) is a mixture of the silicates of soda and lime, the arsenic simply making them more fusible. There are also present traces of sodium sulphide, sodium hyposulphite, calcium sulphate, &c.—F. BARKER COOKE.

[45298].—**Ingrowing Toenails, &c.**—I have perused "Homeo's" letter with pleasure, and should like to be informed if it is the use of the salt-bath that enables him to dispense with poulticing, and will it not cause unnecessary pain to an ulcerated toe? As such an able correspondent on affections of the toes has made his appearance in "Ours," I hope that I shall not be troubling too much by asking "Homeo" to favour me with a reply to my query on corns, 45179, page 218.—CHIROPO.

[45309].—**Chemistry of Alcohol (U.Q.)**—I am not aware that there is any book specially on this subject; but "Dual" will find a good deal about it in "Miller's Organic Chemistry," and also some useful information in "Allen's Commercial Organic Analysis."—F. BARKER COOKE.

[45338].—**Preservative for Iron Ships.**—The best preservative for iron ships Mr. Clifford can use is red-lead mixed with boiled oil and dryers (no turps), the iron must previously be cleaned with petroleum and benzoline, then washed with a mixture of water, twelve; sulphuric acid, one; and wiped dry. This is an anti-corrosive composition; but if Mr. Clifford requires an anti-fouling composition, it will be considerably more difficult to give a satisfactory reply to his query. Over a hundred patents have been taken out in five years for such nostrums, but not one of them will keep clean from April to July, and whether a completely successful anti-fouling preparation will ever be produced it is impossible to say; but if it should so happen the inventor will undoubtedly confer a great benefit, and should reap a rich reward. I have been experimenting for more than five years, and made comparative trials with some of my own, and the best compositions in the market: they were all (about 30) submerged on May 8, but not one of them was clean on the 1st of July. The best composition in the market is Jesty's, but it is very expensive. If Mr. Clifford will advertise his

address in this paper, I will name to him the component parts of an exfoliating preparation, which was tried by the Southampton and Isle of Wight Company, and kept clean over twelve months; the same is also being tried by the Government, and I shall have a report from Portsmouth Dockyard next month, when the ship will be in dry dock, after having been out over twelve months.—G. SCHUTZE.

[45338].—**Preservative for Iron Ships.**—I perfectly agree with the remarks of C. W. Clifford respecting the answer of "Nun. Dor.," and although at present it seems a chimera to discover a remedy for the prevention of barnacles, weeds, &c., it may be done, and perhaps the following hint may be of advantage: In Cornwall, sometimes large heaps of mud are carted on a grassy plot from the mines, and left there some time before being sold, after they have been carted away, for years no vegetation, not a blade of grass, grows on the spot. Might not this be taken advantage of? My idea is, after applying a paint to prevent corrosion of the metal bottoms, to apply a very adhesive sticky paint, and then dab it over with finely-powdered mud.—J. KENDALL.

[45375].—**Water in Gas-pipes.**—This is caused by the pipes passing through a warm room and then into a cold one, or open place. The gas first becomes a light vapour, and is afterwards condensed; the water then finds its way to the nearest low part of the pipe. The gas in passing along the pipe forces the water up-hill; the water then falls back, and so keeps on, causing the light or lights to jump in unison with the rising and falling of the water in the pipes. Condensation takes place immediately it enters the cold—i.e., supposing a service laid on from the house to the further end of the yard or garden, you will find the water in the pipe within a few feet of the house, and none further down the yard. The same rule holds good with brackets near windows; water is always found close to the wall at the bottom of the pipe leading to the bracket. Never blow the water out; always find out where it is, and then fix a siphon to receive it. Wet meters give more trouble in this respect than dry ones.—W. DUMKIN.

[45384].—**Friendly Society Valuation.**—"Secretary" evidently underestimates the difficulty of the task he proposes to undertake. His best course will be, in the first instance, to obtain a "valuation form" from the Friendly Societies' office, 28, Abingdon-street, S.W., when he will be better able to see what information is required. This form, I may mention, has to be filled up properly and completely, as it embodies the results obtained from the actual valuation. A memorandum has lately been issued by the chief registrar on the subject of valuations, wherein matters are made clearer than could be done here, and "Secretary" had better ask for a copy of this at the same time.—VERAX.

[45411].—**Bending-over Edges of Tin (U.Q.)**—If "Amateur Tinker" will take an old tin vessel with turned rim and open with a chisel, the modus operandi will appear quite simple; now close again, using a wood mallet; next, try with small pieces of tin, until a good rim can be made; keep the bend true, and there is no difficulty, but in all cases put in wire and finish the rim before attempting to bend into shape for any vessel, as the case may be. For example, cut a strip of tin 10in. long and 2in. wide at one end, and 1½in. at the other; now neatly turn the edges over, insert the wire, and close down with mallet; now bend into shape of jug-handle, keeping turned edge inside, and see result. An old croquet-mallet, rasped round on one face, makes a capital tool for an amateur.—ON GUARD.

[45474].—**Kilns.**—I do not think there is any work which treats specially of the construction and management of kilns used for terra-cotta, for there is nothing very peculiar about them, and any kiln may be used, though the high heats necessary for porcelain work are not required. The industry is in fact so limited that it would scarcely pay anyone to publish a book about the kilns, but there is some information in such books as "Ure's Dictionary" and I think also in Spon's "Encyclopedia of the Industrial Arts." A visit to Stamford or Watcombe in Devon would be the best way to get really trustworthy information.—NUN. DOR.

[45494].—**Bicycle Crank.**—If it is keyed on, you can drive key out with a hammer and a punch, which latter may be of boxwood or beech if you wish to avoid burring edges. The key is driven cold of course; if hot, it would be loose when cold.—ESSAR.

[45503].—**Printing Press—Power Required.**—This query is one of the indefinite kind. We are told what the machine is to do, but not a word about its construction. If it is one of the ordinary news machines, working one side, with a reciprocating table worked by rack and pinion, one man, with the help of a fly-wheel, could "drive" it for a short time, and at a slow rate; but to get its full

duty out of it, which, I suppose, would be, say, 800 to 1,000 revolutions an hour, an engine of not less than half a horse-power would be needed, and it would be advisable to have one that could give a full horse-power. As to the question, "is there any difference really between 1 H.P. steam-engine and 1 H.P. gas-engine," it would be as well to have a little explanation. One horse-power is a definite amount, whether obtained from a gas-engine or a steam-engine; but a one-horse steam-engine might be capable of exerting 2 or 3 horse-power, according to the pressure of the steam, which is an important factor in calculating the power. Is that what "Power" means?—NUN. DOR.

[45504].—**Electrical Carbons.**—Of the actual method pursued by M. Gaudoin in the production of his carbons I cannot pretend to speak; but outside the factory it is understood that they are made of sticks of wood, which are placed in plumbago retorts and slowly heated to drive off the volatile matter, the final desiccation being made at a very high temperature in a reducing atmosphere. Previous to that last process, however, the partly carbonised sticks are soaked in a solution of acids or alkalis to remove any impurities from the wood. These sticks of carbonised wood are soaked in the carbides of hydrogen and the chlorides of carbon under pressure until their pores are completely filled with a homogeneous deposit of nearly pure carbon. Gaudoin's patents were taken out in 1876 and 1877. The first, however, refers to the method of grinding the carbonised wood to a fine powder, and then agglomerating it under high pressure with a mixture of carbon obtained from pitch, fat, or resin. Since the latter date no doubt Gaudoin has improved on the processes described; but practically it is found that the secret of making good carbons lies in thoroughly purifying the raw material and in rendering the sticks perfectly homogeneous. Retort-dust, finely powdered, mixed with a small quantity of coal-dust, and moulded up with tar, treacle, &c., makes excellent carbons when proper care is taken in the manufacture. I do not know whether the above information is of any use to "Lancashire," but I expect that outside the factory he will obtain no better information than is to be found in the specifications of Gaudoin's patents. NUN. DOR.

[45508].—**Cleaning Woollen Goods.**—Dirt yields readily to ammonia, and grease may be removed by an application of benzine, taking it up with blotting-paper and a warm iron. Turpentine will remove many kinds of spots; but for a full account of stain-removing I would recommend readers to refer to Vol. XX., in which, on pages 189 and 217, directions are given for removing nearly every conceivable stain.—S. R.

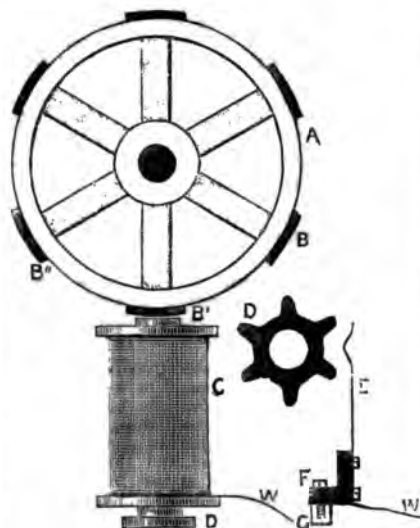
[45535].—**L. and Y. R. Engines in the Blackburn Accident.**—The Manchester express which came into collision at Blackburn was drawn by a trailing bogie tank engine, No. 74, and the engine that was run into was "Vesuvius, No. 632."—CLEMENT E. STREETON.

[45544].—**Tait's Thermic Ventilator.**—The sketch on p. 304 is not so plain as it might be; but there can be no difficulty in understanding the arrangement. A 4in. pipe is connected at its upper and closed end with the atmosphere, and forms a "chimney" to a gas-burner. A 2in. pipe, connected at its lower end with the atmosphere, and passing through the upper end of the 4in. pipe, brings fresh air, which it discharges into the room, warmed by the heat of the gas-burner. Obviously the action can be reversed, and no portion of the products of combustion will enter the room. A Bunsen burner is the best arrangement though, I should think, instead of the flame shown in the cut; and I think very much with "O. R. in Italy," (45552), that the apparatus may be a good ventilator, but can do little to "warm" a room.—NUN. DOR.

[45577].—**Air Currents.**—You cannot successfully draw air down the flue, the very fact of the hot air ascending the flue would altogether prevent cold air descending; there is no convection in a flue. Now, you can easily bore a hole through the chimney to the outside, or if the chimney is between two houses, you could carry a 2in. pipe under the floor either from the front or the back of the house and carry it through stove into the room. The only way you can utilise the flue is to divide it, and then the air brought down one shaft would be anything but fresh when it reached the room.—W. J. LANCASTER.

[45593].—**To Mr. Lancaster.**—I have given the drawings you ask for below, and the information to enable you to make the rotator. A is the wheel made of brass, and should be 3½in. diameter, carried by a spindle between two A's; this part you can build up to your own taste. The six pieces of iron *b*, *b'*, &c., should each be 2in. long by ½in. wide; they must be screwed to the circumference of the wheel so that they overhang equally on each side—this is to allow them to go over both poles of the electro-magnet in the sketch; only one half of the

electro-magnet is shown. The cores of electro-magnet *c* should be made of ½in. iron rod screwed into the iron plate *d*; the two cores should be 1½in. apart, centre to centre. The bobbins 1½in. long on each core, and 1½in. diameter top and bottom, the wire, No. 18, being wound on to a depth of one inch from top to bottom; then you must make a sort of cog-wheel of brass to go on to the spindle carrying the wheel. This cog should be something like *d*, and a spring (*e*) should be so arranged that it touches each of the



cogs as they revolve. This can be done with a piece of ebonite, and attached to part of one of the A's carrying wheel (*g*). The spring is held to the ebonite by two screws, the upper one being arranged to give the spring its proper elasticity and position; the wire at the bottom of spring goes to the battery. Another wire from one of the A's goes to the electro-magnet; the other one (*W*) goes to battery. Thus, when commutator touches spring, then the current from *W* goes through the cog into spindle, down one of the A's to electro-magnet, and out through the wire (*W*); thus, so long as cog touches spring, so long the electro-magnet is magnetised; consequently, if *b* is some distance from the core of electro-magnet, but, at the same time, nearer than either *b* or *b'*, it will be pulled along until it is immediately over the core; then the cog will be away from the spring; no current, no magnetism. The momentum gained carries *b* on until the spring touches next tooth in commutator; then *b'* is pulled, and so on. This motor you will find to be very effective, and will work well with one cell. The arms carrying vacuum-tubes must be screwed into ebonite. One arm is connected to the spindle carrying wheel (*a*), the other arm is connected to a piece of tubing on an ebonite disc fixed on spindle, against which a spring of light brass presses as the rotator revolves. I shall be pleased to give you any further information.—W. J. LANCASTER.

[45605].—**To Mr. Lancaster.**—No; the repulsion would not be 20lb. in the attraction exerted by an electro-magnet upon a piece of iron; there is also the attraction exerted by the piece of iron upon the magnet. Thus, suppose we take the smallest electro-magnet I gave measures, &c., for, and send a very weak current through it that will only enable it to hold 1lb. of iron; then I double the current—the magnetism of the core is as the square; thus the electro-magnet would hold 4lb.; and if I make the current three times the strength as at first, then the attraction becomes sufficient to enable the electro-magnet to hold 9lb.; and so on. You will see in a moment that the repulsion of one magnet upon another is very different to the attraction exerted mutually between a magnetised bar and an unmagnetised bar of iron.—W. J. LANCASTER.

[45608].—**Dissolving Gold and Silver.**—Try 3 or 4 parts of hydrochloric acid to 1 of nitric acid, the whole diluted with an equal bulk of water, for dissolving gold. Chloride of silver is best prepared by precipitation from solution of nitrate, either with common salt or hydrochloric acid; then well wash and dissolve in solution of cyanide of potassium.—PHOTOS.

[45608].—**Dissolving Gold and Silver.**—To make chloride of gold (AuCl₃) dissolve gold by boiling it gently in HCl, and then gradually adding a little HNO₃. When all is dissolved, evaporate the liquid, when yellowish crystals of the trichloride (AuCl₃) will be deposited. Collect these and heat them gradually to about 175° C.; they will lose chlorine and furnish aurous chloride (AuCl), a pale yellow, sparingly soluble compound. Be careful

not to heat them too strongly; otherwise all the chlorine will be expelled and metallic gold left.—F. BARKER COOKE.

[45610].—**To Mr. Lancaster.**—(1) You will gain nothing by increasing the surface of the cores; better even to reduce them if you want to get a great power in a small compass; but for ordinary purposes the cores should be one diameter throughout. (2) My lamp will not work with Leclanché cells. (3) For the first and second in the series, two pint cells will be ample; the third and fourth, you will require two quart Bunsens; fifth and sixth, four quart Bunsens; seventh and eighth, six quarts; ninth and tenth, six quarts. Shall be pleased to give you any more information on these points.—W. J. LANCASTER.

[45619].—**Electric Light.**—(1) The eight gallon Bunsen would not be so effective as 32 quart cells; the probability is that eight gallon cells would fuse some of the connections for you, to begin with. (2) You can coat the zincs with melted paraffin, or cover them with pitch on the surfaces not to be used. (3) By economising the nitric acid, you would economise the amount of current wonderfully by reducing the working of the battery to perhaps a couple of hours instead of five or six hours. (4) An arc lamp would give most light from the Bunsen cells.—W. J. LANCASTER.

[45623].—**Carbonised Bristol Boards.**—You would be unable to make the small carbon filaments for the incandescent lamps, unless you had the special apparatus necessary for carbonising the small portions of board. You cannot bend them about in any way you like: they become brittle, and cannot be handled with impunity.—W. J. LANCASTER.

[45624].—**Gelatine Plates.**—Do not attempt to make gelatine plates unless you have plenty of time and temper to lose. You can buy good plates now at 1s. 6d. per dozen, ¼-plate, and I can assure you if you attempt to make them yourself they will cost you double the money, and the chances are you will spoil a lot of chemicals, glasses as well, before you will be able to turn out a workable plate. The making of gelatine-plates is not a pleasure, I can assure you. There are so many points to be watched, and however careful you may be, there is sure to be something or other cropping up that will perhaps spoil half the batch, and away they go to loss account.—W. J. LANCASTER.

[45624].—**Gelatine Plates.**—A little practice is of course necessary to enable anyone to coat plates successfully, but otherwise it is a very simple matter. I should, however, recommend "F. W." to prepare a stock of plates, and use them dry rather than moist.—PHOTOS.

[45632].—**Oleographs.**—Probably blackened by hydric sulphide. If so, they are best cleaned by moderately dilute hydric peroxide (H₂O₂). This oxidises the black sulphide of lead to white sulphate. Try a corner at first.—PORCUPINE.

[45635].—**Magnetic Induction.**—To Mr. LANCASTER.—The magnets you mention would give an induced current sufficient to deflect a galvanometer when armature was withdrawn; but as to 4 quart Bunsens—why, it would require at least half a dozen 18in. horseshoe magnets, bolted together with armature and bobbins to rotate, to produce a current equal to 4 Bunsens, and it would not be an easy task to make the armature revolve. If you would like to make a machine to give current equal to 4 Bunsens, I shall be pleased to give you the working details.—W. J. LANCASTER.

[45637].—**Faulty Electric Bell.**—You have something wrong, but the difficulty is to point out just the wrong spot. Could I see the arrangement, I might rectify it in a moment. I fancy the current may be too weak to pull down flag in indicator when you use a trembling bell. With the single stroke the current is not broken, and so pulls down flag easily. Just put a piece of cork between hammer and bell, so that the current will not be broken by bell, then send current through; the flag, no doubt, will fall instantly, but let the hammer vibrate—meaning, of course, make and break of circuit; then the probability is the flag will not fall. Now bring a cell close to bell, and couple up short circuit; bell will ring, and flag will drop. If this comes out as I have stated, put on another cell at the other end, and all will go well again.—W. J. LANCASTER.

[45640].—**Tidal Communication between Liverpool and Manchester.**—I am much obliged to "Working Tom" for his useful communication. I am sorry he had not the data by him to enable him to afford more definite information. With regard to the elevation of Manchester above Liverpool the bed of the river Irwell at a point just below Throstle-next-Weir, Manchester, is 61ft. above the sea-level, and it is 49ft. above the point where the tides intersect the stream at Woolston, about 16 miles from Manchester. It is clear, therefore, that the depth of cutting at the Manchester

end would have to be 61ft., to permit of the tide ascending; but what I want to get at is the range of tides in the proposed harbour of Manchester. I understand that a high spring tide rises 33ft. at Liverpool, 16½ft. at Runcorn, and 8ft. at Warrington. With regard to a canal right across the country between the Mersey and the Humber, I have for years thought this will be constructed sooner or later. I don't think, however, it is advisable to have recourse to locks between Liverpool and Manchester. Since Mr. Hamilton Fulton put forward his tidal navigation scheme before the Manchester Chamber of Commerce, most people have given up the notion of lockage. With reference to the towage of sailing vessels, tugs would have to be employed whichever plan were adopted. But the fact is, the Manchester Tidal Navigation Scheme would be incomparably better suited for towage than any canal on the lock principle. Besides, in connection with the Manchester business, which is mainly conducted by steamers, we have to consider which plan is most suited to steam navigation. Now, a canal with locks would occasion vexatious delays, while, with a free tidal channel, steamers would come up to Manchester on one tide without hitch. I may just mention that since 1866, the aggregate steam-tonnage of the United Kingdom has increased by nearly 250 per cent., while in the same period the sailing tonnage has decreased by fully one-fourth, or 25 per cent. This indicates a constant replacement of sailing tonnage by steamers. This will give a fresh impetus to the consideration of the means of improving inland communication with the sea, owing to the ease with which steamers can ascend into the interior, against even a strong river current. — MERSEY, Manchester, January 10th.

[45644.]—Dark Slide and Lens for Camera.—As it is evident you are not an adept in the use of carpenter's tools, it would be a waste of time on your part to try to make a dark slide. You should look over the back volumes of the *Mechanic*; then, having an idea of the exact thing you want, write another query, and I will help you. — W. J. LANCASTER.

[45648.]—Induction in Telephone Circuits.—You will be unable to so balance the currents in the two wires as to practically eliminate induction. Better separate the wires as far as you can apart, or, if you could do it, use only the one wire and couple to earth-plate for return. If you have two different wires, then I do not think you could do better than to hang them as widely apart as possible on the poles. It is not the induction caused by telephone transmission that is heard, but the current for ringing bells or the current in the neighbouring telegraph wire. This causes an annoying induction. If expense was not of moment then the double line for each would be preferable. — W. J. LANCASTER.

[45650.]—Corrosion of Wrought-Iron Plates.—If you could coat the plates with melted paraffin you would at once prevent them from becoming rusty. The iron plates will rust in water only, so that the getting rid of the acid would not do any good. Protect the metal, then you will be safe. — W. J. LANCASTER.

[45659.]—Polishing Tortoiseshell.—If the surface has deep scratches in, scrape with a smooth-edge knife, then rub over with fine emery-cloth (the more worn the better), after which polish with the hand and rottenstone and water. Finish off with the hand and dry rottenstone. — PEGAN-REDSTUFF.

[45660.]—Hydraulic Hammers.—To "SUNLIGHT."—The information that I require is the construction and mode of working of hydraulic hammers, such as are used in ironworks. I believe they are used in the place of the steam-hammer. — G. H.

[45664.]—Collodion Dry Plates.—These may be prepared either with the bath or with emulsion. If "F. W. D." will state which method he prefers, I will give formulae. — PHOTOS.

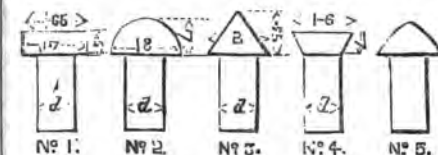
[45664.]—Collodion Dry Plates.—You can make collodion dry plates in a dozen different ways or more. One of the simplest methods is to make up a strong bath, 40 grains of silver to the ounce of water, then coat with collodion, put into bath, and when taken out of bath swirl first with distilled water, then with ordinary water until all greasiness is got rid of, then pour over the plate a strong solution of coffee, with a little sugar in. Let plate drain and dry, then use in the ordinary way. You can preserve the plate with albumen beer, or a lot of things each said to be the best, but the coffee is simple, always at hand, and gives good results. — W. J. LANCASTER.

[45675.]—Battery Carbons.—In answer to J. Hislop's query addressed to Mr. Albert Smith, *re* battery-carbons, the following is the method I have adopted with perfect success for flat plates 5in. by 4in. by ½in. I crushed a quantity of gas-carbon (coke would do, but has a higher resist-

ance) to a fine powder, and having mixed it intimately with about half its volume of flowers of sulphur, I laid it in a layer of ½in. thickness in the top of a biscuit-tin. This was laid on a stove till the sulphur was melted, when the whole was allowed to cool. For rods, I should press the mixture into a brass tube, and heat. There seems very little tendency to stick to the metal. These composite rods have considerably more resistance than gas-carbon rods, but are very convenient. — LL. B. A.

[45685.]—Chinese White.—I was told by the maker not to put water, but spirit of wine or any other white spirit, and to keep it covered with spirit always. This has quite remedied mine, which was in the same condition as the querist's. — BRICKWALL.

[45689.]—Names and Proportions of Rivet Heads.—There are many different forms of rivet heads—that is, speaking of the rivet as it comes from the rivet-maker; four of the commonest kinds I show in sketch. No. 1 is known as "Cheese," or



"Common" head; No. 2, as "Snap," or "Cup" head; and No. 3, as "Conical" head; and No. 4, "Countersink" head. In giving proportions, diameter of rivet is taken as unity, thus: $d = 1$. In this case, $d = \frac{1}{2}$ in. The name snap-head may be applied to several forms of heads, as most leading boiler and bridge-builders have their own form of snap. The commonest form is something near the form of No. 5, and varies in size according to the riveters, as it is possible for two different riveters to use the same amount of metal in a rivet and not make the same size of head, as in one case the hole may be better filled than in the other; a little is also cut away by the snap edges, and a little wasted in heating. No. 5 is the commonest form of head made by the riveting-machine. No. 2 is sometimes called "rose head." No. 3 is the old style of hand-rivet, known in Lancashire as "Pointer," and is still made and occasionally finished by a snap. — S. BOSWELL.

[45690.]—Model Locomotive.—I must thank "Sunlight" and "Meteor" for their kind information, and should be glad if "Meteor" would give me the dimensions, as I am unable to procure them elsewhere. — E. A. M.

[45692.]—Cementing Speculum.—I should certainly not advise you to cement three pieces of glass together and then to attempt to make a speculum out of them: better use a piece of glass ½in. thickness, or, if you can get it, 1in. thickness. You could cement the three ½in. slabs together, but the upper one in being worked would be sure to come apart and spoil the whole thing. It is a pity to lose a lot of time in working at what will ultimately prove a failure. — W. J. LANCASTER.

[45695.]—Ivory.—Ivory can be washed in milk or in water only. Don't wash it with anything that will discolour it. We use a lot of ivory, and of course find it much more brittle than vulcanite. — W. J. LANCASTER.

[45698.]—Leclanche Battery.—You can make a Leclanche cell in the manner you suggest. Some time ago I made a new form of cell, in which the coke and manganese were moulded into a cup-like form, then an inverted cone of zinc attached to a piece of ebonite was suspended over the cell, the zinc going down into the liquid about 1½in. This kind of cell worked very well indeed, and as no porous cell was required it was very simple and worked well. You need not use the blotting-paper at all, it will rather hinder the work of the cell than aid it. Of course the wire from the carbon-layer should be well insulated before it leaves the carbon, and to the outside of cell. In my cell the carbon binding-screw was fastened to the outside of cell. You will find a drawing of the cell I refer to some few volumes back. — W. J. LANCASTER.

[45699.]—Watch-Repairing.—Take your escape-wheel in your left hand, and a piece of true-flat cutting-stone in your right; hold the wheel loose, so that it will find its own surface or level, place the face of the stone against the point of the teeth; work the stone French-polishing fashion until all the points of the teeth have been touched, then bring them up to a point. You can get them cut at Stockalls, 6 and 8, Clerkenwell-road, for 6d. It will pay you best. — A FELLOW WORKMAN.

[45700.]—Lead Wire.—Lead wire is produced by means of a kind of big iron syringe, provided at one end with a nozzle bored to the size of the wire required, and at the other with a screw piston.

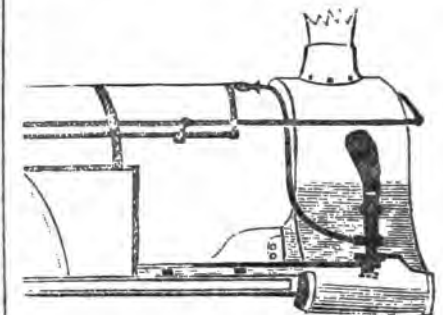
The metal is introduced and the screw piston turned, when the lead, by virtue of its viscosity, issues from the nozzle in the desired form. — ALFRED W. SOWARD.

[45704.]—Case-Hardening Bearings.—Take a piece of leather (old shoe), a piece of bone, put them in the fire and burn them to charcoal, take equal parts of charred bone, charred leather, and charcoal, beat into a powder, and put into an iron box, or anything that will stand heat, and cover the ends over with clay, to keep it air-tight. Now place it in the fire, and let it lie until it gets red-hot; keep it there for two or three hours, take it out with a pair of tongs, and hold it bottom upwards over a pail of cold water, knock the clay off with a poker. This will not cost anything. — A FELLOW WORKMAN.

[45704.]—Case-Hardening Bicycle Bearings.—Crush a small quantity of prussiate of potash on a slab, make the bearings red-hot, and rub them well in the prussiate of potash, and then put them into cold water till they become cool. — VULCAN.

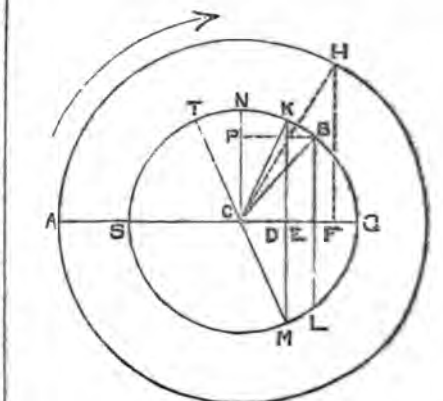
[45710.]—Magnet.—To Mr. LANCASTER.—As you have, I suppose, the armature, with bobbins on, belonging to the machine, you cannot do better than use it for magnetising the magnet with. Send a current through it from three or four cells, then lay the magnet down; then draw the electro-magnet from the curved end of magnet towards the end of magnet, and taking it off both legs at the same time. Then take the electro-magnet back to curved end, and repeat the process until the magnet is quite strong again. You will be able to make the magnet strong without hardening and tempering again. If the magnet does not retain its magnetism for some time, then you will have to harden it and temper before magnetising. You will not use the intensity-coil during the magnetising; it would weaken the current, instead of making it stronger. — W. J. LANCASTER.

[45712.]—Continuous Brakes.—I send a draw-



ing of the brake as fitted to an 8ft. engine (G.N.R.). I am sorry I cannot give a full description of its working. I may just say steam enters the main pipe from the boiler at the top (as seen per sketch) to brake-pipes, and skid the wheels, returning by the pipe shown flat to the large pipe in the smoke-box out in the air. It is the same on the S.E.R., I think. — E. P.

[45713.]—Trigonometry.—The trigonometrical relations between the travel of the piston and that of the slide-valve will be understood with the aid of the accompanying diagram. Suppose the steam-



cylinder to be horizontal, and that the piston is at the end of the cylinder farthest from the crank, then the crank will be horizontal; it is represented by the line AC, and the point A is supposed to move in the direction of the arrow round the centre, C. The smaller circle represents the path

of the centre of the eccentric or crank which moves the slide-valve; this circle is exaggerated in diameter so as to make the various lines distinct. It will simplify the explanation if we consider the valve to be worked by a crank, such as C B, instead of an eccentric. Now, if there were no lap and no lead, when the piston is at the end of its stroke, the crank which works the valve would have to be set at right angles to A C, and would be represented by C N; but if we have lap, we must set the valve-crank in the position C K, where C D represents the amount of lap; if, in addition to the lap, we also have lead, we must set the valve-crank still further from the vertical till it takes the position C B, where D E represents the amount of lead, and in this position the valve-crank should be firmly clamped, so that the angle A C B remains constant. When A C and C B are in the position shown in the diagram, the steam-port at the farthest end of the cylinder will be open to the extent of the lead; and if the engine is turned so that the point B comes to G, the valve will be full open; turn the engine still further, till B comes to L, then the valve will be in the same position at L as it was at B—that is to say, the port farthest away is open to the extent of the lead; if then we turn still far her, till B comes to M, the valve will close the port. We see then that the engine must turn through an angle, B C M, before the steam is shut off. Now, if we make the angle A C H = B C M, the line A F will represent the travel of the piston from the end of the cylinder to the point where the steam is cut off; hence we have to find A F in terms of the known quantities. Call A C = l, B C = r, lap = L, lead = l. Now, C E = L + l = P B, and P B · C B = sin. B C P; or L + l · r = sin. B C P; or B C P = $\sin^{-1} \frac{L + l}{r}$; and if we add 90° to this, we get the angle S C B the constant angle between the two cranks, which is therefore = $\sin^{-1} \frac{L + l}{r} + 90^\circ$. Again, C D = C K cos. K C G = cos. T C S, or T C S = $\cos^{-1} \frac{L}{r}$. Now, B C T = B C S - T C S and B C T = H C G (by construction). We have, therefore, found H C G in terms of known quantities, and therefore we can find its cosine. Now, the line A F (which is what we require to find) = R + R cos. H C G; or R (1 + cos. H C G), we can now substitute the value of H C G (found from the equation given above), and we get A F = R [1 + cos. ($\sin^{-1} \frac{L + l}{r} + 90^\circ$ - $\cos^{-1} \frac{L}{r}$)], which agrees with the verbal statement of the result given in the query. In the present case, R = 24 in., r = 10 in., L = 5 in., l = 3 in. So we have, after substituting these values in the above formula and reducing to decimals: A F = 24 [1 + cos. ($\sin^{-1} .525 + 90^\circ - \cos^{-1} .5$)]. The angle whose sine is .525 is 31° 40', and the angle whose cosine is .5 is 60°. ∴ A F = 24 (1 + cos. 61° 40'). The cosine of 61° 40' is .476; so that A F = 35.4 in. This shows that the steam is cut off at nearly 3 in. of the stroke of the piston.—M. I. C. E.

[45714].—L. Y. R. Tank Engines.—Without an illustration, I think the best means of giving "Centaur" an idea of the 79 class will be to compare it with the Midland bogie-tanks, which I presume he has seen. If "Centaur" will imagine the side-tanks cut off on a line with the front of the firebox, he will have a fair idea of the length of the tanks. The driving-splashes are not inclosed. Like 253, the cab is double, but slightly different from that class; and also in a few other details. The capacity of tanks is:—No. 79, 1,000 gallons; No. 253, 1,250 gallons. I am pleased to see your sketch of No. 653.—R. N. H.

[45716].—Old G.W. Engines.—The "Thunder" was put up in 1837, at Paddington, the materials having been sent by sea from Hawthorn's, at Newcastle. The engine and boiler were carried on separate frames; those of the boiler ran on six wheels. Communication was made between boiler and cylinder by a 9 in. pipe. The steam-pressure used was 60 lb. per square inch. Link motion was not applied to this engine. The power was transmitted from the crank-shaft to the coupled wheels by spur-gearing, in the ratio of 3 to 1, or, in other words, for each turn of the crank-shaft the driving-wheels made three. The principal dimensions were:—Cylinders, diam., 16 in.; stroke, 20 in.; coupled wheels, 6 ft. diam.; boiler diam., 3 ft. 8 in.; length, 8 ft. 7 in.; tubes, number, 135; length, 9 ft.; diam., 1 1/2 in.; heating-surface, 516 square feet; firebox, heating-surface, 108 2/3 square feet; total h.s., 624 2/3 square feet; grate area, 17 1/2 square feet; weight, 12 tons.—CARSTAIRS.

[45717].—Hydraulic Accumulator.—If the ram be 12 in. diameter, its area is 113 sq. in. As we want 700 lb. to the sq. in., we must load with 700 × 113 lb. = 79,100 lb.—L. B. A.

[45721].—Poles in Electro-Magnetic Machine.—You can easily determine the direction of current from electro-magnetic machine, supposing the current to be all in one direction, and not an alternating one, by means of a galvanometer.

First determine the deflection due to passage of current from the positive element in a cell; then test that from the electro-magnetic machine. I am afraid you will find your machine gives alternating currents.—W. J. LANCASTER.

[45722].—Alarm.—Remove the bell and fit a hard wooden box, when he gets used to that replace the bell. Use is second nature.—A FELLOW WORKMAN.

[45722].—Alarm.—I have procured an excellent electrical alarm from a person who devised it for me, which cannot fail to rouse the heaviest sleeper, and if "One in a Fix" will advertise address, I will communicate the maker's name. I was in the same dilemma, sleeping through every alarm till I had this one.—ALARM.

[45726].—Bain's Earth-Battery.—This battery, which consisted of large plates of zinc and copper buried in the ground, was a failure; and I do not know of any earth-battery that has been a success. Make a gravity-battery, or a modified Daniell's; these will work well.—W. J. LANCASTER.

[45726].—Earth Battery.—Bain's original terrestrial battery for electrical clocks consisted of a plate of copper placed in damp earth, opposite a plate of zinc, the area of each surface being about 5 super. ft. I am very glad to see dynamo's coming to the front; I should much like to see a good description of the Bürgin, in the ENGLISH MECHANIC.—L. B. A.

[45737].—Woollen Manufactures.—There is a work on "Woollen and Worsted Manufactures" by J. Bischoff, published in 1842, consisting of two volumes; also one on the "Philosophy of Manufactures," by A. Ure, published 1835, one volume, and another on "British Manufactures," by G. Dodd, published 1845, six volumes. No doubt one of these works will answer "D. C.'s" purpose. I regret that memory will not serve me at present as to who the publishers are of the different works. The best plan will be for "D. C." to get a catalogue from some free library, in which he will find the above, and, no doubt, works of a later date.—A. M.

[45738].—Thermometer.—I presume the "marks of degrees and figures" on the scale are so obliterated that they cannot be renewed by tracing them over in pencil or ink, or by rubbing a mixture of lamp-black and tallow down the scale so as to fill the interstices of the indented scale, and then rubbing the superabundant lamp-black off the scale with a soft cloth. If this be the case a new scale will have to be made. In order to graduate a thermometer two fixed points are required, the freezing-point and the boiling-point. The former of these may be ascertained by immersing the bulb and a part of the stem in melting ice contained in a funnel to let the water run off. Mark the point where the mercury stands with a file on the glass stem. The boiling-point is got by immersing the bulb and tube in the stem of boiling water. Make a second mark on the stem where the mercury stands. The interval between the two file marks is to be divided into 180 equal parts. Mark the freezing-point 32° and the boiling point 180° + 32°, which is equal to 212° F. You can carry the graduation down to the bulb of the thermometer: 32° below the freezing-point is the zero (0°) of the Fahrenheit scale. To obtain the boiling-point with any degree of accuracy, fit into a hole in the lid of a saucepan a tin tube, 1 in. in diameter, open at the top. Make another tin tube 3 in. in diameter, and an inch shorter than the stem of the thermometer, and arrange so that a well-fitting cork can be inserted in an appropriate aperture at the top of this tube. Pass the stem of the thermometer through a hole in the cork, fitting tightly, leaving an inch or so of the stem above the cork. Place this tube over the narrower tube, so that bulb of thermometer is half an inch from boiling water; boil, and mark the point to which mercury rises with a file.—F. I. C.

[45738].—Thermometer.—"Tenant Farmer" should take the tube from the back, and with fine sandpaper rub it clean, then get some ice or snow (if ice, crush it), and place the tube in it; the mercury will then fall to freezing-point. A mark should be made on the wood. Now, for a metal vessel and some pure water, place on a fire with the tube in. Perhaps the tube had better not touch the bottom of the vessel. The mercury will now stand at boiling-point; make another mark on the wood; the space between the marks must be divided into 54 equal divisions of 2 degrees each; at 4 spaces above the freezing-point, a longer mark should be made, and at every 5 above that; at the first long mark 40 must be put, at the next 50, and so on; freezing-point will now stand at 32, and boiling-point at 212; the same space may be made below down to 0, which is zero; below that the numbers increase from 0 to 10, 20, &c. The marks should be made with a dull chisel, some dark stain brushed into them, and the wood again cleaned with sandpaper, and then varnished. The tube should be placed in the back, and the work is finished. This is Fahrenheit's scale.—E. A. B.

[45738].—Thermometer.—Re-black them with blacklead pencil and varnish.—ALBERT SMITH.

[45739].—Cattle Barking Trees.—No composition applied would have the desired effect, without entirely destroying the tree. Infusions of catechu, &c., have been used, but with no effect. The only method is to protect the trees with wire fencing.—J. KENDALL.

[45740].—The Pedal Check.—This is a contrivance for rendering the pedal-keys at pleasure inoperative. It has no real value. It is virtually unknown in England, but is not uncommon in America.—J. W. W.

[45741].—Musical Box.—The quacking noise (chattering) is caused by the tooth of the comb being lifted again before it has ceased vibrating. The small spring underneath should be in such a position as to come in contact with pin in barrel, so as noiselessly to stay vibration before lifting the tooth.—PEGANEDSTUFF.

[45742].—Grinding Model Taps.—Small taps are always a very difficult thing to manage unless the shells are accurately bored, and the plugs are carefully turned, and unless the surfaces are most carefully fitted no grinding will make them tight. If I was to make a small tap I should turn the plug so that it would fit all the way through the shell, when five minutes' grinding would finish it. The best thing I can tell you of is sharp sea-sand, which grinds with water fairly fast, and does not bed in the metal as emery would.—SUNLIGHT.

[45743].—Hydraulic Organ-Blower.—I have had to do with more than one of these, and could perhaps tell you the cause of which you complain as an annoyance. Firstly, the thumping noise can be stopped by adding an air-vessel on the supply side pretty close to the motor. Next, if the exhaust water does not run down from the port to the drain or other outlet, add another air-vessel on the exhaust; that will take away the shock. Then the hissing noise is caused by the valve or piston leaking, or the throttle-valve being nearly closed. Remedy: Let the engine run with the throttle full open until the wind-chest is full so far; then let it be so arranged to close the throttle-valve altogether, until the wind has fallen so far when the engine starts full power again. Without seeing general arrangements, I could not point out how this could be applied to your particular instrument. But it is easily done with an arrangement of tappets on the valve-rod, so that an arm on the top of wind-chest actuates them.—SUNLIGHT.

[45744].—Curious Method of Suction.—Your friend is certainly right, that the action is due to a vacuum. The water surrounding the end of the pipe acts as a water-jet, causing a vacuum by induction. With regard to the question of height, the same plan would work up to, say, 20 ft. or so, if the pipe was in the first instance filled with water or primed. It would then act partly as a siphon, the one end of the pipe delivering into an attenuated medium; the vacuum due to the speed of the water past the end of the pipe would not only counterbalance the difference of levels—i.e., that the water in the boat's hull was lower than that outside; but it would produce sufficient difference of pressure at the one end, so that the fluid would flow out at some little speed. If you will look into the question I think you will find that your friend first filled the pipe with water, as then the vacuum needed would be but little—just sufficient to balance the difference in the height of the column of water inside and outside the vessel.—SUNLIGHT.

[45746].—Oxalate of Iron.—Can be produced as lemon yellow precipitates by precipitating ferrous sulphate with ammoniac oxalate.—ALBERT SMITH.

[45746].—Oxalate of Iron.—Add oxalic acid (hydric oxalate) to a solution of the persulphate of iron (ferric sulphate); a precipitate of a yellow colour is first produced, and afterwards this precipitate is dissolved in the added acid.—F. I. C.

[45746].—Oxalate of Iron.—To obtain ferrous oxalate (which I presume is the salt "J. H. C." requires), add ammoniac oxalate to ferrous sulphate, both being in solution. A yellow crystalline precipitate is formed, which is the substance required. Filter and wash with cold water.—ALFRED W. SOWARD.

[45746].—Oxalate of Iron.—This is generally made by dissolving the oxide in oxalic acid; but you can make it from the sulphate by adding ammonia to the solution. Oxide of iron will be precipitated, which collect and wash free from sulphate of ammonia; digest the precipitate in a strong solution of oxalic acid; the iron will dissolve, and you will have a solution of oxalate of iron. If you wish to obtain the oxalate in powder, evaporate this solution to dryness, taking care not to apply too much heat, or the salt will be decomposed.—F. BARKER COOKE.

[45747].—Platinum Amalgam.—I should not think of using anything but the pure metal itself.

for this purpose. The best way is to get a piece of stout platinum wire, and make a rivet of it in the spring; then drive a similar piece into the end of the screw, and rivet it over. This is done so that the area in contact may be as large as possible.—SUNLIGHT.

[45748.]—**Mounting Engravings.**—Your mounting-fluid is not the correct one. Get a little liquid glue, or, better still, a solution of india-rubber, or a preparation sold by Marion and Co., Soho-square; place a thin coating on the back of the engraving or photo, put it in its place, and rub out all creases with a soft handkerchief.—J. KENDALL.

[45748.]—**Mounting Engravings.**—Procure a piece of stiff linen: strain this over a smooth deal-board in such a way as to be free from any wrinkles; paste back of engraving, then rub well over the linen. Let this dry overnight. In the morning size over the engraving, and when dry give it one coating of paper varnish. If this should not be what is required by the querist, kindly let me know.—G. FRYER.

[45749.]—**Gunpowder.**—Karolyi (Phil. Mag. [4] XV. 489, Oct. 1863), has examined the products of explosion of several forms of powder. His results for that used for small arms are as follows:—

Solids.	By weight.
Potassium sulphate.....	36.17 per cent.
„ carbonate.....	20.78 „
„ hyposulphite.....	1.77 „
Charcoal.....	2.60 „
Sulphur.....	1.16 „
Ammonium sesquicarbonate .	2.66 „
Gases.	
Nitrogen.....	10.06 „
Carbon dioxide.....	21.79 „
„ monoxide.....	1.47 „
Hydrogen.....	0.14 „
Sulphuretted hydrogen.....	0.23 „
Marsh gas.....	0.49 „

100.00

	By volume.
Nitrogen.....	35.33 per cent.
Carbon dioxide.....	48.90 „
„ monoxide.....	5.18 „
Hydrogen.....	6.90 „
Sulphuretted hydrogen.....	0.67 „
Marsh-gas.....	3.02 „

100.00

Abel and Noble (Phil. Trans., 1874, 49), have also investigated the subject. Their results for fine grain (Waltham Abbey) powder are:—

Solids.	Low pres.	High pres.
Potassium carbonate.....	59.39	43.03 per cent.
„ sulphate.....	24.22	21.00 „
„ hyposulphite .	5.30	32.07 „
„ monosulphide .	5.12	— „
„ sulphocyanate .	0.02	0.23 „
„ nitrate.....	0.08	0.19 „
„ oxide.....	—	2.98 „
Ammonium sesquicarbon-		
ate.....	0.15	0.03 „
Sulphur.....	5.72	0.47 „
Carbon.....	trace	trace „

100.00 100.00

Gases.	Low pres.	High pres.
Carbon dioxide.....	47.41	53.02 per cent.
„ monoxide.....	12.35	7.91 „
Nitrogen.....	32.35	34.20 „
Sulphuretted hydrogen ..	3.76	2.03 „
Marsh-gas.....	—	0.50 „
Hydrogen.....	4.13	2.13 „
Oxygen.....	—	0.15 „

100.00 100.00

—ALFRED W. SOWARD.

[45749.]—**Gases.**—Man and other hot-blooded animals inhale atmospheric air, which is chiefly composed of oxygen and nitrogen gases. The oxygen, passing through the fine tissues which compose the lungs in man and the higher animals, enters the blood and there meets with the effete carbon, which is the refuse of the wear and tear caused by the various actions of the vital organism. This action of the oxygen of the air, on the impure blood, may well be compared to the action of a disinfectant when poured into an impure sewer: the disinfectant seizes upon the unhealthy and poisonous matter contained in the sewer, just as the oxygen seizes on the carbon in the veins, which are the sewers of the body. When oxygen unites with carbon, a gas is formed (carbonic acid gas), just as in the combustion which takes place in the flame of a candle. This gas is exhaled from the lungs, and thus the deleterious carbon is removed from the system. The nitrogen does not appear to be chemically acted upon, except that it swells the bulk of the gases, and acts as a vehicle for remov-

ing the used-up water (oxygen and hydrogen) from the system. As to the explosion of gunpowder, it has been found by experiment that 100gr. of gunpowder gave, on explosion, 117.5 cubic inches of gas at 32° F., and 30in. Bar. Some of the products of explosion were sulphate of potash, 36.17; nitrogen 10.06; charcoal, 2.60; carbonic oxide, 1.47; carbonate of potash, 20.78; carbonic acid, 21.79; sulphur, 1.16; hyposulphate of potash, 1.77.—F. I. C.

[45750.]—**Expansion.**—The volume of a gas is inversely proportional to the pressure to which it is subjected. Consequently 1,000 cub. ft. of gas, when the pressure is reduced from 30in. of mercury to 29in., will expand and occupy a volume 1.29th greater than its former volume, which, in this case, will be 1,034.48 cub. ft. If V = the measured volume of a gas, and V^1 the volume under a change of pressure, then $V^1 = V \times p / 30$, where p is the original pressure, and V^1 will be greater or less than V , according as p is greater or less than the standard pressure.—F. I. C.

[45750.]—**Expansion.**—Within limits the volume of a gas varies inversely as the pressure upon it. Therefore, 1,000 cubic feet, with barometer at 30in., would become 1,500 cubic feet with barometer at 20in. The formula (not formula) is:— $V P / p = v$; where V = original volume, v = altered volume, P = original pressure, p = altered pressure.—ALFRED W. SOWARD.

[45751.]—**Preserving Amalgamation of Zinc Battery Plates.**—If “J. W. R.” will sit up his battery with his plates as they are, he will find that they will speedily become bright again.—ALFRED W. SOWARD.

[45751.]—**Preserving Amalgamation of Zinc Battery Plates.**—No doubt you have not put enough mercury upon your plates, or it might be impure mercury forming a sulphate of lead. What sort of battery are you using? If you say I might help you.—ALBERT SMITH.

[45751.]—**Preserving Amalgamation of Zinc Plates.**—The safest plan is to well rinse your zinc in water, wipe them dry, and place them in a spot free from fumes. They will, of course, get a little dull, but use in the battery will brighten them up again. Don't let any nitric acid get on them.—S. G. O.

[45752.]—**Softening Hard Iron.**—Make your iron red hot and place it in an iron box containing charcoal; now heat it again and let it cool very slowly. I think that will suit you.—ALBERT SMITH

[45752.]—**Softening Hard Iron.**—Heat to a cherry-red and plunge in sawdust, cover well up, and leave for several hours to cool.—ON GUARD.

[45753.]—**Taking out Piston.**—You do not say what type your engine is—beam, vertical, or horizontal. If a beam-engine, take cotter out of piston-rod end and turn engine round until crank is on bottom-centre. Remove cylinder-cover, fasten a pair of clips round piston-rod, attach your blocks below the clips, and hoist away. If a vertical (crank overhead), the same process, except crank on top-centre. If horizontal, take cotter out of piston-rod end and when piston is at back end of cylinder, remove back cover, turn engine forward a little, put a piece of wood between rod end and cross-head, turn engine back until piston comes out of cylinder, put chain or rope sling round rod close to piston, and hoist away. I do not know what you mean by “uplacing.”—LABOR OMNIA VINCIT.

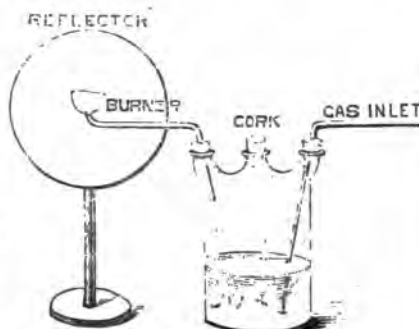
[45754.]—**Polishing Covers of Cylinders.**—Supposing the cover to have been polished originally, the best thing I have found is flour-emery and petroleum mixed to a paste. Above all, don't let it get dirty before you begin your work.—LABOR OMNIA VINCIT.

[45755.]—**Improved Gaslight.**—So many correspondents having asked for particulars respecting this light, I must say it is not fit to use in a room

illumination, and the ordinary pressure of the gas is quite sufficient. The preparation of the chloro-chromic acid is as follows:—Fuse 17 parts of bi-chromate of potash with 10 parts of common salt, then turn out the mixture to cool; when cold break into small pieces and put into a retort with 40 parts by weight of sulphuric acid and distil: that which comes over is a red liquid. Now having made your chloro-chromic acid, place it in a Woulff's bottle; now bring a glass tube from your gas supply down just to touch the surface of the liquid; now have another glass tube leading to your burner, which is best a fishtail made of porcelain—the acid attacks metal. This light is very intense, but gives off clouds of oxide of chromium. Place a reflector at the back of your light, or in place of the chloro-chromic acid you might use bisulphite of carbon or chloride of titanium. I am sorry I have not been able to answer before; but at the present time I am very busy indeed. Now for the carbons: Break your carbons into small pieces about the size of peas and make them hot in an iron saucepan and mix them with equal quantities of oxide of manganese; now put just sufficient flowers of sulphur to bind them together and cast them in a mould of iron or plaster of Paris, well ramming them down. Do not remove them from the mould until cold, these are very suitable for Leclanché batteries: but not superior to carbon, the sulphur being a non-conductor.—ALBERT SMITH.

[45756.]—**Stays v. Corpulence.**—I am afraid that “Old Subscriber” will find neither stays nor belts to answer the purpose. If it is the tendency of his nature to be corpulent, that tendency will progress, independent of the application of the above. The use of either stays or belts, when drawn tight, causes a pressure upon the internal organs, and, as corpulence is growth, and not accretion, the two would act diametrically to each other, and give the individual great pain. The feeling would be that the stomach was continually distended beyond its normal limits. I have made inquiries as to whether the application of the above would be beneficial, but the reply has always been negative. The most philosophical method to adopt would be a careful observance of all those things which have a tendency to fatten, and then a rigid abstinence from the same. We must not think that we can make Nature do just as we please; Nature's ways are not always our ways, and those who study her most can testify to the truth of this. Along with the above, we cannot do better than advise plenty of walking, as this will materially check corpulence, and strengthen the muscles.—A. M.

[45756.]—**Stays v. Corpulence and Indigestion.**—As one of those to whose experience the “Old Subscriber” appeals, I have no difficulty in answering that I am thankful for the publication of the various recommendations of what is called tight-lacing as a cure for indigestion and consequent corpulence. Whether it will answer for corpulence from other causes I cannot say. I have tried all the forms of it which were recommended, and I have found that all that is necessary is as much compression of the stomach as you can bear with pleasure for the first few hours of the morning, which are far more valuable than any other time. I cannot find that for these medical purposes there is any superiority in long stays, which confine the lower ribs, over a belt which lies completely under them; though no doubt stays have some other advantages, and I am inclined to agree with those who said they preferred them to belts; and it is singular that one can enjoy them quite as tight, notwithstanding—or, perhaps, on account of—the greater diffusion of pressure. I only say that they are not necessary. But what I have always found of the greatest value, both for medical effect and pleasantness of internal sensation, is a perfectly stiff busk; and I prefer wooden ones to steel, as being lighter and cooler. I wear them under a leather belt, next the skin, and find it much nicer than over the creases of an under-waistcoat. A former correspondent described his wooden busks as being like a very long and pointed shoe-sole, which is a good description, except that the lower part corresponding to the heel should be the widest. The longer and wider they are consistently with lying flat, the better and more comfortable they are. Mine are from 18in. to 19in. long and 5 to 5½ wide at the lower swell, and about an inch narrower at the upper one. Stays should have them rather longer. I remember one or two men said they wore them 20in. long and more, and rather narrower in the upper part than for a belt. Lacing is in every way better than buckling, and practically takes no more time, if done in front, as it should be, the busk being independent. I do not know what the “Old Subscriber's” occupation is; but I have found, as other correspondents did, that one can stand at a desk much longer without being fatigued when well laced up in this way than without it, though I do not think it a good thing for taking strong exercise. There is nothing equal to it for expanding the chest and preserving uprightness, provided you wear the wooden busk.—CANTAB, NONJUVENES.



unless means are taken to carry off the fumes. It is very suitable for photographic purposes or outside

[45756].—**Stays v. Corpulence.**—I have frequently ordered belts for corpulence: they give great ease to the wearer in walking, &c.: also a great support; but I do not think they would at all tend to decrease the weight, which could only be done by attending to the quality of the food taken, and not the quantity. Any chemist would order you the proper belt. The best maker is Maw, Son, and Thompson.—J. KENDALL.

[45757].—**Bridge.**—It is impossible to give a useful reply without further particulars, or without the preparation in detail of a special design. A wire cable suspension-bridge, with timber piers and platform, could be designed to fully answer the purpose, but would require a good deal of ironwork, and skilled labour in erection. A substantial bridge might be constructed entirely of timber (excepting bolts and plates) by carrying fan-trusses from piers on each side, if the height of banks is sufficient, and would require far less skilled labour in erection. A pontoon bridge would have to be slung down stream at floods, and drawn into place at subsidence. It could possibly be constructed without great difficulty, but would have so many serious objections, as to render it one of the worst forms for your purpose.—SPENCER ROLFE, 7, Westminster-chambers, S.W.

[45758].—**Hay-Press.**—A simple form for your purpose could be constructed as follows:—Construct a strong bare frame on wheels, with the principal framing, about 3ft. 6in. by 8ft., and furnished with rollers a short distance apart. Over this, running longitudinally, fix strong timbers (not necessarily heavy, but strongly framed) at a height of, say, 12in. or 14in. above the lower frame, for a short distance from back, and rising gradually towards the front, where they are turned into a vertical direction. A box of the size of the bale you require, but of greater depth, is constructed with fall-down sides, held when closed by catches at each corner, and the bottom furnished with eight spring catches for holding the wire, two bobbins of which are fixed to two of the four sides. A strong lid is made of such size as to freely enter the box, showing frames on the top carrying rollers, which engage the overhead beams both below and above. A chain or rack is fixed under the box, worked by a wheel fixed on a shaft running across the frame, furnished with hand-levers, or fast-and-loose gear for horse-power. The action would be as follows:—The box being traversed forward, the lid is raised automatically by the overhead beams until vertical, thus leaving the box clear. The wires are drawn across and pressed into the spring clips and the sides closed. The box is then charged and run back, the lid coming down upon it, and being forced in more and more until the end of its traverse. When the wires are twisted and cut, the box again run forward, the sides thrown open, and the bale removed, when it is ready for a repetition of the operation. By making the arrangement double, the action would be continuous. It would probably be advantageous to add a screw for finishing, as the pressure required will be great. An inverted screw-jack would be the simplest arrangement for this purpose, fixed directly above the box when at the end of its traverse.—SPENCER ROLFE, 7, Westminster-Chambers, S.W.

[45760].—**Motor for Dynamo-Electric Machines.**—Very much depends on local surroundings. If you have a good fall of water at your disposal you might use a turbine; but it must depend on the available volume and fall. If a town supply only, I should advise a gas-engine, as the cost of water would be far more than that of gas. If you state more fully the water power you have at hand, I could better advise you: but, if it is ample, you would find it a cheap source of power.—SUNLIGHT.

[45760].—**Motor for Dynamo-Electric Machine.**—If you have sufficient water, then a turbine is cheaper than gas, provided you don't use town's water. If your machine is for electric-lighting I doubt if the turbine will run steadily enough.—LABOR OMNIA VINCIT.

[45760].—**Motor for Dynamo-Electric Machine.**—Messrs. Crossley's ½-h.p. "Otto" engine, price £81 10s., will drive Siemens D 6 machine, with from 7 to 10 Swan's lamps, according to the illumination required.—OTTO.

[45763].—**Steam Tricycle.**—If you will refer to the back numbers of this journal you will find that I fully dealt with this question. A flywheel is not needed, and would be only useless weight. If you refer back you will find an illustration of the hand-gear needed with a single cylinder. Do not also forget that there is such a thing as the "Road Locomotive Act," and that you will find, if you run on the common road, that some officious and intelligent police-officer will invite you to meet the local magnates in conclave, and who will, after due deliberation of the question from their point of view, and as laid down by our talented and unselfish legislators, they will ask you to disburse a

given sum as a penalty for using what they have no moral right to object to. Friend "Stenhouse," but don't attempt it unless you can run your machine in private grounds. In that case it will give me the greatest pleasure to give you every assistance in my power, and as I have had some considerable experience on the question (including fines) I can be of some little help to you, no doubt.—SUNLIGHT.

[45763].—**Steam Tricycle.**—Have you not heard of Sir T. Parkyns and his steam tricycle? You would not be allowed, under the present laws, to run at more than three miles an hour.—LABOR OMNIA VINCIT.

[45764].—**Clarinet Tuning.**—Try your B flat clarinet with B flat in the harmonium, and if they are perfectly in tune with each other you may probably be aided by the harmonium, providing, of course, that it is in good condition and tune. I do not think that the method of having a pipe with a sliding stopper, as proposed by the querist, would be of any assistance in tuning the clarinet. It is not impracticable to make a pipe, but it is certainly unnecessary. There is a little instrument that can be bought in any respectable music-shop that will give all the semi-tones included within the range of an octave. The price, I believe, is about 4s. Should be happy to further assist you if necessary.—G. FRYER.

[45764].—**Clarinet Tuning.**—The best way is to obtain a tuning-fork of concert pitch, and then test your friend's harmonium. If you must make a standard, procure a box 10in. by 4in. by 2in., with a hinged lid made air-tight at the edges with sheet rubber or felt; then fasten an octave of harmonium reeds to the underside of lid, each having a hole bored through to the outside and stopped by a cork when required. Then get a tuner to tune these reeds to concert pitch, supply the box with wind from a suitable bellows, and you will get something near what you require. The best standard of pitch is the "Typophone," made by Mustel, of Paris, which consists of 48 tuning-forks, with resonators and keyboard; but it is expensive. I am sorry that wind instrument-making is so seldom attempted by "Ours," as flutes, clarinets, oboes, and bassoons do not present very great difficulties, and it should be a pleasure to every player to be able to make, improve, or correct defects in his instrument. I shall be pleased to reply further through "Ours," or others by advertising their addresses.—VULCANITE.

[45767].—**Comparative Light of the Moon and Planets.**—Notwithstanding the moon's brightness, she reflects but a small portion of the sun's light incident upon her. It has been estimated that she absorbs or retains for her own use nearly 5-8ths of the solar rays, reflecting only the remainder, or not more than would be reflected by "grey weathered sandstone rock." Some of the planets reflect far more than the Moon—the *albedo* or reflecting power of Mars being ¼ of the incident light, of Saturn ½, and of Jupiter nearly ¾. The cloudy atmosphere of the latter planet must, therefore, be nearly as brilliant as white paper. The following are the determinations that have been made of the luminous intensity of the Moon as compared with that of the Sun:—1829, Wollaston, by the intervention of a candle (*Phil. Tr.*, 1829, p. 89) 1/801072. 1865, Zöllner, with his photometer ("Photometrische Untersuchungen") 1/618000. 1845, Sir John Herschel, Jupiter with respect to mean full Moon (*M. N. XXI.*) 1/6620. 1865, Zöllner, with his photometer ("Photometrische Untersuchungen") 1/5,472,000,000 × Sun. In 1859 Seidel, by the aid of Steinheil's photometer, estimated the brilliancy of Saturn at 0.482 time that of Vega ("Untersuchungen über die Lichtstärke des Planeten," Munich, 4to). In 1865 Zöllner has found, by his polarisation photometer, brilliancy of Saturn 1/130,980,000,000 that of the Sun. In 1865, Zöllner has determined the brilliancy of Uranus with his photometer ("Photometrische Untersuchungen," Leipzig, 4to) Uranus = 1/8,486,000,000,000 of the Sun. The *albedo* of Uranus is 0.6406. (2.) A little consideration will show that the intensity of the light reflected by the Moon and planets cannot be in any way altered by an instrument placed on the Earth. The light of any luminous body may be cut off from the eye by the interposition of a dark screen, but there is no means of increasing the intensity of the brilliancy of the surfaces of these bodies. If the planets were enlarged in the telescope to the apparent size of the Moon's disc we should not receive any more light from them; the fact is, the light would be less intense, as it would be spread over a larger space. Then, to increase the discs of the planets you mention, different magnifying powers would have to be used in the telescope. It is a well-known law in optics that "surfaces appear equally bright at all distances in the same direction, providing no light is stopped by the air or other intervening medium," therefore the brightness of the planets would not be altered if we could view them at the same dis-

tance as that at which we view the Moon, and consequently the luminous intensities above quoted are the respective luminous intensities of the Moon and planets at any distance. Finally it may be accepted as a general principle in optics, that it is impossible, by any optical arrangement whatever, to obtain an image whose brightest part shall surpass the brightest part of the object. (3.) The ratio for the central parts of the field of view in a telescope is about 0.85 in the best achromatic telescopes. The brightness of the image cannot exceed 0.85 of the brightness of the object to the naked eye.—F. I. C.

[45768].—**L. & N. W. Engines.**—Atlas, 2150, and Marlborough are stationed at Birmingham; Alaric, Latona, and Sir Alexander Cockburn are at Rugby; Caractacus, October, 1881, and Commodore, October, 1881, are at Crewe; Mammoth, October, '61, is, or was, at Northampton; Petrel is at Derby, and Zygia at Manchester. Councillor, 981, Wyre 1166, and Elwy 1167; Baltic, November, '74; Cambrian, May, '75; Centaur, May, '79; Caithness, November, '61; Dalton, May, '66; Hecate, October, '51; Kestrel, May, '79; Langdale, October, '59; Mammoth, October, '61; Mastodon, May, '79; Maberley, March, '61; Salopian, May, '75.—PHAEON.

[45768].—**L. and N.W. Engines.**—No. 2150 Atlas, 981 Councillor, 1168 (I think) Elwy, 1166 Wyre. Can give you the dates of many to within about a year, if that is near enough? Cannot give them to months. As to sheds, subject to alterations since last seen, Atlas and Herald are at Birmingham; Alaric, Burmah, and Sir Alexander Cockburn at Rugby; Caractacus and Commodore at Crewe; Hardwicke and Marlborough at Bushbury.—W. B. P.

[45771].—**Air-Pump.**—If you do not wish to go to the expense of new rings (which are best in the end), get some dry soft deal strips, of a width and thickness in proportion to size of bucket; cut and fit into bucket, between cover and block (or where the rings would go if you had any in). Pare off the outside so that it will fit the pump-barrel, then, when at work, the water will cause the wood to swell out and keep the bucket water-tight. Another way is to wrap the bucket with cotton-ropes. Both these could be done at a week-end without external help. If you don't understand sufficiently, write again.—LABOR OMNIA VINCIT.

[45771].—**Air-Pump.**—To "SUNLIGHT" OR OTHERS.—It entirely depends on how the air-pump piston is packed, and if the pump-barrel is worn. Frequently the bucket is packed with hard rope, but it is a bad plan. If your bucket is of that class, then you have only to disconnect and repack as it was originally. If, as it should be, the bucket is packed with steel rings, then it is certain that the bore of the barrel is worn oval, and therefore should be rebored as soon as possible; that will mean rings shrunk on the bucket, and again turned up to size. If packed with rope only, you should be able to get it out, repacked, and in again in a few hours, and you might get partly ready by arranging many matters before actually stopping the engine. Does the pump-barrel show any signs of scoring or cutting along the bottom side; and is the bucket a bad fit? That is, can you see over the top of it against a light? If so, it is a job that must go to an engineer's shop to be put to rights. If I saw the back cover off, I could tell you in a minute whether it was a job to be done on the spot, or whether it must go to a shop for repair.—SUNLIGHT.

[45773].—**Tractive Force of Locomotive.**—To calculate the tractive force of a locomotive the rule is as follows: D = diameter of cylinder in inches, P = mean pressure of steam in cylinders in pounds per square inch, L = length of stroke in inches, W = diameter of driving-wheel in inches, T = tractive force on rails in pounds; T = D³ P L / W.—T. R. SEXTON.

[45773].—**Tractive Force of Locomotives.**—The usual rule is the diameter of the cylinders squared, multiplied by the stroke, and divided by the diameter of the driving-wheels, all in inches.—W. B. P.

[45774].—**G. W. R. Engines.**—163, 7ft. single, 1879; 710, goods, Oct., 1872; 713, goods, Nov. 1872; 1118, 7ft. single, June, 1875; 1125, 7ft. single, June, 1875. Am sorry I cannot oblige "C. H." with the others.—N. W. EALING.

[45778].—**Cold Chisel.**—To temper cast-steel chisels, first dress, and allow them to cool; now take a bucket of cold water, in which put a handful of slaked lime; now heat chisel to cherry-red, and dip the point in about lin., rub clean, and watch the colour—it should be somewhat of a pink, i.e., between straw and blue; now quench in water, and if the steel has not been burnt it should stand well.—ON GUARD.

[45778].—**Cold Chisel.**—The usual way is to forge to shape; then make hot for hardening. When a full blood-heat is attained dip partly in water and then quickly withdraw. If a piece of

old grindstone be rubbed on the edge part, so as to brighten it, the colour can be seen travelling up the portion that is still hot. When the colour on the cutting part is right, cool off entirely. This gives an edge of good cutting hardness, backed up by a gradually softer portion. If you use good steel, worked at a moderate heat carefully, there should not be the least difficulty in keeping a good edge.—SUNLIGHT.

[45779].—**Largest Wheel of G.W. Engines.**—Is at present 8ft., but six of their engines, Nos. 2001 to 2006, before altered, and when the property of the late Bristol and Exeter Company, had 9ft. single driving-wheels.—W. B. P.

[45780].—**Engine for Launch.**—Yes; you might fit your 2in. bore cylinder to an 18ft. launch, 6ft. beam, with a resultant speed, perhaps, of two miles an hour. The fact is, the cylinder is far too small, and is altogether of insufficient power. An 18ft. launch with 6ft. beam is a bluff boat, and would want at least a 3in. or 5in. cylinder to drive it at even a slow speed. Do not try the 2in. one, as it would simply disgust you, from the very slow speed you would get, to say nothing of the jeers you would be subject to, owing to the want of go. I would gladly tell you the necessary size for the 18ft. boat, or the size of hull to suit the 2in. bore engine, if either of those alternatives would be of any assistance to you.—SUNLIGHT.

[45782].—**Oxy-Hydrogen Dissolving-View Lantern.**—If a bialal lantern, I should decidedly say that it would not be practicable. If it was a case of a single lantern, of good size, it might be applied; but even if the lantern bodies would be able to carry a pair of regulators, the cost of the necessary batteries, and the expense of working, would be so great that it would not be worth your going to the expense of fitting it up. But with a bialal it could not, in my opinion, be successfully applied at all. The electric-light will, I think, never be so suitable for the lantern as the limelight. I have myself used the electric for the illumination of pictures 40ft. diameter, but although beautifully bright, the changing tint of the light was a decided drawback. With an arc-light, the violet colour shows very strong at times, so as to interfere with the tints of slides, diagrams, &c.—SUNLIGHT.

[45783].—**Faint Photograph.**—I should recommend the taking of a negative, either by the collodion or gelatine process; and if that should prove too thin to print from, then make a transparency from it, and a second negative from that. Of course, every effort should be made to sufficiently intensify the first negative if possible.—PHOTON.

[45788].—**Wind-Power.**—Before going into the question fully, let me ask the querist whether the locality in which the proposed wind-motor is to be fixed, is a suitable one; as it would be simply useless to fix one in some situations. Is the wheel on rising ground, where is a good expanse of open country, so that the wind-power may not be broken up by hills, trees, or buildings. Wind-motors in the inland districts are likely to prove but very moderate successes, except in situations near the sea, or on elevations like Salisbury Plain. If you have a suitable locality, I will endeavour to help you to particulars how to construct one. What you want is, to pump the water to a store tank, and from thence it could be carried to any household appliances. With a good-size tank you might easily work a small motor to drive a sewing-machine, or other small machinery. The wind-motor is a very simple affair; simply a wood frame, a pair of bevel-wheels, and a three-throw crank-shaft to work the pumps.—SUNLIGHT.

[45790].—**To Mr. W. H. Davies.**—If the six top notes are to be left on, the other sizes should be in proportion to them, and should increase in the same ratio as that given below: but to leave the decision of the sizes to the one that happens to be left on, and which, after all, may be the wrong size, seems anything but judicious. A more sensible method would be to renew the whole of the steel strings with the following sizes, commencing at the treble, 6 notes of No. 13, 6 of 14, 12 of 15, 12 of 16, 13 of 17, 3 of 18, and 2 of 19 (all music wire gauge). The lowest five notes also will probably be the better for renewing, as these are especially apt to get tubby with age. If this course is decided upon, they should be placed in rotation upon a piece of string, and given to a coverer, who will match them with new strings for about 3s. 6d.—W. H. DAVIES.

[45791].—**Galvanic Action on Screw-Propellers.**—The iron propeller formed the positive plate to the copper bottom as a negative plate. Consequently, the propeller was gradually converted into oxide and various salts of iron. A gun-metal propeller would be much less positive, and, therefore, much less affected. I believe it is usual when electrical action is desired (for its effect upon parasitical organisms) to fix blocks of zinc on various parts of the copper bottom.—S. G. O.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, F. Barker Cooke has replied to 45049, 45151, 45800: On Guard, 45411.

45222. Indiarubber Hose and Steam, p. 240.
45231. Spring Clockwork, 242.
45234. Organ. To Mr. Dresser, 242.
45237. Loosens, 242.
45242. Small Dynamo Machine, 242.
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QUERIES.

[45792].—**L. and N. W. New Tank Engines.**—Can "Cigeria" give details of No. 1030, eight-wheeled six-coupled leaders (which I saw the other day) after the L. and N. model? I understand there are only a few of them out yet. Are the wheels cast?—R. N. H.

[45793].—**Ginger Tea.**—Would Dr. Edmunds kindly say how the tea recommended on p. 403 should be made?—C. T.

[45794].—**Bunsen Photometer.**—Will someone of your readers favour me with the description of a Bunsen photometer? And, also, the name and description of any of the pocket photometers sometimes advertised?—J. M. A.

[45795].—**Burnishing Scabbard.**—I wish to burnish the scabbard of a sword. Can I do this on my lathe? If so, how?—J. M. A.

[45796].—**Snuff Mill.**—I should like to have sketch and instructions on the best method to be worked by hand power.—LUMAX.

[45797].—**Gelatine Moulds for Plaster Casts.**—How can I make gelatine moulds for casting plaster of Paris ornaments for building purposes?—PLASTERER.

[45798].—**The Telescope: How to Make and Use It.**—When will Mr. Lancaster finish the articles on the above subject? I have read the articles which have already appeared with great interest, and should like to see their completion, as I am waiting to begin making one.—W.

[45799].—**L. and N. W. Engines.**—Would some correspondent kindly tell me the names and numbers, also class and height of wheels, of engines stationed at Birmingham and Chester? Also, numbers and names of sheds?—DUBLIN.

[45800].—**Jet Brooches.**—What kind of cement is best for cementing catches and joints to jet brooches? Any information will oblige.—TRYING TO LEARN.

[45801].—**Blueing Mainspring.**—Will "Alfojoc" kindly tell me how to blue a mainspring of watch? I have been trying to blue one in a spirit-lamp flame, but could not succeed. Can't it be done without a blueing pan? If not, where can I get one?—TRYING TO LEARN.

[45802].—**Brasing.**—Would "Jack of All Trades," or any other of our kind readers, inform me how I can brase (using brass fittings) strips of iron on a tube a foot long and upwards without getting the tube hot or injuring it, as hot brasing I find causes the tube to bend?—W. G.

[45803].—**Boiling Linseed, &c.**—Can any reader kindly inform me if there is any way of boiling linseed and other stuffs which burn too quickly unless constantly stirred, so as to avoid having to do this? As the food is for cattle, a quantity is required.—J.

[45804].—**Water-Gas for Illuminator.**—Will any of the "E. M." readers give me information as to process of extraction, cost of plant (for a town of 6,000 inhabitants), and cost of production compared with gas made from coals at 18s. per ton, and its illuminating power, and much oblige.—INQUIRITIVE.

[45805].—**Cal. and G. and S. W. Engines.**—I am much obliged to "Carstairs" for his reply to 45653. My object was to get at the date when the first engine of each class was built. Can he give the same particulars for G. and S. W. goods engines with four-coupled leaders 5ft. diameter, flush boiler, no dome, but cab and inside bearings? I cannot give numbers. Also, 272 class?—E. N. H.

[45806].—**Electromotor.**—I am thinking of constructing an electromotor suitable for propelling a light pleasure boat, 10ft. in length, at the rate of, say, five miles per hour, and will be very thankful for some information as to construction. Would a machine made on Birgini principle be suitable? And, if so, size of armature and field magnets, quantity and size of wire, and description of battery power required to work such a machine, will much oblige?—JAMES EDWARD THOMPSON.

[45807].—**Gas-Engine.**—In what way, and to what amount, do they increase the diameter and stroke of gas-engines for increase of h.p.? Are the sizes of cylinder and stroke the same as the steam engine? I should be glad if anyone could give me the diameter and stroke for 1 H.P.—SEVEROUS.

[45808].—**Erasing Letters from Leather Bag.**—I have a nearly new light-coloured leather Gladstone bag, which has initials in black on each side, and these I wish to remove. Will any kind reader tell me how to proceed? And, whether this can be done without injuring the leather?—IGORAMUS.

[45809].—**Lunar Craters.**—In his letter on the Moon, Mr. Peal speaks of "the generally received notions regarding the absence of atmosphere and water"; and then he goes on speaking of mistiness or haze. If air and water are quite absent, how are these produced? I should like to know how they are accounted for, as we generally connect these with air and water.—EDW. THOS. SCOTT.

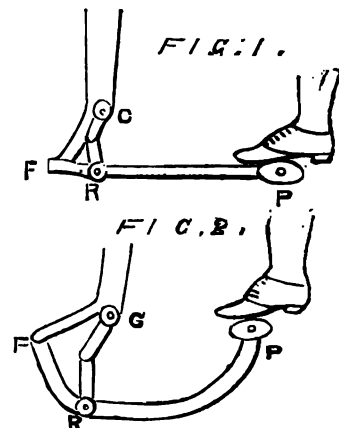
[45810].—**Aperture of Object-Glasses.**—I am much obliged to the writer of letter 19465 for his information. I have not been in the way of learning the present mode of making object-glasses, and I should feel much obliged if the writer could inform me what should be the diameters of the two back lenses when the front one is a thick plano-convex of 0.1in. focus, to do well?—EDW. THOS. SCOTT.

[45811].—**Comets.**—Stars can be seen through comets. "W. C. E." (letter 19464) says comets are streams of meteors; meteors are masses of stones. Now, to appear like comets, there must be great quantities of them, many of large size. You look at a star through the head of a comet. Surely, if these streams of stones are so thick and numerous, they must sometimes hide the view of the star. Do they do so? And, if we come into collision as they say we have done, with a comet, surely numbers of these stones must have been stopped by our earth. Is this the case?—EDW. THOS. SCOTT.

[45812].—**Combustion.**—Will any reader kindly give the weight of aqueous vapour or water that is given off per hour from the combustion of an ordinary tallow candle?—INQUIRER.

[45813].—**Liability for Damage.**—My neighbor has a glass roof to his shop, built against my wall, but twenty feet lower than my roof. During a storm one of my chimneys blew down, and, going through the glass roof, caused much damage, for which my neighbor claims compensation from me. Am I liable? Also, am I liable to make good the damage caused by a slide from my roof falling through his glass roof?—STANDARD.

[45814].—**Curved Lever Applied to a Bicycle from its Fork End.**—Given two levers of the same kind, viz., having fulcrum and power at opposite ends, resistance equidistant from fulcrum in both cases. No. 1 is a straight lever, say the chord 12in. long, of 5in. arc; No. 2 lever being, in curve and length, the arc of the chord in No. 1. What additional power is gained by No. 2, power acting in both levers from above by pressure?



the foot on a treadle? References to sketch?—C. Myles crank; F, fulcrum at fork end; R, resistance point where crank is joined by rod to lever bar; P, power of treadle end driven by foot.—G. J. B.

[45815].—**Legal.**—I hold a field in extent about seven acres, through which a railway passes. There is a bridge adjoining this field, as also a passage through it, both constructed for accommodation to parties who hold fields beyond that bridge. Now, what I want to know is this—Is not every railway company obliged to buy such passages? Or, do they not really own them? If some legal readers would reply they would greatly oblige. I ask this because I have been paying for this passage for years previously.—LUMAX.

[45816].—**Euglena.**—There is a strange microscopic creature, whether an animal or a vegetable seems an undecided matter with naturalists; it is called the Euglena, and is well known to all every microscopist. Out of its head proceeds a filament called a flagellum, which I see clearly enough with Swift's 1-2 objective. The filament moves about vigorously; apparently it is the motive power which impels the creature forward. If it was placed at the tail or hinder part, I could understand its action to be like the single oar a man often employs boat onward with; but here it is in front, as though the man used his scull over the bow instead of on the stern, and yet worked his boat forward. Will somebody explain?—E. B. F.

[45817].—**Telephone.**—I have two telephones with bell at one end, and one telephone with microphones at the other end, with separate batteries for bells and microphone transmitter, with earth terminals, and all working

CHESS.

All Communications for this department must be addressed Chess Editor, 22, Chancery-lane, W.C.

PROBLEM DCCXXIV.—By B. G. LAWS.
Black.



White.
White to play and mate in three moves.

PROBLEM DCCXXV.—By J. H. FIMLINSON.
(From the Chess Players' Magazine.)



White.
White to play and mate in three moves.

PROBLEM DCCXX.—By T. P. TAYLOR.

This problem unfortunately admits of a second solution as printed. In justice to the author we republish it, withholding the solution for another week. It has been reported by our request by the Chess Players' Chronicle in the following form:—



White.
Mate in two.

Through the kindness of the Chess Editor the column has been, we regret, omitted the past few weeks. If any correspondents have not received replies to queries, we trust they will overlook the deficiencies and repeat their queries, which, in a few cases have been unfortunately and unintentionally overlooked.

CHESS PLAYERS' ANNUAL AND CLUB DIRECTORY.—The above is the title of a work that is in preparation for publication by Mr. W. R. Eades. It will contain statistics, names, numerous sketches, chess trivials, &c. Among the contributors we find the well-known names of Messrs. Anderson, Beach, Birmingham, Derry, Freer, Gillingham, McLachlan, Marks, Miles, Pearce, Potter, Russell, Taylor, Thompson, and Miss Beechey. Those who are acquainted with the previous compilation of Mr. Eades—the Chess Club Directory, 1900—will have no hesitation in supporting this venture. We shall be happy to forward

any further particulars that may be necessary. We can only add we hope the work will be, as it will undoubtedly deserve to be, a thorough success. The price for subscribers is 2s. 6d., which will after publication be raised. Subscriptions to be forwarded to Mr. W. R. Eades, Duffield, Derby.

The following is the result of the Problem Tourney just finished in the *Jamaica Family Journal*:—1st. prize, £3, V. Ariano. 2nd prize, £1 10s., Miss F. F. Beechey. 3rd prize, "Queen's Knight" of Jamaica. The judges were Mr. F. O. Collins. We intend reproducing the prize problems shortly.

We regret to learn the death of Mr. Boden, one of our foremost players; he died January 13th last in the 55th year of his age. For some years past Mr. Boden has ceased to take an active interest in the game, much to the regret of all chess-players.

The death of another veteran chess-player we are sorry to have to record—Mr. Janssens. The last time he played in a match of any importance was in the match between the City of London Chess Club against the St. George's of last year, when he played Mr. Minchin. He died on the 28th ult., in his 50th year.

Answers to Correspondents and solutions held over until next week.

ANSWERS TO CORRESPONDENTS.

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 51, Tavistock-street, Covent Garden, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 18, and unacknowledged elsewhere:—

F. A. MILLAR.—Britannia Co.—J. H. Blacklock.—J. Coombe.—E. Owen.—M. L. Millington.—Science Observer.—E. M. Richards.—Major Ind.—McEachran, Adam, and Co.—Dr. Mantell.—G. J. Hewson.—E. W. Berry.—W. Hume.—W. Hall.—H. O'B.—Ignoramus. Country Johnny.—A 10 Years' Reader.—G. Welborn, Ph.C.—F. Gairdner Tipping.—Throttle Valve.—Taj Agra.—G. C. F.—Fortuna.—O. W.—Larch Leaves.—H. A.—Carstairs.—C. E. L.—Seyah.—Blackburn.—Founder.—Dealbus.—W. L. O.—Pyro.—Treadle.—Ioride.—Butterhaw.—R. L. H.—A Fellow of the Royal Astronomical Society.

G. D. G. (Drill with copper tube, notching the edges and feeding with fine emery and oil. Round edges against a grindstone, or mount the disc and rub edges with emery.)—W. HONEY. (That was a medical coil. See p. 410, Vol. XXXI., for a table.)—ORAQUE. (No one can answer without seeing them. See the indices. 2. Probably exposure too long. 3. You have simply to regulate the light. We scarcely understand what you mean by a "studio" under such conditions.)—HOMO. (What metal do you mean? Brass, iron, bronze, or what?)—HAMBER STREET. (If the floor is raised 10 in. from the ground, we do not see how it can be damp, unless you mean it is wetted by rain beating in. Cut a wing feather is the simplest.)—WILLIAM WADDE. (Merry local weakness, probably brought about by cold and damp. Try fomenting with hot water, and the application of hartsorn and sweet oil.)—MEXE. (You can make it in a glass retort, or with a flask connected to a coil submerged in a vessel of cold water, or by using an ordinary kettle. Several devices illustrated in back volumes. See p. 302, No. 428.)—M. C. H. (Consult an arithmetic. The answer is 6 calves, 2 pigs, 32 geese.)—BESPOON. (If you mean French polish, see pp. 175, 227, Vol. XXXII. Many recipes in back volumes.)—RUDIMENTARY. (See a table on p. 336, present volume. The question has been answered many times.)—LEARNER. (It is impossible to answer such a question as your first. How many lamps would be required, and what size? 2. Multiply the quantity of water in cubic feet per minute by the head of water in feet. Multiply the sum by '00126, and the product will be the effective h.p. for overhead wheels. The constant is '00104 for low breast wheels. Such questions can be answered by reference to a book like Molesworth's Pocket Book.)—VITAL BEAK. (See recent back numbers, or immerse in nitric acid 1 part, sulphuric acid 6, heated to 110° Fahr.)—BOILER-MINDER. (The phenomena are well known; but without full details as to position, &c., of the pipes, and other parts, no full explanation can be given.)—C. A., Londonderry. (It is the vinegar plant, Penicillium glaucum, a widely distributed mould. The beverage is wholesome, we believe, but is generally used as vinegar, which it becomes if exposed to air.)—S. W., Castleton. (You must give dimensions of cylinders, pressure of steam, &c., before any assistance can be offered. Certainly, if you burn 37 lb of coal to evaporate 39 gallons of water, it is time something was done. Can you take a diagram with the indicator?)—DANDIE DICKSON. (The address is quite correct. We sent your letter to the patentees, but they say they have not heard from

you. Write again, and give name and address, and omit both in your letter to us, or the matter will be settled at once.)—N. K. S. (Position in the "Address" column might be better.)—J. N. O. (It is probable Museum authorities might allow you to see the objects named, but we do not think them. An advertisement in the "Sale" column would procure you a loan from some private collector. It is not necessary to employ a solicitor but in the case mentioned it would be a waste of money to answer the last query with mortgage.)—KHODA BUX. (Very glad from you again. Send us something when it is finished.)—B. G. F. (Of course now referred to cannot be patented; may patent modifications, as was the microphone. 2. We do not remember reduction.)—W. H. P. (We must be about the new preparation before we can give you any more lead to ad guised as replies.)—J. H. MORRIS. (W the matter, when you do not give the advertiser you complain of a dozen advertisers offering similar goods. F. W. W. BURY. (We do not not covered the accident, and that, altogether charged you very reasonable (Photography, by all means; the oil is comparatively useless.)—A. WOOLLI. 116, 212, 452, 473, Vol. XXXI., and also watch the subject in recent back BEAVIS. (Procure Mr. Eldridge's Murray-street, Hoxton, N. See also No. 510. (The analysis of wines for detecting and identifying the deleterious rather too wide a query, as an answer many pages of matter. Say what i detect.)—JNO. MOORHOUSE. (Coloured dyes; made at the glue works, most the indices. Vol. XXXI., p. 497; Vol. XXXI., p. 538.)—J. B. (French be best; to be obtained of dealers in some of those who supply electrical material (It is silicate of soda. See pp. 504 XXXII. To be had of any wholesale dealer (They are simply glass goblets ground and tuned by adding more or less water, but can be bought in suitable sizes. The first with pumice-stone.)—A. MECHANIC. (but if really "great debility," consult —HIGHLANDER. (Consult the advertiser British and Foreign Confectioner, public buildings, St. Mary Axe, E.C.)—AMA can answer your question without knowing you used, and the fabric dyed. Most an fast on wool and silk; but black appears one that takes on cotton. See p. 636. NOVIOX 4. (Answered in recent back numbers. Plane, mitre-box, shoot hammer, vice, nails, glue, &c.)—64 CAS. an examination it is impossible to say; the sketch it is a *Hippocampus brevirostris* E. A. B. (Look through recent back consult the files of the technical papers.) (You will find the "process" in the J. O. NERILL. (Birdlime is made from the of the holly, from mistletoe berries, the of the elder, &c. In the first case the ba in summer, boiled till it becomes soft, and in a pit to ferment. It is subsequently washed in running water. 2. Fitman's row, E.C. Depends on the student and practice; perhaps two years. 3. The fit and not enough air to keep bars cool. 4. is incorrectly worded; but, as stated, solved by means of a lathe of the requisite horizontal line on a wall; that is, suppose it not underdone d.)—WAS-HAIL. (No volumes.)—A. SMITH. (Get one of Mr. C logues, 99, Great Jackson-street, Hulme, —O. P. Q. (In Mr. Brinsmead's little piano there is a list of patentees. The bo of the firm, we believe, Wigmore-street, W. (Apply to Mr. David Nutt, foreign books W.C.)—LIGNUM. (We doubt whether it book. See reply to A. Smith.)—TASMAN old works do not describe them, we are at get no information without giving some o of the passages in which the terms are u WALTER. (Full instructions for fitting up in back volumes. Get a catalogue from of Leicester.)—F. COWLEY. (The Electric in the form of supplements, just such a mean. There is the *British Journal of Phot several American papers. 3. Birmingha series of arithmetical works by H. Smith, w together.* Collins Sons and Co. also put Mathematics," by Atkins, which would be AJAX. (No. The manganese battery is no butas you want to use it every three seconds, battery would be the "strongest" in p size. 2. The plates would not be magn surrounded by a coil of wire, through which passed. If they are free to move, they would and repel" one another.)—A COVENTRY MAN question of no interest. Inquire at the 1 Shipping there. 2. Because they are not so as fixed engines. Used in paddle vessels to dispense with a connecting-rod.)—ARMON (The only remedy is a better climate, and always successful.)—METEOR. (No one understand.)—EDWARD KEAN. (If you n back numbers you will find records of the known as Swift's was announced on May 1 discovered at Rochester, New York.)—ELIAS (Consult a textbook on chemistry for the fations, and recent back numbers for the other —ROMEO. (Answered last week. See p. XXXIII.)—G. A. VENTURE. (No; why sho THOS. GILLASPIE. (The points raised in y not uninteresting, but they are, after all interest only.)—W. J. LANCASTER. (Un serted: seems more suitable for the Building subject has been discussed a good deal lately, and we have accordingly transferred to its columns.)

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, JANUARY 27, 1882.

A LESSON IN FILING.

By J. H. EVANS.

TO use a file is one thing, but to file with the same is quite a different matter, and I think a few hints upon this most important branch of mechanics will be found of much service to many of our readers.

To file properly, then, must be the aim of all who undertake to do it at all, and until a flat surface can be filed with a certain amount of ease, it cannot be said that the workman, whoever he is, can file; therefore, before going on to different things, let the beginner settle down to his work with the determination to overcome the difficulty of filing a flat surface. I say the difficulty, because it is a matter that will take some practice, and now I will endeavour to show the best means of setting about such a job.

Take a piece of wrought-iron about 2in. square, and with a 10in. file, bastard cut, make a commencement. The vice should be so fixed that it is a convenient height, and that ought to be about the level of the right elbow, or a little below, if anything. The point of the file should be held in the left-hand and the handle grasped with the right, so that the thumb is uppermost. To one who has not filed before it will feel very awkward at first. The left knee should be slightly bent, and the body must move in conjunction with the knee; by doing this the weight of former is thrown on to the file, and a pressure created, which will compel the file to cut the material. The right foot ought to be about 2ft. 6in. from the left; but here a great deal must be left to the operators, and it will be found that the most convenient pose is always the best; the elbow, should be kept well into the sides, as nothing looks worse than to see a man at work who requires the room of two or three for his arms. However, as I say, it must rest in a great measure with the person about to learn. Having, then, obtained to a certain extent an insight as to how the file should be held, and the best position to stand in, fix the piece of iron as level as possible in the vice, and shoot the file forward, bearing upon it at the same time. When the whole of the cutting-part has gone over the surface bring the file back, but without the slightest pressure upon it; otherwise all the teeth will soon be taken off, and the file become useless. There is not the least doubt that much dissatisfaction will be felt at the first few attempts, but that must not be allowed to interfere with the determination to succeed. There is no necessity to grasp the file in the right hand, as if it were going to run away, but just sufficiently tight to prevent its moving where it is not wanted. Having filed away at the iron for some time, upon examination it will be found to be anything but a flat surface; but this cannot be helped. After a little practice it will be a good reward to find that great improvement is visible; and when this is the case, fresh interest will be instilled into the one who is learning, and such anxiety to accomplish what he has set about that a little more practice and the difficulty will be overcome. As we proceed, the file may be used from left to right, or *vice versa*. I dare say, in the course of using a bastard file on a piece of wrought iron, it will be found to, what we term, pin—that is, small

pieces of the material will become wedged in the teeth, and the effect of this will be to tear the work. By rubbing a little chalk on the file a deal of this may be prevented; but the pins, when once in, must be removed, and a piece of brass, pointed, will be the best to do this with. The files must always be kept clean by what we term a file-card. This is simply a piece of old carding-wire, nailed to a piece of wood about 2in. by 4in. And now, by the time half the substance of the metal being worked is disposed of, some advance ought to have been made; and assuming that it is so, a second-cut file may take the place of the bastard. This is much finer in the cut, and, before being used, should have some chalk also, or a little oil, rubbed in the teeth, as this is more likely of the two to get full of pins. The same position, the same action—in fact, the same process entirely—has to be gone through with this as with the other; and one of the principal things to attend to is to let the movement of the elbow be simultaneous with that of the left knee.

Having, then, had a certain amount of practice on a piece of iron, as described, and become somewhat efficient, it will be time to alter the style of work, in which there will be a deal of sameness; and I should advise the tyro to try and file all the edges square to the face. To begin this, it must, of course, be reversed in the vice, with the edge to be filed fixed at the most convenient height. Now the same process will again be necessary, and extra care exercised in order not to break all the teeth out of the file. A first-class viceman ought to be able to file up anything of this kind without much reference to the square; but this latter tool is an absolute necessity to the vice, and should be what we call a back square, which means that the part usually placed on the work is broader than the blade. By applying this to the work, it will show where it is out of square, and to get it true it must be filed on the highest part only; and here I may say plainly that nothing but practice will perfect anyone in this particular art. So far, then, we see what the position is that is required, how to hold the file, and to test what is being operated upon. I will leave this part and proceed to explain a few of the uses of different cut and shape files for shaping up work of various forms.

I dare say, in these enlightened days, when so much work is done by machinery of different kinds, that many may look upon these few remarks as worth very little; but to whatever extent machinery is eventually brought into use, we shall not be able to dispense with the file. It is a well-known fact that first-class vicemen are at a premium, and the only reason I can assign for it is that so many youths are now brought up to simply watch machinery at work and grind tools, without any idea of ever using their hands at all; this, however, is not my business.

To shape up curves, either convex or concave, will be found on the whole a more easy matter than a flat surface, and only requires practice and a variety of different shaped files, such as pillar, crossing, round, and half-round. These are almost as many varieties as will be required for general purposes, and in using a crossing or half-round file, the movement of the wrist will be found to follow almost the curve of the work naturally. That is to say, no one desirous of following a curved line would drive the file straight across. Here, again, is scope for determination and practice. I have filed the teeth in a number of different circular cutters in my time; but this I may say is obsolete now, as such things are now all cut with a cutter. It afforded, however, good experience in the use of files, and was most useful at the time.

Another important part will be to get out mortise-holes; for instance, the receptacle

in a spindle to hold vertical cutters. To get such a hole out quite square on the flat and ends is no easy matter, and the first thing to do will be to set out the lines to the size the hole is required, and to get an entrance for a file. First, then, drill a series of round holes as closely together as possible, then plug each one up, and drill between each one again, and when the plugs, or, rather, what remains of them, are removed, a small pillar file will enter; if there is any part of the steel left between the holes that will impede the progress of the file, it can be removed by aid of a small round file; but as files of this shape and size are delicate and likely to break, great care must be exercised. As soon as the pillar file will pass through the space, the hole may be roughed into shape by resting the round part of the spindle on the vice, holding the work in the left hand and using the file with the right; the vice should be slightly opened, and the work allowed to move with the action of the file; this is an assistance in making the hole quite flat. Another very good way to effect the same purpose is to place the work between the centres of a lathe, in which case both hands are at liberty for the file. In getting out a hole or mortise slot of this character, it is most important, in good work, to have the ends flat and square. It is true, if not absolutely so, it would hold the cutter; but that is not the thing in high-class work.

We now are advancing to a very great extent, and when a flat surface, a square edge, and a good clean hole can be filed, the workman may begin to think he is arriving at a certain stage of perfection. In filing up, say, a square stem for an eccentric cutting frame, or any similar piece of work, before finishing, the flats should be made smooth by what is termed draw-filing, that is, the file placed across the work, and instead of shooting the file as before shown, it must be drawn up and down the work while it lies on it at a right angle. Here care and practice will show that it is not an easy matter to keep the cut of the file straight: it is, however, only a question of holding it in the proper position, which will soon show itself, and the result will be satisfactory.

In proceeding with work of various kinds, a workman is almost sure to require a square hole for some purposes or another, and a few hints on this will help. Suppose, then, such is needed, whatever size the hole is across the flats, a round hole should be drilled through a little under the size of hole; then open out the corners with a square file. Now to get out a square hole is a troublesome job; but no great difficulty should present itself to an experienced fitter. But as there is a means of assisting in the progress of it, it is as well to know all about it; therefore, I should advise anybody doing such a thing to file up a square drift. This must be made of steel, cut across at the bottom where it enters the hole, and then hardened and tempered. In making a hole in steel, the drift must be used very carefully, and not driven down with much force, or the steel will split across the corners; but for brass or gun-metal, after the corners are cleared, the drift may be driven through, and a square hole flat and sharp will be the result; drifts of any shape may be made for this purpose, such as hexagon, octagon, &c., and to get out a clean hole, that which is drilled first must, of course, be under the size of the flats. In finishing up all good work, the best file is a Lancashire superfine smooth file, and when this is properly applied having on it a little oil, very little emery-paper will be required, and the less of the latter that is used the better; the best way of applying it at all is to have, in the first place, the highest quality paper to be obtained, and make one fold of it round a file, so that the paper is as flat as the file itself.

I have often noticed in different factories the men with a whole sheet of emery-cloth round a file. This, it will be seen, must render the surface anything but flat. Cloth should be avoided in all cases, and in my opinion emery-cloth is only fit for housemaids to polish fenders, &c. I am anxious to explain to others how to produce equally good work, as may be done in a factory where nothing but the best is produced, and as it is only by using the same means and ways that this is to be done, I cheerfully endeavour to tell what I know, in the hope that it may help, at all events, the tyro in the art of using the file.

There are so many things at the present time done by machinery that it is a difficult matter to name any single article that would most likely require to be filed; therefore it is necessary to be able to do any and everything.

A few words as to the use of what are termed saw-files. These are a triangle shape, and cut on each flat, the edges being used for setting the teeth of a frame or bow saw. As there are various kinds of blades to those saws, and some much harder than others, great care must be used when sharpening one that is hard, and the files must be used slowly, or the teeth will not last to set one blade; there are, of course, many other purposes to which a saw-file may be devoted, and they should never be discarded, for when absolutely used up as a file, they make the best triangular tools for turning iron and steel.

While I am on the subject, I will just remark upon the best kind of handle. I know many amateurs who have tools of all kinds fitted with hard wood handles. Now, this is essentially bad, as they never hold in; and when using a 12in. file, should it come out of the handle, it would probably do a deal of damage. I have seen it occur, and the tang of the file I have, in one instance, known to enter the foot of the workman. The best handles are those of soft wood, common and cheap, to be had at all tool-shops at a trifling cost. I merely mention these points, as it may help anyone who may desire to become an efficient workman; and I should recommend those who desire to become good workmen in general, not to lose a single opportunity of learning the art of filing.

REVIEWS.

The First Book of Knowledge. By FREDERICK GUTHRIE, F.R.S. London: Marcus Ward and Co.

THIS book is a type of a useful series that might find a place in our schools with great advantage to the pupils, for it endeavours to impart a knowledge of common things, and presumably is to be supplemented by oral explanation and amplification by the teacher. Prof. Guthrie wants "boys and girls, and so, by-and-by, everybody, to know something about stuffs and things," and therefore, in this first book of knowledge he has striven to make clear what stuffs are, and how things are made from them. The idea is an excellent one; but the way in which it is worked out is not altogether satisfactory, for the statements made are sometimes so condensed that they are liable to give erroneous impressions. Prof. Guthrie takes for his text the things and stuffs used for house-building, and at the outset commences with coal, his first sentence being calculated to mislead the pupil:—"When wood or woody matter—such as roots, bark, leaves, moss, peat, and so on—lies buried in the earth for a very long time, it changes into coal." We who are grown up and have our own notions of the coal formation, and know that children include an error

removed by the subsequent statements. If the book is confined to the teacher, who, we will assume, is competent to enlarge upon the subject, no harm will be done; but if fewer subjects were noticed and more ample information given, the work would be more useful. As it is, it is little better than a guide to the teacher. The field covered includes not only the material of the house, but its finishing and furnishing, methods of heating, lighting, and cleaning, together with notes on the substances employed, as well as on the food and clothing of the inmates. A chapter on writing and printing is included, but it occupies only eight pages. The heading of each part or chapter gives a list of "things to be seen"—i.e., of the substances and articles which the teacher is to have at hand to show the pupils. It will be understood, then, that the "First Book of Knowledge" contains a number of object-lessons, having for their subjects "things" and "stuffs" which can be seen in an ordinary house.

The Revisers' English. By G. WASHINGTON MOON. London: Hatchards.

As its name almost implies, this book is a criticism of the Revised Version of the New Testament, from the grammarian's point of view. It takes the form of a series of letters which appeared in a contemporary; but as the replies they elicited are omitted, the work is robbed of much of the interest which it might otherwise have had. Nevertheless, no student of the English language can read one of Mr. Moon's works without learning something—generally something that he would not find elsewhere. Mr. Moon's list of grammatical errors in the Revised Version is certainly a long one, and though some of his corrections may savour of pedantry, he is invariably accurate in his remarks as to the rules of grammar. A perusal of the book will generally bring up the old question whether language exists for the grammarians or whether grammar is only a collection of rules which scholars have tacitly agreed should be recognised in writing and speaking the language to which they apply. The frontispiece to the book is a plate containing the photographic portraits of the "revisers."

Our Factories, Workshops, and Warehouses, their Sanitary and Fire-resisting Arrangements. By B. H. THWAITE, C.E. London: E. and F. N. Spon.

THE author of this work thinks that if we are to compete successfully with our commercial rivals we must carefully preserve the vigour of our workpeople, and he quotes the account of a visit to the Lowell (Mass.) factories which Charles Dickens made some years ago, as proof that the Americans take many precautions to secure healthy conditions in their factories and workrooms. As the title of the book indicates, it is a general description of the methods pursued in building, draining, warming, and lighting factories and workshops, with illustrations when necessary of the appliances which have met with most favour from architects, or are deserving of attention from their special merits. The preliminary chapters are occupied with introductory matters, showing how the development of English manufacturing industries affected the health of the operatives, and compelled legislative interference. The arrangements permitted nowadays are unsatisfactory, to say the least; but they are infinitely better than they would be if the law did not step in with certain compulsory regulations. Occupations which are carried on in rooms, the atmosphere of which is loaded with metallic or mineral dust, are well known to stand high in the lists of disease, the percentage of workers suffering from phthisis being 62 for filemakers, 40 for

grinders, 80 for flint-cutters, and 40 for grind-stonemakers. Brushmakers, weavers, workers in glass, and others suffer severely from that disease, owing, probably, to the dusty nature of their work, though it is a singular fact that coalminers are very low on the list. In flax, cotton, and woollen mills, some branches are especially deadly, and general unsanitary conditions, apart from the mere atmosphere of the workroom, help to intensify the evil. Mr. Thwaite has collected a large quantity of useful information, which is divided under three heads—viz., Factory and workshop sanitation; Arrangements for the prevention of accidents; and the Origin of conflagrations and their prevention. In these three "parts," he gives descriptions, mostly with illustrations, of the various approved appliances for ventilation, heating, draining, and lighting, for preventing accidents in factories, and for rendering buildings fireproof. The book will consequently be useful to professional men, and will also serve as a guide to the manufacturer and factory owner, showing him what he can have, and what he ought to expect from those he engages to erect his premises. It would, however, be unwise to rely altogether on the statements contained in the book, or to adopt the appliances described without expert advice. Some statements have been introduced which do not increase the value of the work, and there are many others which are at least open to dispute. For instance, in the chapter on boiler explosions, we find in a quotation, "At a moderately high temperature, heat decomposes water, and may impart to it a most destructive explosive power, akin in its nature to that of dynamite." The allusion to dynamite renders this statement absurd, while there is no proof that water is ever decomposed in a steam-boiler. Taken as a whole, the book may be described as an epitome of the best treatment in the arts and trades which it describes, and will unquestionably be found useful by the professional man.

We have also received *Model Yachts and Boats*, by J. DU V. GROSVENOR (Lt. Upcott Gill), a book that just meets the wants of those who wish to build and sail model yachts. The instructions are full, and the diagrams help to render everything clear. — *Whitaker's Almanack* for 1882 is, as usual, full of information, and, with the supplement, is enlarged by nearly fifty pages. It is a book that is useful to everybody, and to many is indispensable. The astronomical notes and nautical tables are very useful features. — *Lessons on Form*, by R. P. WRIGHT (Longmans), is an elementary treatise on geometry based on Pestalozzi's system. The book is well adapted for use in elementary schools, and in cases where the time during which the pupil can attend is limited. It is mainly intended for the use of teachers, but is so clearly written that it may be recommended to those who are desirous of acquiring some knowledge of geometry and have not leisure to attend classes. — *Fifty Years of Science*, by Sir JOHN LUBBOCK, Bart. (Macmillan), is a large-type edition of the full text of the address of the president of the British Association at the York meeting. — *A Glimpse through the Corridors of Time*, by Prof. E. S. BALL, F.R.S. (Macmillan), is the full text of the lecture delivered by the Astronomer Royal for Ireland, at the Midland Institute, in October last. We mentioned this lecture on p. 204, ante.

We have also to acknowledge the receipt of *Elementary Lessons in Electricity and Magnetism*, by SILVANUS P. THOMPSON, D.Sc. (Macmillan), and *Physics of the Earth's Crust*, by Rev. OSMOND FISHER, M.A. (Macmillan), two works which deserve a lengthier notice than we can give here.

Saturn.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	°	h. m.
1	2 18.5	11° 23.1	5 31.2 p.m.
6	2 19.5	11 29.4	5 12.5 "
11	2 20.6	11 36.5	4 54.0 "
16	2 21.9	11 44.2	4 35.6 "
21	2 23.3	11 52.6	4 17.3 "
26	2 24.8	12 1.6	3 59.2 "

Saturn, as will be thus seen, remains in Aries too.

Uranus

Is a Morning Star, in so far as his meridian passage is concerned, during the greater part of February; but he rises between 8 and 9 p.m. at the beginning of the month, and at about a quarter past 6 at the end of it. Hence he is very well placed for the observer before midnight. His angular diameter (4") remains sensibly constant.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	°	h. m.
1	11 16.7	5 32.0	2 30.9 a.m.
6	11 16.1	5 36.1	2 11.6 "
11	11 15.4	5 40.5	1 51.3 "
16	11 14.7	5 45.1	1 31.0 "
21	11 14.0	5 50.0	1 10.5 "
26	11 13.0	5 56.0	12 46.0 p.m.

The very short arc indicated above is described wholly in Leo.

Neptune

Is an Evening Star, and may be fairly well seen during the working hours of the night. Like Jupiter and Saturn, though, he should be looked for as soon after sunset as practicable to be most advantageously seen. He will be in quadrature with the Sun at 5 p.m. on the 2nd.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	°	h. m.
1	2 47.5	14 17.7	6 0.3 p.m.
6	2 47.7	14 18.6	5 40.7 "
11	2 47.8	14 19.7	5 21.1 "
16	2 48.1	14 21.1	5 1.7 "
21	2 48.4	14 22.7	4 42.4 "
26	2 48.7	14 24.5	4 23.1 "

Neptune thus is travelling, imperceptibly, away from α Arietis.

Shooting Stars

Are somewhat infrequent in February, but may be looked for between the 10th and 19th inclusive.

Greenwich Mean Time of Southing of Fourteen of the Principal Fixed Stars on the Night of February 1st, 1882.

Star	Souths.
	h. m. s.
α Ceti	6 8 46.57 p.m.
α Persei	6 28 30.91 "
γ Eridani	7 5 1.37 "
Aldebaran	7 41 33.55 "
Capella	8 20 17.53 "
Rigel	8 21 9.93 "
α Leporis	8 42 28.09 "
α Orionis	9 0 58.74 "
Sirius	9 52 0.21 "
Castor	10 39 0.57 "
Procyon	10 45 2.41 "
α Canis	11 21 55.83 "
α Majoris	12 2 50.48 "
α Hydræ	12 33 24.35 "

Method of ascertaining the Greenwich Mean Time of Southing of either of the Stars in the above List—night in February, the instant of its Station, will be

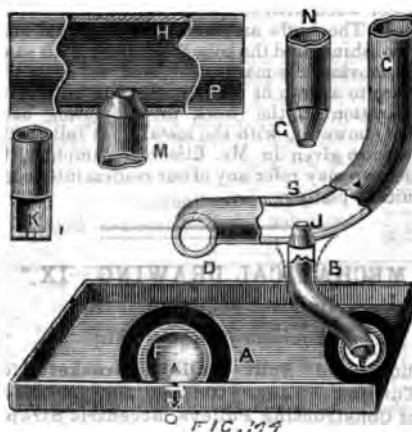
PRACTICAL NOTES ON PLUMBING.—XXV.*

By P. J. DAVIES, H.M.A.S.P., &c.

Closet Safe Traps and Flushing them with Weeping-Pipes.

It not uncommonly occurs that closets have to be fixed in the centre of a large building, on a staircase, or in some out-of-the-way place, and generally where it is almost impossible to take an overflow-pipe from the closet safe, and it would be a great deal too expensive to run one down by the side of the soil-pipe,—in fact, it would be picking the proprietor's pocket.

Under such circumstances, the difficulty may be overcome in the following manner:—Fix an additional small 6in. $\odot$ -trap, as at E, Fig. 144.



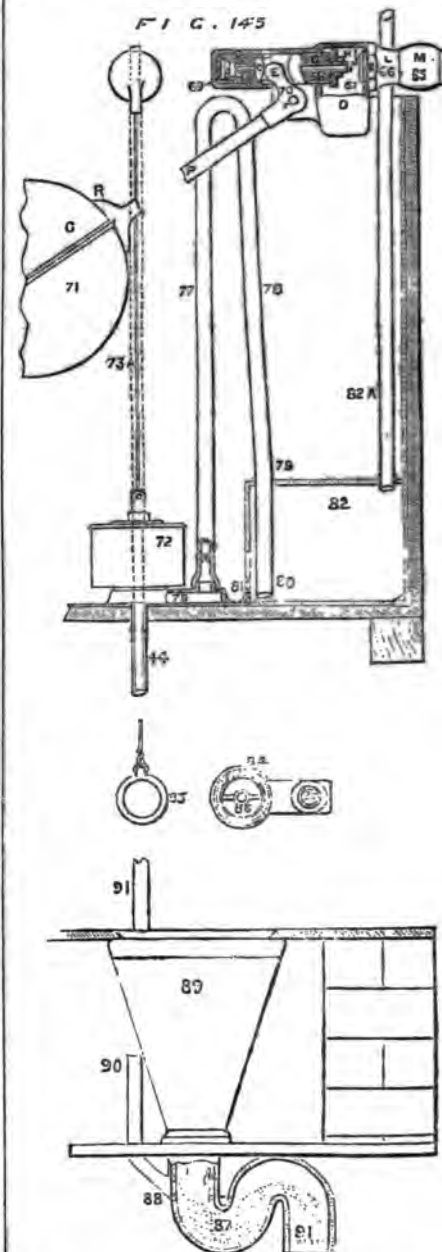
which, of course, is for taking away any overflow that might take place owing to the closet or pipe being out of order. For a plan of such traps refer to E, Fig. 126.

When these small traps are fixed, whether $\odot$, $\odot$, or $\odot$, it is imperative that they should be properly supplied with water every time the closet is used, and that they are securely protected against siphonage.

It very frequently happens that when closets are fixed in such isolated positions as those just mentioned, no provision is made for ventilation. Where this is the case great care must be taken that a good $\odot$ -trap is fixed and made in such a manner, that it is impossible to siphon it out. In all such cases the trap must be made according to my first method of making $\odot$ -traps, i.e., strike the cheek out as shown, but make the band at least half as wide again as the dip: thus, suppose the dip to be 4in., you must make the band 6in., as the reason why $\odot$ and other traps siphon out is because the body is too narrow—that is, where the band is only the width of the dip. The consequence is, that all the water is driven out of the trap to allow the air to pass, and then this water is urged onward from the dip towards the out-go. N.B.—It is very seldom that any more water can be siphoned out of a $\odot$ -trap than is contained within the dip itself; therefore, when the trap is wider than the dip, it is proportionately more difficult to lower the water below the dip; and if, on the other hand, the trap is made proportionately longer, the action will be pretty much the same, and it may be considered almost an impossibility to siphon it out. But while, by this system of making the $\odot$ -trap, you, to a great extent, overcome the evil of non-ventilation, you meet with another serious difficulty—namely, that traps so made are not self-cleansing to the extent they should be; but, nevertheless, it is the best method to adopt under the circumstances. The only other thing to be done is to cleanse them thoroughly every time there is occasion to take them up, and, indeed, it would be advisable for plumbers to make this a standing rule—never to refix them without cleansing.

But to proceed with the flushing of the small safe trap, we must again examine Fig. 144. B is a piece of $\frac{1}{2}$ in. lead pipe, the joint, J, being worked to a taper point, having a full $\frac{1}{2}$ in. hole bored into the point, as shown. Let this hole be the largest at the outside edge, and branched into the $\frac{1}{2}$ in. or $\frac{1}{4}$ in. closet supply-pipe, as shown (this may come off regulator or other supply-pipes). Cures should be taken to let the end of this

pipe stand up inside the larger one about $\frac{1}{2}$ in. or $\frac{3}{4}$ in.; thus, the water thoroughly scours the end of this pipe, which, together with the hole being tapered from the outside, prevents any foreign substance getting or lodging in this small hole of the weeping-pipe. M.H.P. is an enlarged view of this pipe. I, Fig. 144, illustrates the end of a weeping-pipe having the outer end closed, excepting the bradawl hole at K. Such a method is exceedingly dangerous, as the least



bit of dirt, &c., is likely to block or wedge up the hole, and so prevent the passage of the water to supply the trap. N illustrates the end of the weeping-pipe as it is generally left by an unskilled plumber, which is as bad, or worse, than that shown at M.

Closet Flushing.—Servants' and Hopper Closets Continued.

Plumbers cannot give too much attention to the thorough flushing of closets, for upon this point, to a very great extent, depends the health of the poorer-class homes. It so happens, more by Providence than anything else, that these homes are not pested with the too-complicated apparatus in the water-closet; but, on the contrary, are of the very simplest kind, for the reason that they are the cheapest that can be obtained, and good rough ones work much the best; but even these closets require, and must have, the proper flushing, more so than a valve closet, because the latter may have only a dribble into the basin, and then it will work; but not so with the cottage closet, which must be complete in all points—viz., a thorough supply and proper sized pipe,

* From the Building News. All rights reserved.

valve, &c., when all will go well without attention for years excepting proper treatment, no matter to what extent it may be used.

Fig. 145 illustrates one of the simple closets, with my improved flushing waste-preventer and siphon arrangement; 89 is the basin, which may be of any pattern, though I prefer "Sharp's Flush-rim," as shown at Fig. 143; but 89, Fig. 145, is an excellent basin for some work; 87 is an ordinary O-trap, and an examination at 88 will show a pipe, 90, branched into the heel of the trap. This has a wonderful effect in cleaning the trap, especially in workmen's closets; between 90 and 91 is the supply to the arm of the basin, which is continued up to the valve 72, fixed in the lead cistern; the water-way, 75, leads direct into the down pipe, and so far acts as an air-pipe; but trace it farther to 76, 77, 78, 79, 80—here it is converted into a siphon; the open end dips into a service-box, as shown at 80; 81 is a small inlet hole, say a quarter the size of the pipe, and 82 A, the air-pipe; 73, the ball-lever, 73 A the wire from the ball-lever to the valve 72; 83 is the pull; 84, 85, 86, is the plan of the valve-seating, showing the bridge and siphon aperture, 85. The effect of this simple arrangement is that the box 82 being submerged, soon fills with water through the small hole 81; the full-sized valve, 72, also being submerged, on being lifted allows the water to rush full bore down the pipe 44. Now shut this valve, and for want of air the water rushing down the pipe 44, so to speak, drags the water out of the box 82; by reason of the air-pipe 82 A, the box becomes empty, and of course the siphon ceases to run, but it soon fills up again, and is ready for another supply. Care should be taken not to, in the least degree, trap the pipe 44.

(To be continued.)

NICKEL PLATING.

A VALUABLE article full of practical details in connection with the art of nickel-plating will be found in the new catalogue which Mr. W. Elmore, of Blackfriars-road, has recently issued. The Elmore dynamo electric-machine is well known in all large electro-plating establishments for the facility with which it lends itself in combination with the resistance-switch, to either large or small work, and to the deposition of various kinds of metal at the same time. For nickel-plating especially, a dynamo-machine is almost a necessity if first-class work is to be produced with economy, and a battery is but of the question from a commercial point of view. Where, however, it is required to plate small articles occasionally, Mr. Elmore has introduced the double-carbon battery, which answers the purpose in a satisfactory manner. Nickel solutions best adapted for the work do not readily dissolve the anodes, and it is necessary, especially when cast iron has to be covered, to use anodes with a surface far exceeding that of the article to be plated, or the deposit will be not only irregular but of an indifferent colour. The double sulphate of nickel and ammonia is the salt most generally used, and it is highly important that it should be pure. The tank should hold at least 10 per cent. more solution than will be needed, and the anodes should be preferably placed all round the article to be coated. It is, we learn from Mr. Elmore's pamphlet, very important that the work should receive a slight film immediately after immersion, while it is of equal importance that the deposit should go on slowly afterwards. Hence the battery cells must be connected for intensity while the bath is being supplied with the work, and subsequently for quantity. Articles of different metals require special treatment, but all must undergo a thorough cleansing and polishing if a satisfactory coat of nickel is to be laid on. Dipping in the cyanide bath for brass and copper, and in the hydrochloric acid tank for iron and steel are operations essential to success. Cast iron is made to take a fine surface of nickel with comparative ease when it is properly prepared. It is first immersed in the potash bath; then in the sulphuric acid pickle, which loosens the scale. It is then thoroughly rinsed, and scoured with sand and hard brushes. After examining it for sand holes, the cast iron has a final brush, just a dip into the hydrochloric acid tank, a rinse, and it is ready for the nickel bath. With other metals, such as brass and copper, a great deal of hard polishing with buffs and lime

has to be done; but that is not the case with cast iron and steel, which, however, may with advantage have a coating of copper previous to immersion in the nickel tank. Adequate battery power is necessary to good work, two double-carbon cells being advisable for even the smallest articles. Polished nickel is not affected by the oxygen of the atmosphere or by those sulphurous fumes which tarnish silver; but, as many bicycle riders have discovered, it is rendered dull by exposure to damp. That, however, may easily be remedied by a daily wipe, especially if made with a piece of leather and a little washed crocus. If wet is allowed to remain on nickel-plated goods they are sure to become spotted, no matter how well plated they may be. The appliances used for polishing are buffs made of walrus skin, bull-neck leather, &c., and bobs—discs of wood with strips of leather glued upon them. The buffs are used with a special lime for polishing, and the bobs are dressed with sand for removing file-marks, &c., and reducing the surface to a state fit for the polishing buff. The preparation of the work for the plating bath varies, however, with the metal, but full particulars are given in Mr. Elmore's pamphlet, to which we may refer any of our readers interested in nickel-plating.

MECHANICAL DRAWING.—IX.*

By PROF. JOHN E. SWEET.

(Continued from page 181.)

Whole and Split Pulleys—Brackets for Turning Pulleys—Old and New Methods of Constructing Pulleys, Eccentric Straps, &c.—Examples of Journal Boxes.

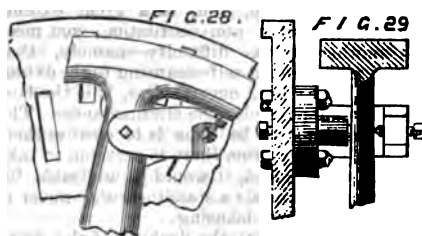
IN the last paper on drawing, it was hinted that the pulley subject might be a good one for the student or apprentice to experiment with; and it may be found, like many others, to grow wonderfully as the investigation progresses. If one begins to study the subject from observation, he will find an endless variety and many curious examples, with as many scientific reasons from the designers, pattern makers, and moulders why each is correct, as he will find kinds of pulleys.

The scientifically correct he will find with broken arms; the practically correct with broken arms, and those that are all wrong in proportion he may find as sound as could be desired.

While in general practice it is desirable to keep all the parts of a casting as nearly of equal thickness as possible, and the thinner the metal the more desirable this becomes; still, in making belt pulleys, this is impracticable, since arms and bosses as thin as the rim would be too light, or the rim would be too heavy. Make the drawing to meet the requirements, and the foundrymen will find a way to make the pulley. If you have the good fortune to find a Sellers' pulley for a sample, try and study out what there is about it that so many who have endeavoured to counterfeit it have never found out—that is, find out what constitutes the difference between the original and the counterfeit.

The fewer arms there are in a pulley the less likely it is to crack in casting; but six arms for pulleys of all common sizes is a better number than any other, for then the pulley can be held for boring and turning by each alternate arm without putting any strain upon it.

By far the best method of holding pulleys for boring and turning is the one devised by W. H. Craig, in which are used three very strong cast-iron brackets shown in Figs. 28 and 29. These

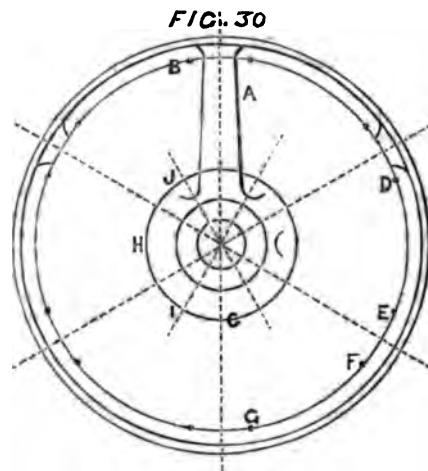


brackets are secured to the face-plate by bolts at equal distances from the centre of the lathe, and equal distances apart. The set-screws coming through the slots of the face-plate and the set-screws in front, grasping the arms, admit of adjusting the pulley true sidewise, while the three radial screws coming against the inside of the pulley give a ready means of setting it true and holding it firmly.

* From the American Machinist.

All pulleys, hand-wheels, and the like, that are to be turned in part, and left partly as cast, should be set by the part that is not to be turned. Thus the unturned portion will run as true as it can be set, and the turned part will be made true by turning.

In making the drawings of a pulley, some time may be saved by drawing centre lines through the six arms, as shown by the dotted lines in Fig. 30.



Next, complete the drawing of one arm, as at *a*, strike two circles, *b* and *c*, through the compass centres, and upon these circles set off from the centre lines the compass centres *d*, *e*, *f*, *g*, and *h*, from which the circles at the ends of each arm can be struck, and from these the straight sides of the

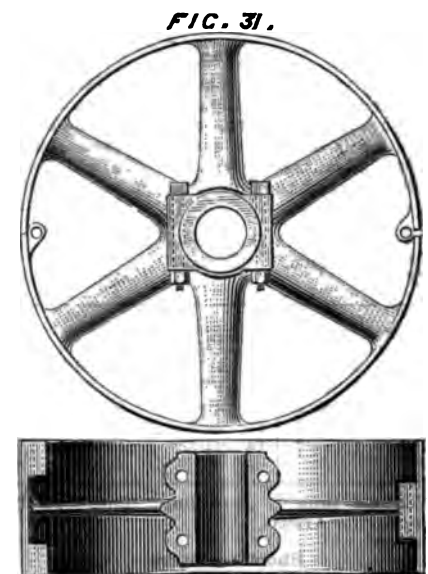
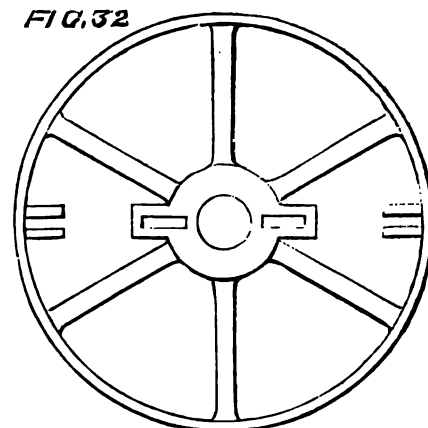


FIG. 32



arms can be drawn, without making any other measurements.

The study of the subject of pulleys may embrace that of sectional or split pulleys, and if no other lesson is learned, this may be—viz., the difference between the practice of modern machine designers.

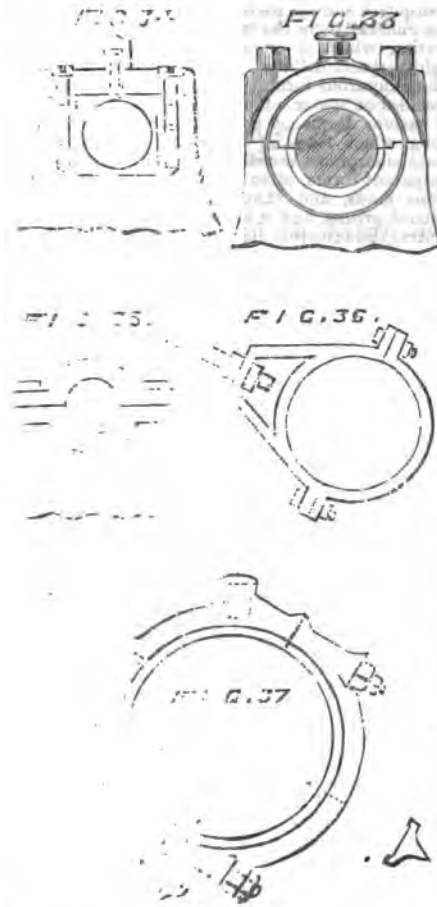
improvement of minor details, and the practice of this generation.

Fig. 32 gives an example of split pulleys that illustrate the characteristic difference, when compared with Fig. 33. The bolts used in the former are to clamp the two halves of the boss together, as close to the shaft as they well can, and if tightened until something gives way, it will be the cheap bolt, and not the costly pulley that breaks.

The later method of joining the ends of the rim is less unsightly than the old way; and by removing one of the pins the two halves of the pulley may be opened like a door hinge, and placed on the shaft much more conveniently than if completely separated.

This bolting of two parts together around a shaft, or round piece, is an important detail in machine-work, and is employed in putting together a large percentage of the journal boxes in use, in nearly all eccentric-rod strays, in some connecting-rod ends, and in many other places.

Fig. 33 shows a journal box for lathe spindle by Sellers; Fig. 34 something for the same purpose by Pratt and Whitney; Fig. 35 one of the common



and Fig. 36 an eccentric strap of the old sort; and Fig. 37 a new one according to later practice.

A few examples illustrate the same general principle, and the result of the best practice. The modern way is more mechanical, whatever that means, and costs more, but the result is far more satisfactory, and is the correct thing to follow. If you copy the right sort, and leave the wrong one to be a lesson, the chances are that, when you come to draw your machine in which this principle is involved, you will adopt the best.

Fig. 37 shows the common method of joining the eccentric strap, and Fig. 37 a better one, for it is not difficult, if not impossible, to bore one of the two holes truly circular, and then set it in place, and have it still true. The tightening of the bolts, as in Fig. 37, will pull the strap in a greater degree out of truth, while that shown in Fig. 37 will pull it in, however tight the bolts are.

IMPROVED STAIN AND POLISHING COMPOUND

A certain stain and polishing compound has been discovered by the discovery of Nurell, which contains a substance which has been found to be a new hydrated state compound of iron and other substances, and is a very effective stain and polishing compound.

matters. The carnauba wax surpasses all other kinds by its hardness, and by melting at not less than 206° Fahr. Between the teeth it breaks into pieces without molting, and when applied in a hydrated state in connection with other substances produces an excellent durable lustre and protects against the penetration of humidity. The polishing material is prepared in the following manner:—Dissolve 1 part of soap in 30 parts of boiling water, to this add an equal quantity of carnauba wax and boil the whole until the wax is dissolved, and looks like white milk. Then pour in a quantity of caustic ammonia until the milky solution of wax has become clearer; let it cool. According to what the polishing matter is intended for, precipitate this solution of wax with a solution of alum, sulphate of magnesia, iron, or zinc, &c., thus obtaining precipitates of combinations of sebacic and carnauba wax acids with the bases of the above mentioned salts. After washing out these precipitates, mix the compounds thus obtained with a small quantity of caustic ammonia and the precipitates of the desired colour. To get, for instance, a black colour, use a decoction of campeachy wood and acid chromate of potash. It is to be understood that the polishing matters differ from those generally used by their not being composed of a mixture of beeswax and soap solution, soluble in water like the latter, but of chemical combinations of sebacic, and especially carnauba wax acid with the oxides of the above mentioned salts and colouring matters.

COMETS: THEIR COMPOSITION, PURPOSE, AND EFFECT UPON THE EARTH.*

By Professor LEWIS BOSS, Director of Dudley Observatory, N.Y.

THOUGH modern science has taught us much concerning the physical nature of comets, no one has yet been able to construct a theory which is either complete or free from objection. With these facts in view, and so far as possible within our brief limits, and without the use of technical language, we will endeavour to outline some of the more important results of observation and reflection upon this subject. We shall be obliged to draw freely from the results elaborated during the last 50 years by Bessel, Wurmcke, Bond, Newton, Zollner, Bredichin, and many others, without reference to individual authorities, or digressions upon rival theories and claims.

Meteors—Offspring of Comets.

1. About twenty years ago it was proved that certain annually recurring displays of meteors are due to swarms of small bodies, which revolve about the sun in elliptical paths, so situated in space as to encounter the earth at nearly the same time in each succeeding year. These paths or orbits were found to be identical in some cases with those of certain well-known comets. The conclusion seemed irresistible and is now accepted, that shooting stars, or meteoroids, are simply the offspring of disintegrated comets.

Most likely, aerolites (large meteors) which sometimes reach the surface of the earth, are of the same origin. These bodies usually enter our atmosphere with velocities (relative to the earth) ranging from twenty to forty-five miles per second. In consequence of the inconceivable heat which would be generated by such contact—manifested by the fiery train they leave behind—the smaller meteors, however dense, would be at once converted into impalpable vapour. Only the larger ones could survive the tremendous encounter, and reach the earth. Still others, composed of more fusible substance, though very large, may be unable either to overcome the mechanical resistance of the air, or the transcendent heat produced. Furthermore, that fiery ordeal must strip aerolites of all volatile matter and leave only refractory substances behind. Hence, analysis of meteoric stones might give us an idea of the real composition of comets which would be totally misleading; just as the ruins of a house, destroyed by fire, would be no index of the chemical composition of all the material it contained before the disaster.

Testimony of the Spectroscope and Polariscopes.

2. The Spectroscope (light analyzer) rather reluctantly yields some testimony as to the chemical and physical nature of comets. It seems to show that the nucleus is a solid or liquid incandescent (high temperature) mass. It proves quite that the matter surrounding the nucleus is hydrogen and carbon in one of its compounds. The flame of the comet which contains one of the compounds (light analysis) which is not identical with that observed by observers have reported that evidence of their presence in

the tails of comets at considerable distances from the head. If so, we must suppose the attenuated matter of the tail to be self-luminous. This may be attributed to some form of electrical action; since, considering the low temperature of space, it cannot be due to incandescence produced by ordinary heat.

Recent observations with the spectroscope seem to prove that a part of the light from comets is really reflected sunlight, since it faintly exhibits a spectrum like that of other bodies, which shine by reflected light alone.

The polariscopes (instrument for detecting reflected light) also gives evidence which leads to the same conclusion. The use of this instrument in examining faint sources of light is attended with great difficulties; and in the present connection, the records of different observers are not strictly harmonious.

Record of the Telescope.

3. Comets are seen in their simplest form as faint patches of nebulous light. They are usually circular or oval in outline, without remarkable difference of brightness from centre to circumference. At a later stage of development the comet shows a diffused brightness in its central parts, known as central condensation.

When a large comet approaches the sun, the structure becomes far more complex. The central condensation gathers intensity. Finally, a point of light appears near its centre, which shines with a light approximating that of the planets. This is called the nucleus.

Nucleus has no Definite Magnitude.

Observers with powerful telescopes usually find that what we commonly call the nucleus has no definite magnitude. It continually measures less with increase of optical power. The inference is that the real nucleus, if it consists of a single solid body, must be very small, and much obscured by the vapours which surround it. Generally the nucleus appears to shrink in size as it approaches the sun. The most plausible explanation seems to be, that with lessened distance from the sun, the real nucleus gets hotter and brighter and that at the same time, the vapours near it become more transparent. Other explanations have been offered which we have no space to consider.

The Envelopes.

We commonly find that the coma (nebulous matter about the nucleus) appears much brighter on the sunward side. In many cases, streams of matter appear to issue from the nucleus on that side. These assume a variety of forms, and are almost always curved backward, from the direction of the sun, at their extremities. Above the stream, or jets, are sometimes seen one or more arcs of light, concentric with the nucleus from which they appear to recede,—just as waves recede in widening circles from a stone dropped into still water. These envelopes, as they are called, are supposed to be hollow spherical segments of matter, more dense than the surrounding parts of the coma.

One highly important characteristic of the matter which surrounds the nucleus is well established. The rays of light from distant stars seen through it are not sensibly bent, or refracted. This shows that gases of an appreciable amount do not exist in comets.

The Phenomena of the Tail.

The strange appearance of the tail and its gigantic dimensions it sometimes attains, are well calculated to arrest the attention of mankind. It is not wonderful that the ancients should have regarded it with trembling apprehension, nor is it surprising that, even yet, it excites an absorbing curiosity among the educated, and the superstitious terrors of the ignorant. The matter of which it is composed must be expanded to an almost inconceivable degree; for even when it is millions of miles in diameter, the light of the faintest star is seen through it with scarcely diminished brightness.

The Black Streak in the Tail.

Near the head it often appears to consist of two streams of matter issuing from either side of the coma with a dark channel of separation between. The tail at this point generally appears to have the same diameter, from whatever direction in space it is viewed. We must, therefore, conclude that its interior is nearly or quite free from matter, and like a hollow cylinder, or portion of a cone, as far as the dark channel extends. Beyond that point we may suppose that the interior fills up by gradual diffusion from the circumference. In some cases, and especially with small comets, the dark channel is wholly wanting, or but faintly indicated.

Curved Direction of the Tail.

In order to give an idea of the situation of the tail in space, let us imagine a line from the sun continually prolonged through the moving head of

comet into space beyond. We shall always find the tail extending nearly opposite the sun, in the general direction of this prolongation, but curved more or less backward from it, in the direction from which the comet is moving. Sometimes we find more than one tail—each distinguished by the degree of its backward inclination. They have, indeed, been classified on this ground, and found conformable to three general types.

Origin of Comets.

4. The facts thus far presented prove nothing as to the origin of comets. That question demands for its solution mathematical reasoning based on the calculated paths of all comets which have been observed. That discussion is beset with great difficulties, and as yet points to no absolutely certain conclusion. The balance of testimony seems to favour the supposition that comets originate outside the solar system. The planets move in nearly circular orbits about the sun; and no one has been able to show why comets, if they have the same origin, should move in elongated orbits, entirely differing from those of planets.

Let us suppose, however, that all comets must have taken their origin in some primeval nebula from which a solar system has been evolved. It has been shown that the velocity of a comet may be so much increased by the disturbing action of a large planet, that it may escape from the control of the sun, and be projected into the illimitable regions of space. Thus freed, it will go on in a nearly straight line for ever; unless, perchance, some powerful source of attraction, like another sun, lying near its path, arrests its flight. The possibility of such an occurrence is by no means imaginary. At least one comet (Lexell's, 1770), is supposed with good reason to have undergone that fate. There is every reason to believe that the same thing may have happened in other cases.

Stellar Comets.

All argument drawn from observation and reflection prove that the stars which surround us on all sides are remarkably like our own sun. Some of them are even larger and more powerful than he. Reasoning from analogy, we must suppose that these stars are also attended by comets. Hence, we are led to the conclusion that uncounted myriads of comets projected forth from millions of suns, during countless ages past, are now flying through space in every direction—restless messengers from star to star. By mere chance some of these bodies must come under the sun's far-reaching power and be drawn into our planetary system.

Physical History of Comets.

5. The mass (quantity of matter) of comets is conceded to be very small in comparison with that of the earth. How small it is we cannot say. No comet has been found large enough to exert a sensible attraction upon any celestial body found in its vicinity. This fact confirms the conclusion derived from telescopic examination, that the real, solar nucleus, if it exists, must be extremely small.

It is certain that no body entirely gaseous could exist in space. The conditions for the stability of liquid bodies in their practical application to the explanation of cometary phenomena, are extremely complicated; since they are closely associated with the unknown elements—mass of the comet, solar radiation, and absolute temperature of space. It would also be extremely difficult to show how a swarm of small bodies could be preserved in a state of equilibrium, or resist the tremendous tidal action to which it would be subjected in the vicinity of the sun. In fact, we must view the conversion of a comet through some unusual catastrophe, into such a swarm, as the sure precursor of approaching dissolution. On the whole, it is probable that there is a solid or partly liquid body near the centre of the comet. This body is more likely to consist of an aggregation of loosely cohering pieces or particles, than of a single firmly united mass.

Owing to the smallness of their attractive force, comets cannot retain a sensible atmosphere. This conclusion is confirmed by telescopic observation, as we have seen.

If, now, we suppose the nucleus to be approaching the sun, it will eventually reach a point where the liquid or other volatile matter on the "sunny" side commences to evaporate and be diffused about the comet. Without following the consequences of this evaporation into details, one can imagine for himself how the appearance of central condensation, of the streaming jets, and of the nucleus heavily obscured by vapours, might be produced.

To account for the backward curvature of the jets and the peculiar form and direction of the tail, we must look for some additional force. In all probability this force resides in the sun, and is directly opposite in its effects to the power of gravitation. But since the body of the comet obeys the law of gravitation with sufficient fidelity, we must find a repulsion which sensibly acts only on the molecules of gas or vapour.

The only force suggested by experience as competent to these requirements is that of electrical repulsion. Anyone can prove for himself that two bodies similarly electrified mutually repel each other. We know that the earth, through effects of constant evaporation and other causes, is to some extent an electrified body. For the same reasons, we should expect comets to be electrified in a much higher degree. The sun itself certainly exerts an influence upon terrestrial magnetism. Violent commotions on his surface have occurred at the same time with unusual disturbances of the magnetic needle. Electrical repulsion acts in proportion to surfaces, and not to volumes. On particles of matter in a state of infinitesimal subdivision it might act most powerfully, while not affecting a large body to an appreciable degree.

Theory of Formation of Tails.

If, then, we suppose the sun and comets to be sufficiently and similarly electrified, we have the force necessary to produce the backward curvature of the jets, and to drive off the smallest and probably outermost molecules of the coma to form the tail. Since, according to our hypothesis, very little matter can be given off from the shaded side of the nucleus, we readily perceive why the tail should be hollow in appearance.

The orbit of the moving nucleus being curved, it is evident that the particles driven off at any time with less than infinite velocity, would continually fall more and more behind the prolongation of a line through the sun and comet—just as has been observed. If the matter contains molecules, varying considerably in size, the larger ones would be driven off with less velocity. These would curve backward more than would the lighter molecules driven off at the same time; and so we have the multiple tails which have been seen, as well as the classification already described. Elaborate examinations of their average observed direction and form suggest that each class may be composed of chemical elements peculiar to itself. We may even venture to suppose that the tail of great velocity and least inclination is composed of hydrogen. The second type may contain carbon, with or without other elements; and among those of the third, chlorine would most likely be found.

It is a common error to suppose that this hypothesis, as to the formation of the tail, requires a repulsive force of inconceivable power. The straightest tails which have been observed are accounted for by supposing a repulsive force not much greater than twelve times the sun's attractive power. The tails most frequently seen (scimitar-like in form) may be produced by a force about one-ninth of that amount, which is but little more than sufficient to overcome the attraction of gravitation.

It will be seen that it is equally erroneous to suppose any great amount of material wasted in the formation of the tail, when one reflects upon the transcendent lightness of its structure.

How Comets Affect the Earth.

6. The influence of comets upon the earth is in all probability quite insignificant. They may, like the sun, affect the earth's magnetic condition, and thus to some extent, possibly, its meteorology. No such effect has ever been perceived. In spite of some chance coincidences between the apparitions of great comets and remarkable public events, no well-informed person now believes that there is any real connection between them. By a liberal and credulous interpretation of any frequently-occurring celestial phenomenon, similar coincidences could be shown.

When a comet is converted into meteoric bodies, which impinge upon the earth's atmosphere, there is some direct though probably minute effect. Some have thought that a sensible portion of the heat which the earth receives is generated in this way; but the weight of scientific opinion seems to be against that hypothesis. The impact of meteors upon our atmosphere must add some matter to it, and this is probably in the form of dust. This may be the origin of the so-called cosmic dust, which has been collected at sea in recent times. The finer particles of it may have some influence on cloud formations, and other meteorological phenomena; but all this is merely conjecture.

A more remote effect may be sought in the possible fall of meteors and comets upon the surface of the sun. Owing to his vast bulk, the sun would attract an immense number of these bodies; but it is quite certain that their effect upon the sun's heat is insignificant. It is now generally admitted that we must look for the origin of the sun's heat in a constant, though to us, imperceptible shrinkage of his vast bulk.

Some connection between the frequency of sun-spots and comets has been rather vaguely suspected. Were the search for comets systematically pursued with equal persistence for a long period, we might have some data for the formation of a sound opinion. Yet it would still be an open question whether comets cause the spots, or whether greater activity of the sun tends in some way to render

comets brighter, so that more will be visible, with probability in favour of the latter supposition.

Finally, it may be said, with all due respect to scientific decorum, that the appearance of a great comet does exert one most happy influence on the earth, in that it stimulates the curiosity of mankind, and directs their thoughts to the more particular contemplation of the glorious universe which surrounds them.

SOME OF THE INDUSTRIAL USES OF THE CALCIUM COMPOUNDS.—III.*

By THOMAS BOLAS, F.C.S.

THE sulphate of calcium, although it is neither so abundant nor so important from an industrial point of view as the carbonate, has properties which are perhaps more interesting and noteworthy in themselves. Sulphate of calcium is perhaps as widely diffused as the carbonate, being present in almost all spring waters and soils, but we do not meet with compact masses of the sulphate which are at all comparable in magnitude with the larger deposits of calcium carbonate. In some instances, the sulphate and the carbonate occur together in the same mineral, as in the case of the so-called montmartrite, which is so abundantly found in the neighbourhood of Paris. Sulphate of calcium occurs in the anhydrous form. When combined with two molecules of water of crystallisation, it presents the various forms of gypsum or plaster stone; among which may be mentioned the earthy or almost amorphous varieties, the clear and nearly transparent forms, often known as alabaster; the fibrous kinds, and that which is crystallised in flattened prisms, and is known as selenite. In this country, the principal deposits of calcium sulphate which are useful industrially occur in Nottinghamshire, Leicestershire, and Derbyshire; but notable quantities occur in Cumberland, and smaller deposits in Sussex, Kent, and Somerset. Few countries are without tolerably large deposits of gypsum in one form or another, and Switzerland, the Tyrol, Sicily, the United States, some of the South American districts being notable in this respect. Apart from these localities, the immediate neighbourhood of Paris stands pre-eminent; but the gypsum found there usually contains over 10 per cent. of carbonate of calcium, not, as a rule, in intimate union with the sulphate, but interspersed in the form of grains. This carbonate gives the Paris plaster some of its most useful properties as a constructive material. The flat crystalline prisms, like the amorphous masses of gypsum, contain $\text{CaSO}_4 + 2\text{H}_2\text{O}$, and if you reckon this out, it will correspond to nearly 21 per cent. of water. Sulphate of calcium is soluble in about 525 parts at the freezing-point, and in 466 parts of water, at a temperature of 38° Centigrade. As the temperature is elevated above this point, the solubility of the sulphate of lime diminishes until, at a heat of 150° Centigrade, it becomes almost insoluble. The presence of certain saline bodies notably increases the solubility of sulphate of calcium in water; sodium chloride, or common salt, to a moderate extent; while sodium hypo-sulphite increases the solubility of the gypsum about eightfold. This circumstance gives chemists a useful method for effecting the analytical separation of barium and calcium. The crystallisation of gypsum from warm water, or from water containing a little hydrochloric acid, is a pretty experiment, and as the solution in this globe cools you will see fine needle-shaped crystals or the hydrated sulphate shoot out, and form tufts nearly resembling the crystals of sulphate of quinine. These crystals make an admirable material for the binding of paper, as they possess a certain amount of strength or toughness themselves. Here is a sample of the hard and stony sulphate of calcium, which separates from water when it is evaporated in a steam boiler, and you know well how severe accidents frequently happen through the undue accumulation of such incrustations. In connection with this matter, you will not forget that at a temperature of 150° Centigrade, sulphate of calcium is nearly insoluble in water.

Sulphate of calcium is readily obtained in a state of purity by precipitation, when a soluble calcium salt is mixed with a sulphate in solution. There is a moderately dilute solution of calcium chloride, to which will be added some sodium sulphate, and after a few minutes the deposition of the calcium sulphate will commence, the precipitate consisting of minute needles, similar to those obtained by deposition from warm water, but somewhat smaller. Sulphate of calcium fuses at a bright red heat, and on cooling assumes the crystalline state.

One of the most remarkable circumstances in connection with sulphate of lime is the fact that when the crystals are heated sufficiently to drive off two-thirds of their water, the residue possesses the property of rapidly setting or hardening when mixed with somewhat more water than that which was originally driven off. In this case it appears

* Being an Abstract of the Lecture delivered before the Society of Arts.

that chemical union with the added water takes place, and that the original body, $\text{CaSO}_4 + 2\text{H}_2\text{O}$ is reproduced.

When plaster of Paris sets, or the partially dehydrated gypsum reunites with the water which was driven off in the baking, a perceptible amount of heat is produced, an elevation of temperature to the extent of 30° Centigrade being often observable.

The residual water of plaster of Paris may be replaced by certain saline bodies, as, for example, alum, sulphate of potassium, or borax, these substances being generally added to the baked gypsum in the form of solution; after which it is subjected to a somewhat higher temperature than before—a temperature which would dead-burn ordinary plaster. These cements (Keene's, Martin's, and Keating's) set in a few hours, and ultimately become so hard as to be capable of receiving a high polish.

The various kinds of stucco consist essentially of plaster, to which slaked lime may have been added, a solution of size being used for mixing; these additions causing the material to set sufficiently slowly to enable the mixture to be worked in the pasty or dough form. Marble-dust, sand, brick-dust, and other materials may be added to stucco in order to modify its character when necessary. The applications of plaster in its various forms are numerous and important.

The use of a selenitic or gypsum mortar is of advantage in many cases, the usual thing being a mixture of well-burned gypsum and lime; samples which are known to have been used over 350 years ago, being now in excellent condition and harder than the stones which are cemented. In Paris, various kinds of gypsum mortars are in general use, raw gypsum and other inert materials being often intermixed. It will be remembered that the plaster used in Paris contains free lime or carbonate of lime according to the degree of heat to which the raw stone has been subjected.

Plaster of Paris makes admirable drying tiles for laboratory or manufacturing use; its porous structure rapidly removing and carrying away moisture from any wet and insoluble powder. The operation of stereotyping affords a good illustration of an important use of plaster of Paris. Here is a form of type, the surface of which is slightly oiled. A border being placed round the edges of the forme, you see that liquid plaster is poured on, the production of air bubbles on the surface of the type being prevented by dabbing through the liquid plaster with a camel's hair brush. In a few minutes it will be sufficiently set for removal from the type, but in order to expedite matters, a similar cast was prepared before the lecture, and is now dry and hot in yonder gas oven. The hot cast is now placed face downwards in this flat metal pan, which is also hot; and after it has been properly secured, melted type metal is allowed to flow between it and the bottom of the pan. Sufficient has now been run in to thoroughly cover the cast, and this gas burner will keep it melted until the end of the lecture, after which it will be allowed to cool, when a cast, free from air bubbles or defects, is likely to be obtained.

Imitation marble can be made by mixing plaster to a pasty consistency, with a dilute solution of size, the required pigments being added. When the differently-coloured plasters have been incorporated, and the articles have become hard, the material is soaked with linseed oil, and polished with turpentine and wax. The mineral tripolite, which consists principally of silica, lime, and protoxide of iron, yields a quick setting cement when slightly calcined, and may be used instead of plaster in many cases.

Petroleum in Canada.—Petroleum has been found in large quantities in Sarnia, Ontario. About three and a half miles south-east of the town of Sarnia, the usual indications of oil were found at one of the borings at a depth of 600ft. from the surface. Suddenly operations were suspended by the bursting forth of a powerful jet of gas, which became ignited by a torch held by one of the workmen standing at a distance of 20ft. or 30ft. from the well. The gas seemed to be forced out with extraordinary power till it formed a volume of vivid silvery flame, fully 30ft. high. "But the most remarkable feature of this very remarkable exhibition," says the *Sarnia Observer*, in describing the phenomenon, "is that at intervals of exactly fifteen minutes by the watch, there is a grand eruption of water, which mingles with the flames, and, so far from extinguishing them, drives them in sheets far above the highest trees, and falls in showers for a considerable distance around the well. This eruption of water, which lasts about two or three minutes, is preceded by a gradually increasing roar, accompanied by a series of powerful gasps like the strokes of some mighty engine. The mixture of the water, which is said to be strongly impregnated with sulphur, produces effects in colour which are dazzling in their brilliancy and beauty, various shades of yellow and purple predominating."

SCIENTIFIC SOCIETIES.

THE METEOROLOGICAL SOCIETY.

THE Annual General Meeting of this Society was held on Wednesday evening, the 18th inst., at the Institution of Civil Engineers, Mr. G. J. Symons, F.R.S., President, in the chair.

The Secretary read the Report of Council for the past year, which showed the Society to be in a very flourishing condition, for while, in 1871, the Society continued its work without an office, accessible library, or an Assistant Secretary, and the number of the Fellows was 314, the staff at present very fully employed consists of an Assistant Secretary and three Computers, with 555 Fellows on the roll. The receipts and expenditure in 1871 show a marked contrast to the year just past; the receipts amounted to only £244, against more than £840 in 1881. The expenditure was only £197, against £780 in 1881. The Society also now receives second order and climatological observations from 83 stations, the results of which are published quarterly in the "Meteorological Record." In addition to the "Quarterly Journal," two publications have been prepared and issued under the direction of the Council, viz., "Hints to Meteorological Observers, with Instructions for taking Observations, and Tables for their Reduction"; and "Index to the Publications of the English Meteorological Societies, 1839 to 1881."

The President (Mr. Symons) then delivered his address, which was devoted to the consideration of the present state, and future prospects of Meteorology. He began by asking in what respects is our present system of observation capable of improvement? Should it be extended, either as regards distribution of stations, additional instruments, or additional hours of observation? Can any of the millions of entries at present made annually be safely dispensed with? These questions can only be properly answered after considering two others—What observations are being made, and for what object? After referring to the different patterns of barometers, and the number of observations made, Mr. Symons said that he is aware there are several grounds upon which the maintenance of numbers of stations in excess of all possible requirements can be defended. In the first place, there is the constant difficulty which arises from the removals and deaths of the observers, and from the extension of buildings and growth of trees, &c. This renders it necessary that we should have two or three stations wherever we desire to make sure of a continuous record. But a far better and more scientific plan would be to choose a few unexceptionable localities, remote from towns, purchase the freehold of a few surrounding acres, erect thereon stations identical in design and in every respect, and endow them with moderate funds, so that the observations may, humanly speaking, be established on an unalterable basis. That would be the way to direct secular changes. For climatic purposes, the numerous climatological stations started by the Society are of great value. After speaking of hygrometers, anemometers, and ozonometers, the President referred to daily maps of Atlantic weather, which should be on a scale of not less than 1in. for 100 miles. A compilation of such charts is essentially national work, and falls wholly within the domain of the Government Office. After referring to weather forecasts, the lack of original workers in discussing meteorological observations, and the absence of academical encouragement, and the little prospect of those who devote themselves to meteorology obtaining more than a bare livelihood, the President concluded as follows—It is just possible that the severe manner in which I have criticised a few of our existing arrangements may have led someone to consider that meteorology is languishing, feeble, or even moribund. I believe that the very contrary is the fact. When a case is weak, one hesitates to point out its weaknesses for fear of a total collapse. No; the Meteorological Society never advanced so rapidly in numbers as it has in the last two years, and if it will but apply the pruning-knife to fruitless observations, and try to secure the application of more brain-power to the many problems yet unsolved, it will continue to receive an ever-increasing amount of recognition and support, and to maintain that high position among kindred societies which it at present holds.

The deep-seated springs in the chalk formation of the river Thames basin maintain the dry-weather flow of the river, the minimum of which amounts to 350,000,000 gals. per diem, of which London water companies have Parliamentary powers to draw 110,000,000 gals., or nearly one-third. The water companies, however, do not take the maximum quantity to which they are entitled, but are rather increasing their supply by sinking wells to the chalk and obtaining water free from organic impurity.

SCIENTIFIC NEWS.

THE death of Prof. Theodor Schwann, the distinguished biologist, which took place recently at Liège, will be regretted throughout the whole scientific world. The famous professor was born near Düsseldorf in 1810, and after studying at Bonn became assistant to Müller at the Anatomical Museum, Berlin, where he remained until, in 1839, he accepted the post of professor of general and descriptive anatomy at Louvain, whence he migrated in 1848 to Liège. In 1839 Schwann published his "cell theory," which, stated briefly, asserts that the most different elementary parts of organisms are developed on one common principle, and that this principle is cell-formation. This theory, and the investigations by which it was supported, had an important effect on the study of biology—in fact it marks an epoch in the history of that science. In 1848, on the fortieth anniversary of Schwann's professoriate, deputations from all the important universities in the world went to Liège and presented addresses, while all distinguished biologists contributed their cartes to an album which was presented to the Professor. It is not too much to say that Schwann occupies in biology, the same position that Faraday holds in the history of electricity.

All who have had occasion to visit the library of the Linnean Society will regret to hear that Mr. Kippist, who for about fifty years discharged the duties of librarian, is dead. Mr. Kippist was born in 1811, and was elected librarian in 1842, his connection with the society dating from 1830. In 1880 he retired on a full pension.

Carl Louis Schwendler, a man who had made his mark in connection with the Telegraph Department in India, died recently at Schöneberg, near Berlin, in his 42nd year. Mr. Schwendler was formerly an employé of Siemens Brothers, and of late years had paid especial attention to the utilisation of currents from dynamo-machines for telegraphic purposes.

The international conference on the Transit of Venus expeditions was held at Paris last October, and the French Government have published the results. Mr. Stone, who presided over the British Commission, announced that the British stations would be as follows: Jamaica and Barbuda (one of the Caribbee Islands) in the West Indies, the Bermudas and the Falkland Islands, the Cape of Good Hope, Madagascar, New Zealand, and two stations in Australia—Sydney and Melbourne. The French stations are chiefly in the West Indies, Mexico, and the territory of the Argentine Republic. The German are not yet all selected. The Netherlands, Denmark, Spain, and Portugal also propose to take part in the observation of a phenomenon which will not be repeated until the twenty-first century. Steps will be taken to arrive at some international agreement about the final result for the solar parallax, as deducible from the transits of 1874 and 1882. That of this year occurs on Wednesday, December 6th.

In another column we reproduce the Warner Essay on Comets, a prize for which was offered by Mr. Warner, of Rochester, New York. In January, 1881, he offered a prize of 200 dollars to any American or Canadian who should discover a telescopic unexpected comet; but when comet *b* (the great one) was discovered, there were so many claimants that it was impossible to decide who was entitled to the prize. Accordingly Mr. Warner determined to give a special prize of 200 dollars for the best essay on "comets." One hundred and twenty-five essays were sent in, and the prize was unanimously awarded by the judges, Profs. Colbert, H. A. Newton, and H. M. Parkhurst, to Prof. L. Boss, of the Dudley observatory, Albany, New York.

On Monday last Prof. Judd lectured at the London Institution on the probability of finding coal under London. Recent borings tend to show that it is not unlikely that workable coal-seams do lie beneath the metropolis, and it is suggested that trial borings might be made at Croydon, somewhere in the North Downs, at Maidstone and Folkestone, in order to settle the vexed question, which is obviously one of considerable importance to Londoners.

Prof. Dudley states that a rod of iridium,

prepared by the process introduced by Mr. J. Holland, of Cincinnati, has been used successfully in an electric lamp for 60 hours without change or loss of weight.

The Academy of Meteorological Aërostation is to hold an exhibition of appliances used in the "aerial arts" in Paris during the summer of 1883. The exhibition will form the "centenary" of the Brothers Montgolfier, and commemorate their invention of balloons in 1783. The "aerial arts" include a great variety of materials, from gas to ropes, and barometers to pocket-knives.

The *Courier of the Rhine* reports the discovery at Steeten, on the Lahn, of a hitherto hidden cave, in which seven human skeletons have been found. At the opening to the cave, a huge heap of bones of animals and other remains of primitive existence has been laid bare.

The North Middlesex Natural History Association has been established pro tem. at 26, Ingleby-road, Grove-road, Holloway, N., and we commend it to the attention of those readers who reside in the North of London.

The Royal Society of New South Wales offers a prize for the best communication, containing the results of original research or observation, upon each of the following subjects:—Series I. (to be sent in not later than September 30th, 1882): "On the Aborigines of New South Wales," £25; "On the Treatment of Auriferous Pyrites," £25; "On the Forage Plants indigenous to New South Wales," £25; "On the Influence of the Australian Climates and Pastures upon the Growth of Wool," £25. Series II. (to be sent in not later than August 31st, 1883): "On the Chemistry of the Australian Gums and Resins," £25; "On Water Supply in the Interior of New South Wales," £25; "On the Embryology and Development of the Marsupials," £25; "On the Infusoria peculiar to Australia," £25. The competition is open, but the communication to be successful must be either wholly or in part the result of original observation or research on the part of the contributor. The successful papers will be published in the Society's Annual Volume. Fifty reprint copies will be furnished to the author free of expense. The Society's address is Elizabeth Street, Sydney.

In a work lately published in St. Petersburg, Herr Kolbe describes a new method of studying and measuring colour-blindness. By means of a rotating apparatus (on the same principle as Maxwell's disc), he mixes pigmentary colours—red, orange, yellow, green, and blue—with variable proportions of white; and measures, each time, for a person seeing normally, then for a colour-blind person, the proportion of a given colour that must be mixed with white for that colour to be perceived. By most Daltonians examined, yellow and blue were perceived, though strongly diluted with white, whereas red and green were not perceived unless almost saturated. The reverse was the case with other Daltonians. Herr Kolbe gives, in his work, a very complete bibliography of the subject, with an analysis and discussion of all the methods hitherto employed for study of the vision of colours.

According to an Austrian paper, the number of breweries in Great Britain in 1880 was 26,114, in Germany 23,940, in the United States 3,293, in France 3,100, in Belgium 2,500, in Austria-Hungary 2,297, in Holland 560, in Russia 460, in Norway and in Switzerland 400 each, in Denmark and Sweden 240 each. The quantity of beer produced in Great Britain was about 49 million hectolitres (the hectol. = about 22 gallons), in Germany about 37 millions, in the United States 14, in Austria-Hungary 11, in Belgium 8, in France 7, in Russia 3, in Holland 2, &c. Russia has the largest breweries, and there is an average production of 6,950hl. to each, Denmark 6,250hl., Austria-Hungary 4,770, the United States 4,182, France 2,555, Great Britain 1,900, Germany 1,550. Norway has the smallest breweries, with an average of 1,300hl. The beer production per head of the population, in litres, is in Belgium 151, Great Britain 140, Germany 83, Denmark 76, Holland 52, Switzerland 31, the United States 30, Austria-Hungary 29, Norway 23, France 20, Sweden 16, Russia 4, Italy 3.7.

The following case was lately reported by Dr.

Helot in the *Revue d'Hygiène*. A tripe-seller in a very healthy village in the district of Caux was accustomed to throw into a pond near his house the detritus and water charged with animal matters resulting from his work. This pond soon became very filthy and gave off such a stench, that horses passing along the road near it would sometimes run off. The neighbours complained; the pond was emptied, and its waters were applied as manure to the land of an adjoining farm. Presently a terrible epidemic of diphtheria broke out, beginning with the farmer's family, and continuing six months, during which it made numerous victims. The tripe-seller, cause of all this evil, having meanwhile gone to another part of the country, took to his former practices. He made a trench near his new abode, to receive water charged with detritus. After eleven years, this ditch was emptied and the contents used for manure, as before. There was a fresh epidemic; but the municipal authorities stopped the manuring process, and thereby limited the ravages of the disease.

When a sound is produced near the sounding-board of a piano, the chords in unison with the sound, or with one of its harmonics, are, it is known, set vibrating. M. Bourbouze has lately observed that if a microphone be applied to the sounding-board, the sound transmitted in a telephone-circuit is considerably strengthened, and neither the distinctness nor timbre of the voice are sensibly affected. Thus, with a sounding-board containing three octaves (the extent of the voice), and a carbon microphone on the side opposite that of the strings, he makes a very sensitive transmitter.

Some interesting contributions to a knowledge of hysteria have been made by MM. Dumontpallier and Magnan, in a recent note to the Paris Academy; and it would appear that phenomena in hysteric persons, attributed to a mysterious radiating *neuric* or nerve force in the person producing them, may be explained more simply as results of mere physical action, on a state of greatly exalted sensibility. One experiment, proving this remarkable sensibility, consisted in bringing one end of a caoutchouc tube, about 20ft. long, near the foot of a patient, while a watch was brought to a speaking-trumpet at the other end of the tube. The foot was at once set in rhythmic motion, the movements corresponding exactly to the ticking of the watch.

The *Journal Officiel* states that in 1880 there were 25 steam-boiler accidents in France, by which 30 persons were killed, and 30 others wounded. The number includes two steamboat accidents, which had 31 victims (killed and wounded). Of the 25 accidents, 4 arose from defective installation, 9 from defective maintenance, 15 from bad use of apparatus, and 3 from unknown causes.

A crocodile must certainly be an awkward customer for physiologists with a penchant for vivisection, but we note (in *La Nature*) that two Frenchmen, Drs. Regnard and Blanchard, have managed to strap one of these animals on a laboratory table, and measure the force with which it snaps its jaws, when stimulated with an electric current. The upper jaw was raised and attached at its extremity to a dynamometer. They calculate that a force of 150 kilogrammes is applied (in a crocodile about 8ft. long) primarily on the space at the end of four large projecting teeth, and this corresponds to nearly 400 atmospheres.

A fine work, on the Alps, by M. Civiale, has been presented to the Paris Academy. It is the result of 25 years' diligent work, and is a collection of 600 large photographic views, comprising 41 complete panoramas, in which are represented all the interesting points of view of the Great Alpine Chain. A volume of text, and two large topographic maps, accompany the atlas, which, of itself, forms ten huge volumes.

It is well known that zinc, in acidulated water, is oxidised and liberates the hydrogen of the water; but not so well known that a like action occurs, though more slowly, of course, when zinc is in water containing carbonic acid, even rainwater. A curious accident, arising from this action, lately occurred to M. Sébère, in Saint Brienne. He has been long used to keep oxygen in a gasometer of galvanised iron, of 100 litres capacity, sunk in water. Several weeks

recently passed without his using the apparatus, in which there were 30 to 40 litres of gas, and during this time, the hydrogen resulting from decomposition of the water by the zinc in the interior of the bell sufficed to produce a detonating mixture. M. Sébère, supposing only oxygen to be present, opened the stopcock at the top to admit a jet of that gas to a flame, whereupon the gasometer exploded, fracturing his right hand, inundating the laboratory, and doing considerable mischief to it. The gasometer contained an abundant deposit of carbonate of zinc, and the author assured himself, by means of a test-tube filled with small fragments of the metal and inverted over the water, that the production of hydrogen goes on with considerable rapidity. He now thickly varnishes the interior of the bell.

It has been stated in several industrial journals in France, that a courageous agriculturist, in view of the ravages of phylloxera, has sought a substitute for the vine, and finds such in a variety of red beet—also that his work has received the sanction and encouragement of learned societies. This beet, strongly saccharine, yields on fermentation, a wine which is said to be quite equal to many of southern growth; and the plant has the advantage of being adapted to all soils and climates.

An instrument-maker in Göttingen, Herr Sartorius, has taken up an idea conceived long ago by Ritchie—viz., that of weighing by means of torsion of wires, and he now furnishes balances of the kind for chemical analysis. He finds aluminium bronze the best material for the wire.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 51, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-offices Orders to be made Payable to J. PARNHAM EDWARDS.

* * * In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physics: a vice from whence great inconveniences derive their original."—Montaigne's Essays.

GREENWICH MEAN TIME FOR THE WHOLE WORLD—THERMOMETER—COMPARATIVE LIGHT OF THE MOON AND PLANETS—ERECTING EQUATOREAL—SUNSPOTS AND THE WEATHER, AGAIN—COMBINING BERTHS AT BROMPTON—THE BAROMETER AS A WEATHER-GLASS—PROFESSOR GRANT AND THE METEOROLOGICAL OFFICE—DIVIDING A THERMOMETER SCALE—"HAZE" OVER LUNAR CRATERS—EUGLENA—LOANS—TAURI—MEASURING GLOBES.

[19657].—THE absurdity of any attempt to make Greenwich Mean Time universal in every part of the globe, to which you refer in your "Scientific News," p. 445, may be illustrated by a supposititious example. "What is the time?" inquires a drowsy New Yorker of a friend who has come to rouse him at the beginning of the New Year. "Five minutes past noon," is the response; whereupon, gazing dreamily through his window, he exclaims, "Five minutes past noon, why, the sun hasn't risen yet!" and turning round, straightway goes to sleep again. Nor, perhaps, would it be much easier to persuade a man looking out of his quarters at Nagpur, that it was only 2 p.m., when before his eyes was a brilliant winter Moon, high up in the sky.

If "Tenant Farmer" (query 45738, p. 459), will mix a little lamp-black and salad oil, and rub this upon the scale of his thermometer, afterwards wiping it off the face of the scale with a clean piece of rag, he will find that the divisions will be decidedly more perceptible. He must get the surface of the wood as clean as he can, leaving the black mixture in the divided lines.

I do not believe that the materials are in existence for a categorical reply to query 45767 (p. 460). The late Prof. G. P. Bond did, however, during the year 1860, determine the photometric Jupiter at Mean Opposition

proportion. $\frac{\text{Mean Full Moon}}{\text{Jupiter at Mean Opposition}} = \frac{1}{6430}$
Light degrades as the square of the magnifying power. An eyepiece magnifying 48 diameters will show Jupiter of the same size as the Moon appears when viewed with the naked eye.

"A Mechanic" (query 45784, p. 460) must elevate the Polar Axis of his Equatorial 53° 21' if he is going to erect it in Liverpool.

As I am told by my clerical friends, in explanation or extenuation of the somewhat frequent repetitions in their sermons, that iteration is invaluable as a means of impressing and enforcing facts, I am going to act upon the assumption that it is so, and once more invite attention to the extraordinary diversity of weather prevailing upon the globe. During the past two or three weeks, we note in the Meteorological Report from the Royal Observatory at Greenwich, that the mean temperature has varied from 2·6° to 6·2° above the 20 years' average; and yet, concurrently with this abnormal heat in England, we read that—"The cold is so intense upon the Sahara frontier, that in one day the Louis column lost 400 camels. Many soldiers are dead, and more are ill. . . . Many men are said to have perished in the snow, and the companies are greatly reduced." Now, it is pretty certain that as long as there is a farthing to be extracted from the public purse, that paltry imposture, the "Committee on Solar Physics," will continue to exist for the benefit of the persons composing it. Hence, if the Vice-President of Council really has, in his secret heart, the slightest faith in this wretched scientific sham, he might get something for the nation's money by proposing to the "Committee" to explain (if they can) whether the Sun and his spots are acting at present upon the British Islands or upon North Africa? They can't well be simultaneously influencing both.

Apropos of sunspots, I have not, for a very long time, come across a more striking specimen of fatuity than that afforded by a letter in Friday's *Daily News* by a gentleman named Swinton, on "Sunspots and Volcanic Eruptions," in which the writer tries to connect the occurrence of these two phenomena. His idea is "that the eruption of Vesuvius and Etna are marked by the cycles intervening between the fewest and the most sunspots, although their periods of activity may begin one or two years before the minima, and terminate one or two years after the maxima are reached" (!). I would simply invite attention to the words which I have italicised in my quotation; and further ask every one interested in the subject to compare Mr. Swinton's list of eruptions with Wolf's sunspot tables in Vol. XLIII. of the *Memoirs of the Royal Astronomical Society*. He will not be very many minutes in coming to an exceedingly definite conclusion as the value of Mr. S.'s "facts."

I see by the papers that McLeod of McLeod has resigned the Assistant-Secretaryship of the Science and Art Department, and that he is to be succeeded by Colonel Donnelly, now Director of the Science Division "who, while retaining his present post, will, as Assistant-Secretary of the Education Department, be the Chief Officer of the Science and Art Department at South Kensington." Now I observe in *Whitaker's Almanack*, that McLeod's salary is returned at £1,200, and that of Colonel Donnelly at £955; and I think it very desirable indeed, in the national interest, that the public should speedily be informed whether this somewhat exceptionally favoured officer of engineers is, for the future, to draw £2,155 annually from the Exchequer, or whether he is to forego any portion of the salaries attached to two offices, which seem to any common-sense outsider, as too distinct and important to be simultaneously filled with efficiency by one and the same person? Some day, perhaps, we may have a Vice-President of the Committee of Council on Education sufficiently strong-minded and unqueable to put a peremptory stop to the abuses of pluralism, &c., at Brompton. Meanwhile the British taxpayer, whose money is being dealt with by a practically irresponsible Ring, has at least a right to demand that the details of its expenditure shall be furnished to him.

The recent extraordinary height of the barometer suggests to me to remark on its singular untrustworthiness as a "weather-glass." On Sunday, the 15th, with the mercury indicating a pressure of 30·51 (250ft. above the sea-level), and steadily rising, we had rain at the station whence I write.

In the Meteorological connection, too, I would express my regret that that very eminent and most estimable man of Science, Dr. Grant, the Professor of Astronomy in the University of Glasgow, has been lending the weight of his great and undoubted authority to the supposition that the Meteorological Department is making an adequate return for the comparatively large sum annually devoted to it. That the "millions of useless

observations," of which Sir George Airy once spoke, are being sedulously added to at the seven observatories affiliated to the Meteorological Office I am not concerned to question; but that any effectual attempt to co-ordinate this Ossa upon Pelion of details has ever been made, or that any theory worth the paper it was developed upon has ever been deduced from them, I most strenuously deny. No doubt a certain amount of work is done by the actual staff in Victoria-street; but the real head of that staff (who is, in effect, the Meteorological office himself), Mr. Scott, was more candid than some of his defenders when he wrote in *Good Words* for last August:—"As regards the possibility of really predicting the weather for these islands, weeks, or even days, beforehand, it is the duty of all honest meteorologists to warn the public against expecting what is clearly impossible." The whole gist and tendency of Professor Grant's speech seems to me to lie towards a further appeal to Government for funds. Had such an appeal been urged by any of the gentry composing the so-called "Meteorological Committee of the Royal Society," who already divide the modest annual sum of £1,000 among them for their services—it would scarcely have needed the wisdom of Solomon to divine their motives pretty accurately. That any one whose motives are so unimpeachable as those of Professor Grant though, should, even by implication, sanction a most discreditable system of scientific mendacity is, in every sense, deplorable.

In his reply to query 45738 (p. 479) "F. I. C." ignores the fact that the boiling-point of water varies with the barometric pressure. The boiling point, 212°, in the Kew Standard instrument corresponds to a barometric pressure (reduced to 32° Fah.) in London of 29·905, in Dublin to 29·900, and Edinburgh to 29·803in. Should the reading differ from this quantity and the temperature not be 32°, an allowance must be made. Wollaston says that 1° of Fahrenheit corresponds to 0·588in. of the height of the mercury in the barometer. Thus, if in London the barometer, reduced to 32° Fah., stands at 29·316in. water will boil at 211° Fah. On the other hand, with the barometer standing at 30·9in., as it has during the last few days, water would boil at 213·7° Fah. The same remarks apply to the succeeding reply by "E. A. B."

I would join Mr. Scott (query 45809, p. 482) in his appeal for information on the subject of air and water on the Lunar surface. We are told, in effect, that most probably haze will be seen over various regions of the Lunar surface, because air and water must—in however attenuated a form—be present there; and then we are informed that the indications of haze are indications of the existence of air and water. In the days when I was reading Logic, this used to be called the "Circularis in probando."

I fancy that "E. B. F." (query 45816, p. 482) is a little mistaken about the Euglena propelling itself by its flagellum: because it is not uncommon to find those organisms without flagella, and they are equally active. Their locomotion would rather seem to be effected by the contraction and undulation of the whole body; the Euglena making their way through the water much as loaches crawl over glass.

I regret extremely my inability to reply to query 45824 (p. 483). The question, in one sense, is rather a commercial or monetary than a mathematical one. I have sometimes seen advertisements of books on subjects allied to that on which "C. W." asks my aid, from a publisher called Effingham Wilson, in London. It might be worth while for my querist to write to him and inquire if he has any such book as "C. W." wants.

I do not at all know to what stars "Zenas" is referring in query 45836 (p. 483). There is the well-known companion to Aldebaran some 1' 43" from him at a position angle of about 33°; but your correspondent must have an uncommonly sharp eye, as well as a first-class instrument, to see this with 180 on a 2lin. object-glass. The other recognised ones about 50' off, discovered by Burnham, is only visible in the largest instruments. How did "Zenas" obtain or estimate his position angles?

The method of determining the cubic contents of a globe devised by "P. W." (query 45856, p. 483) may be "simple," but it is, unfortunately, incorrect. The volume of a globe of 30ft. in diameter is, almost exactly 14137·07 cubic feet. The formula is remarkably easy. It is simply: multiply the cube of the diameter by one-sixth of π (3·14159265, &c.).

A Fellow of the Royal Astronomical Society.

MEDICAL REPLIES.

NUTRITIVE VALUE OF FOOD.

[19653].—THIS question is one of great practical interest. In my judgment the value of flesh food is vastly over-estimated. Taking the price of pure lean beef-steak, without bone or fat, as one shilling a pound, four-fifths of this consists of water, and only one-fifth of solid food residue. The solid matter of beef-steak therefore costs its

consumer five shillings per pound. Taking the price of good milk at fivepence per quart, for which the most excellent milk can be distributed in London, that comes to twopence per pound. Now good milk contains one-eighth part of solid residue with seven-eighths of water. The solid food-matter of milk therefore costs sixteen-pence a pound as against five shillings per pound for that of lean beef.

Now milk is a typical and perfect food if only the cows are fed upon a fresh and varied food, and good milk is the only food upon which man's health can be continuously kept in a perfect condition. The solid residue of milk, though now costing only one-fourth as much as that of beef, is in reality far more valuable as a food material.

As to the adulteration of milk, that can easily be checked. There is in every district of London a public analyst attached to the vestry, and if a letter complaining of the milk supplied by a particular milk-vendor be sent on to the public analyst at the vestry office for the district—the letter stating that its writer is a working man who cannot afford the expense of paying for the analysis—it will be found that the analyst will himself take the matter up, have specimens of the milk in question taken and analysed, and the vendor warned or prosecuted. So much for the at-present unappreciated food value of milk, and the method of insuring a public supply of sound, unadulterated milk.

Those who suffer much for want of food being properly selected may be divided into four categories. 1. There is the growing child and youth. 2. There is the nursing mother. 3. There is the fully-worked mechanic whose wife is not clever at wholesome cooking. 4. There is the dyspeptic middle-aged patient, who emaciates and becomes feeble for want of proper nutrition.

1.—Growing children must have food which will supply the body with materials for additional building, as well as for repair of tissue, and for the production of heat and force. In the extension of the frame lime salts act as bricks and mortar, and are indispensable for the construction of solid bone and other tissues. Now, flesh food is useless for this purpose. True it is that carnivorous animals, such as lions, tigers, &c., have magnificent bones; but that is because they gnaw the bones of their prey as well as eat its flesh and suck its blood. And carnivorous animals have a powerful solvent for earthy matter in their gastric juice, which enables them to digest bones very perfectly. But with growing children and youths this earthy basis has to be got from grain and milk foods. The rickety limbs, diseased spines, and stunted forms that are seen in the children of large towns, and especially in those towns where factory-work tempts the mother away from her natural sphere of work at home, is due, not so much to want of means, as to want of sense in the selection of food and in its preparation. This tells especially whenever good milk is not used as an article of food for the children.

2.—Nursing mothers, often very fully worked in attending to their homes, are supplying to the babies at their breasts all these earthy matters which serve to build up the bones and framework of their children. Now, if they nurse their babies upon beer, or upon flesh food, these elements go into the milk at the expense of the mother's own tissues. Hence a form of starvation in nursing mothers, which does not show itself at all in emaciation, but which is often rather attended with corpulence.

Such mothers get fat and pasty, are low-spirited, incapable of exertion, and often sleepless and irritable; their teeth rapidly soften and decay, and their children, though often very fat, are very unhealthy, and prone to die of convulsions, of brain-disease, and of bronchitis.

Such women, if they attempt to give up their beer, find their milk stop and themselves feel still more feeble. But this I say—that if a mother cannot nurse her baby without beer, she is not fit to nurse it at all, and the child should have a wet-nurse, or be fed upon cow's milk and water and sugar.

Boiling water should be poured into good cow's milk—half and half—and this be sweetened with loaf sugar. The food should be sucked out of a clean bottle just as if the baby were sucking from the mother's breast. At six months of age, when the child's teeth begin to appear and its bones to grow very rapidly, well-boiled thin coarse oatmeal gruel should be added to the milk in place of water, and towards the end of the year the child may eat a little bread-and-butter occasionally, but not be allowed to swallow lumps of crust. In this way a baby is safely launched into its bread-and-butter and milk days. If the oatmeal gruel does not agree, a little baked or boiled flour may be used instead, the flour being well boiled into a thin food, and the milk then poured direct into the saucepan. Perfect cleanliness and sweetness in bottles, saucepans, &c., is indispensable to prevent souring of the food and illness of the child. If clots of curd come away in the napkins the amount of milk must be reduced. If

the child be constipated, the food must be made thinner.

The nursing mother, if she would make good milk, must live largely upon milk foods, and none is better than oatmeal porridge eaten with milk. The porridge, made as I have before described, must be cooked in water, and boiled hard for half an hour, so as to be thoroughly cooked. It should be poured out into a vegetable-dish, and set like a jelly, and should cool without a cover, or the steam will condense upon it and spoil its flavour. The porridge when set, should be a smooth uniform tremulous jelly, not starchy, and not pasty in flavour; and free from burning, smoking, and lumpiness.

3. Taking the working adult, whose body is fully grown, it will be seen that he has less need of the earthy salts, having only repair of frame to provide for, in addition to the production of heat, and the liberation of force. The dyspeptic has often ruined his stomach by smoking or drinking, or sometimes by swallowing unchewed food owing to defective teeth. Here the remedies are the leaving off tobacco and alcohol; also not drinking strong tea or coffee, and either the addition of supplementary teeth, or the use of food that needs but little chewing. For all such persons—the nursing mother, the fully-worked adult, and the dyspeptic, I would advise the following breakfast as that which for, say sixpence or less, will be a substantial and valuable meal on which to commence the day's work. A slice of fat bacon, toasted in a Dutch oven, and the fat collected carefully. The bacon should be efficiently cooked, but not frizzled up, and the fat should not taste at all burnt. A boiled egg turned out over the bacon, and a round or more of yesterday's bread, toasted if preferred. This should be carefully eaten, so that it is thoroughly masticated, and all the bacon that is cooked, including the fat, should be eaten. Then finish up with a large saucerful of oatmeal porridge, eaten with a half-pint of good rich cold milk. No tea, coffee, or other slops, to breakfast. The porridge left from breakfast, if covered over and set aside in a cool sweet place, will be very nice at supper time; and a saucerful or two, with another half pint of milk, will make as good a supper as man could wish to sleep upon.

Tea and coffee are nice upon occasions, say, at tea time, when a little break in the day is wanted, and the heavy labour is generally done, and the body wants rinsing out. But to drink tea or coffee at breakfast time, when a man has all his sleep in him, is unphilosophical, and is a practice which is a great producer of dyspepsia.

The free use of milk with some persons needs discretion. A large glass of milk swallowed suddenly will form in the stomach a lump of dense, cheesy curd. Under the action of the stomach this will turn over and over like a heavy weight, and as the gastric juice can only attack its surface, it digests very slowly. The same milk taken with a biscuit, a slice of dry toast, a roll, or a saucerful of porridge, forms a porous friable clot, which breaks up every time that the stomach turns it over, and through which the gastric juice can easily pass. Therefore, milk taken with bread-stuffs is much more digestible than by itself. If the milk be still found too strong, a little boiling water poured into it, and a piece of sugar added, makes it still more easily digested.

In economising food, life is improved, and also lengthened. Every particle of surplus material that goes into a man has to be excreted again, or to block up his system. Extra labour thrown upon the kidneys, liver, and other excretory organs means that they are prematurely worn out; unsuitable food blocking up the system means the deterioration of fibre and the spoiling of the vital powers throughout the system. Our mortality returns show that most men die from the premature decay of those internal organs on which the duties of digesting the food or scavenging the body fall. A man's measure of life may be taken out as surely in the amount of food which he can pass through his body as in the amount of work which he can perform, or the number of years which he can continue to produce heat enough to live through. Therefore, the philosophy of making the best and most of life hangs largely upon questions of diet, and upon simplicity and sparseness in diet. All this will be unpalatable doctrine to gentlemen who devour so much more than they can consume that they invoke the aid of the *ENGLISH MECHANIC* to devise stays which will enable them to truss up and carry about their overgrown carcasses. But I would lay it down as a proposition that the heavier the carcass a man carries through the world the sooner he drops into the grave. Redundant eating is truly enough one of the most prolific causes of disease and decay.

As the production of heat to keep up the temperature of the body is one of the main sources of demand for food, the external temperature, and the clothing in which the body is enveloped, largely determine the amount of this need for food. In clothing, the object should be: porosity to the

exhalations of the skin, non-conductivity to the heat of the body, lightness, so as to impose on the body a minimum of weight; such cut and configuration as to impose upon the body the least interference with its movements. Young children have a very large surface in proportion to their bulk, and they are very prone to suffer from cold. Emaciated persons, who have but a very thin blanket of fat beneath their skins, need more clothing than others. As a broad rule, flannel clothing on our bodies is cheaper and healthier than firing in our dwellings.

James Edmunds, M.D., M.R.C.P. Lond.
8, Grafton-street, Bond-street.

AN INEXPENSIVE BUT EFFICIENT MICROSCOPE.

[19659].—WITH your permission I venture to submit for the consideration of the numerous scientific and other readers of the "*E. M.*," whether the time has not arrived for the production of a cheap, and at the same time, reliable microscope?

The "brass and glass" men, with heavy purses, have had a long innings, and it is hoped and believed that they have met with instruments sufficiently elaborate to satisfy their requirements.

It may well be asked, however, of what use is the brilliant lacquer and highly-finished workmanship bestowed on the stand and other—non-working or moving—parts? Could not an equally efficient instrument be produced at one-half the present prices by confining the skill of the highly-trained workmen to the lenses in the first place, and next on the accuracy of the coarse and fine adjustments and moving parts generally, leaving the other parts to take care of themselves?

What would it matter to thousands who would doubtless like to possess a microscope, if the appearance of the exterior were like that of old bronze? There would be all the less need of a glass shade or mahogany cabinet to keep it out of the dust, and, moreover, it would be ready when required for use.

Many forms of stands appear to be too light and small at the base to be firm and steady. I am of opinion that the stand should be rather heavy—resting on three points sufficiently wide apart to afford a firm basis to carry the instrument. Let the chief efforts be directed to the construction of the lenses and moving parts, and to the framing of a model in which utility shall be combined with simplicity.

G. Welborn, Ph.C.

CHEAP MICROSCOPES.

[19660].—I AM pleased to see this subject mentioned in your paper; I can imagine no indoor or outdoor amusement which can surpass the microscope for pleasure and knowledge.

To say that it is an inexpensive amusement would be as misleading as it would be false. But it need not be an extravagant one.

Let the beginner first confine himself to looking at live objects, whether belonging to earth, air, or water, and many a happy and intellectual day will be his, in searching the country far and near, lingering by sunny tarns overgrown with weed swarming with aquatic larva and minute animalcula, and never passing the seemingly clear, still waters of a shady wayside pond without first peering to its depth in search of fresh beauties of creation.

Armed with a long rod, a net and hook to fit on its end—the net made from an old pocket-handkerchief, and about 6 in. in diameter—a bag with a few bottles, he will set out, and, maybe, with his little cheap microscope in his pocket; and oh what wonders will he bring to shore from that sunny tarn, and what marvels will be exhibited to his delighted gaze, as, after he has let the water in his net nearly drain away, he has sent the last few drops into a bottle! And oh! what happy hours will he spend when, after he has reached home, he has emptied the contents of the bottles into a basin or pie-dish he has bagged on the sly! He has placed a small piece of weed and a few drops of water in his live-box, and is gazing upon the inhabitants of that small piece of weed, and the occupants of those few drops of water, and is studying their internal, but transparent, economy through the aid of his microscope.

Maybe he will witness many desperate fights, and learn by experience that intellectual animals are not the only ones that wage an endless war.

Nothing will reveal to him the infinite wisdom of his Creator and the marvels of His creation more than a few drops of water.

I have not the power to put my thoughts into words, and can only refer your readers to such books as Slack's "*Marvels of Pond Life*," John Wheeldon, Great Russell-street and Paternoster-row (out of print, price 2s. 6d.), and M. C. Cooke's "*Ponds and Ditches*," Society for Promotion of Christian Knowledge, published at 2s. 6d.

My microscope I bought at the Civil Service Stores, and it originally cost—I say originally, for that is not the expense of a microscope—£3.

It is contemptuously called by my friends a "Toy." Be it a toy or not, it is an exceedingly nice one, and admired by those who have used it for its clearness of field, handiness, &c.; one old microscopist saying as we were viewing the wonders of nature through a Ross's 100 guineas—"That's a very nice little tool of yours, and I reckon that when you get a bigger and better one, you will often go back to your old little one." And I reckon so too. It has a combination of three powers, English made, lin., $\frac{1}{2}$, and $\frac{1}{4}$. Of course it will not show tests. I said original cost was £3. I should be sorry to take for it and its £12 now.

A £3 microscope may be as near the height of ambition of many as a 100 guineas one is to mine; but get what you can: when you can afford a better you will know how to use it.

Once, when at the Stores, I wanted to see an object, and took up a small cheap microscope, and was much struck with the same iron stand—inclined at any angle—French combination of three powers, coarse adjustment sliding in tube fixed to stage, also fine adjustment eyepiece drew out, live-box and forceps case about 5 in. or 10 in. "What is the price?" "15s. 6d." This is, indeed, a cheap microscope, and surely, with a little self-denial, within the reach of the many. They are usually sold at about £1 10s. "Yes, but I don't belong to the Stores, and I can't afford £1 10s." If you will send your name and address to me I shall be happy to introduce you, and you can then use my ticket for the purpose of purchasing one. You can see the microscopes without a ticket at 136, Queen Victoria-street, third floor. Walk in—there is no one who will stop you.

A tarn is a small lake made by nature, and should be preferred to a pond which is made artificially.

John Alex. Ollard.

136, Fenchurch-street.

[19661].—I WAS very much pleased to read the letter on "Cheap Microscopes" in this week's issue, and should also be pleased to have some information on the subject. I am interested in botany, but cannot afford to spend three guineas or more upon a microscope, so have had to content myself with a small pocket lens of three powers, which I find very useful, especially for outdoor cursory examinations. But I also want to do more than I can with a pocket lens, but am debarred by the high prices of microscopes. I remember seeing an instrument at a conversation of the Quekett M. S. that would, I think, do very well, and be reasonable in price, as well as give good results. The tube was supported on three legs (forming a tripod) with coars- and fine adjustments, small stage, &c., condenser, the whole folding up small and compact. I could not get any information about price or maker. I am sure a little information on the subject would interest many, and trust it may be forthcoming.

C. C. Cooper.

[19662].—HAVING had some experience as an amateur, I should like to make a few remarks upon the subject of "Cheap Microscopes," suggested by the letter of "C." in your last number. It is true there are such cheap instruments as your correspondent describes, costing less than 20s., with non-achromatic object-glasses. These, however, are not to be recommended to the student. "C." says they "will show a large majority of the objects figured in any of the microscopical manuals." That may be so; but *how* would they be shown? Your correspondent may rely upon it that such microscopes would only disappoint, if not actually delude, their purchasers. As for their being "brought into notice by use at the soirées of the various societies," it is not to be expected. Who would care to be a spectator of such a very unsatisfactory and unattractive display? A respectable firm in Birmingham, whose catalogue is now before me, supplies an "improved school microscope," with achromatic combination which separates to form two powers, and rack adjustment to compound body, for 30s.; and a "student's first size microscope," with corrected Huyghenian eyepiece and achromatic combination forming three powers, for £2 2s. Anything lower in price I would not advise the student to buy. Even to one of limited means, I would rather suggest that he should go in for something analogous to the "student's model microscope" of the same firm, which, with two eyepieces and two superior achromatic object-glasses, may be had for £3 3s.; with fine adjustment, for £3 10s.; and with the addition of polarising apparatus complete for £1 14s. This is an instrument which could be used with pleasure as well as profit. And what attention does its total cost represent? Why, scarcely more than the price of one pint of ale per day for a twelve-month. This very moderate allowance of liquor, at 1s. 9d. per week, comes to £1 14s. for the year. And (though it is no purpose of mine to advocate teetotalism) what earnest seeker into the hidden mysteries of nature would, if such self-denial were necessary, hesitate to make so small a sacrifice with such an end in view? My advice to the student is to obtain the very best instrument he can afford. Some

time ago, I saw in print an excellent suggestion, viz., that opticians should supply microscopes on the hire system, now so generally applied to pianofortes. That seems to me to be a matter well worthy of attention.

Wolverhampton.

J. F.

MICROSCOPICAL SOCIETY—SPIDERS.

[18663.]—At page 125 of Vol. XXVIII. you kindly inserted a communication from me re spiders' webs, to which I beg to refer those members of the above society who may be interested in this subject, which was brought before them by Dr. Anthony, at their meeting reported in the "E. M." of this date. In my letter I described, from practice, the best mode of obtaining and collecting the proper webs for optical purposes, and how to reel them, so as not to impart any twist. Some of the members who spoke to Dr. Anthony's paper seem not to be aware that the geometric spider never spins a glutinous web; the entire net is first made, beginning with the long stays (those alone suitable for optical purposes), then those at the circumference, next the radial threads, and finishes the net with the spiral "ratlins" (to use a nautical expression). When these are complete, the spinner begins at the "ratlin" next to the exterior threads, and bedews them at regular intervals with the glutinous fluid, walking round and round until all is complete. This fluid spreads, in time, over the "ratlins," and so the thread appears as if spun in a glutinous state at the commencement. A new net, thus bedewed, is an exquisitely beautiful object in the early morning sun—a silver cord strung with pearls.

It is extremely interesting to watch a spider at this operation. When going round and round she gives a tug to each of the radial stays, and should she not approve of it, she goes to one end or the other, sets all right, and then speedily returning to the other operation, finishes up, retires to her den, and awaits her prey with exemplary patience.

3, Lorton-terrace, Jan. 20. Robt. J. Lecky.

THE EFFECTIVENESS OF A 2in. TELESCOPE.

[18664.]—As I have very often seen the utility of a 2in. achromatic telescope unwarrantably disparaged, and having derived so much benefit and such unexpected results from one myself, I feel inclined (if you will permit me) to address a few words on the subject to those readers of "ours" who are interested in astronomy, and who are (as I once was myself) in doubt whether it is worth while to construct a telescope of so small an aperture. To try and remove this doubt, I will relate my own experience. One thing let me state, however, optical apparatus of all kinds are more than double the price here they are in England. I could have made a 3.5in., for the same money I spent on my 2in., had I been in England. But to proceed.

I procured from Beck's (here) a 2in. object-glass for 6dols. = £1 4s. I then got a brass-turner to make me a cell to take the o.g., and a flange for the end of the body, into which the cell screwed, this cost 2dols. = 8s. I then got a tinsmith to make a tube 32in. long, to take the flange—cost 3s. Next, I had a wood-turner turn a piece of hard wood to go in the other end—cost 2s. In the centre of the wooden end, I had a hole 1½in. in diameter turned, and into this I inserted a 6in. length of mandril-drawn brass tube, 3in. Inside the first tube I put another, and connecting the two with the rack and pinion motion of an old photographic lens, had my eyepiece-tubes—4s.

Now, the tube of tin for the body, I covered with several layers of brown paper. At first I had great difficulty in getting the layers to dry smooth; but seeing this was caused by the outside layer drying first, and so cockling the under ones, I held the tube over an argand gas-jet, and by thus drying the inner layer first, got a perfectly smooth surface. I then covered the whole with book-binders' morocco cloth. So much for the telescope. Cost £2 1s.

Now for the mounting. My telescope is mounted on the top of a four-story building, and (although in the centre of Philadelphia) I have an unobstructed view in every direction. This being the case, I thought no stand would suit me so well as that described by Mr. Philip Vallance in "E. M.," Vol. II., p. 334. Being exposed to every breath of air, I found the tripod base too unstable, as every passing breeze would set the whole affair vibrating. After many trials of different bases, a friend suggested a pyramid of lin. pine, 18 by 20 at the bottom and 3 by 5 at the top, and 5ft. high. This, when placed on a platform made by screwing two boards 3ft. by 2ft. together crosswise, made a firm stand. Cost, £1 16s.

Now I had a 2in. telescope, 36in. focus, with powers of 80, 100, 120, 200, equatorially mounted at a cost of about £4. I did not make this all at once, but bit by bit for about a year.

I even found that standing on tip-toe to look at

something near the horizon, or alternately squatting or kneeling on the floor, to shoot at something in the zenith, was, to say the least, "rather uncomfortable." I, however, overcame the difficulty by making an observing chair in this way: I made two triangular frames, 5ft. high at one end and 1ft. high at the other, and 8ft. long. Between these I arranged a sliding seat which could be raised or lowered to any height. The back being hinged I could lie down or sit erect. With this chair I can now observe any part of the heavens with ease.

Now I will state, from my "Observatory Book," a few things the telescope, so arranged, will do.

Aug. 8, 1881. Mizar easily divided. Two stars besides Mizar and Alcor in the field. Pr. 100.

Aug. 12. Cor Caroli well divided, as are also α and β Libræ. Pr. 100.

I found in a short time, by training the eye, I was enabled to see much more delicate objects: and on

Aug. 14 I saw the ring neb. in Lyrae was annular. I could also make out 13 M. distinctly.

Pr. 120. On trying the planet Jupiter, I could see the red spot transit, and the broken-up condition of the belts. Saturn I could see beautifully, and divide the ring. I have seen four of Saturn's moons, and can easily see three when in right position.

Oct. 13. I saw one of Jupiter's satellites in opposition under the planet's disc.

Oct. 15. When trying the grt. neb. Orion. I thought, with 120, I could see four stars in the Trapezium. I tried 200, and was sure. Still, to



have no doubt, I set my sharp-eyed friend to describe the neb.; and he also saw them distinctly, as I had previously. Since then I have often seen them. (To "F.R.A.S.")—Is it usual to see four stars with so small an aperture?

Dec. 1st. I shot at β Cygni and saw it very beautifully divided with 100. ρ Orionis easily divided with 200. γ Andromedæ, Castor, γ Arietis, are very easy objects.

I could give numbers of beautiful objects that I have observed; but I think these will show anyone who cannot afford a more costly instrument, that it is decidedly worth while to get a 2in. With patience and care, more can be done with a 2in. than most people would think possible for a 2½in. I have often been sitting at the eyepiece fifteen and twenty minutes, without removing my eye, trying to divide a close double, and at last have succeeded. And after once dividing it, I have been able to do it next time in one-half the time.

Would our kind and talented friend, "F.R.A.S." be so good as to give me some acknowledged test objects for a 2in., powers of 100 and 200. Also, I want to know what lens or combination of lenses I must insert between the eyepiece and the screen, on which I throw the enlarged image of a sunspot, to make said image sharp.

I wish to put R.A. and Decl. circles to my equatorial. I know how they ought to be put on, but the thing which puzzles me is, how to keep the zero of the R.A. circle coincident with the first meridian.

It has to be kept coincident, does it not? If not, how do you read R.A. and Decl.? Suppose I want to put the telescope on, say, 61 Cygni, how am I going to read R.A. 20h. 59m. 43s., Decl. N. 37° 58' 0"?

In answering the above, please do not refer me to any vols. between Vol. XII. and Vol. XXIV, as I have not them with me just now.

M. Herbert Bridle.

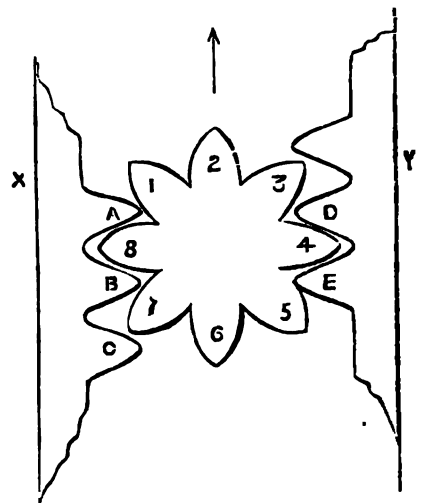
1018, Wood-street, Philadelphia, U.S.

TRICYCLES—DIFFERENTIAL BALANCE GEARS.

[18665.]—MR. STACPOOLE WESTROFF has done well in raising the question as to whether the Salvo is or is not a double-driver. As he has remarked, assertion one way or the other, is not proof. Therefore, as I believe the Salvo is a double-driver, I will endeavour to prove it so. Whether I am successful or not I leave to your readers to decide.

If the machine is raised from off the ground and the pedals are rotated, one wheel can be easily stopped, yet the other continues to revolve, and it seems to me that this is the reason why many people have imagined that it is a single driver. For the sake of argument, let us assume that the machine is speeded level: in this case the wheel that rotates makes two revolutions to one of the crank. A well-known correspondent has said that "the wheel which meets with the most resistance does the least work": that I admit. Further he says "that on a curve the outer wheel having the most work to do (because it covers the most ground), therefore does not drive." Now if the machine is made to turn round such a sharp curve, that the inner wheel does not rotate on its axis at all—that is, if the outer wheel describes a circle whose radius is equal to the distance between the two wheels, then the outer wheel must drive or the machine would not move at all. Clearly the inner wheel cannot drive the machine, since it does not, in the case supposed, turn on its axis at all. The steering wheel in this case acts as a resistant to the inner wheel. The outer wheel meets with the least resistance and does all the work.

If we take the gear itself and examine its working, we shall, I think, have additional proof that this conclusion is correct. Suppose the driving-pinion has eight teeth, and that x and y are the two side-wheels of the gear. When the machine is running straight and road resistances are equal, 7



and 5 press equally on b and c . But on a curve, the inner wheel (say the one attached to y), being checked by the steering-wheel, c , will move or less resist the pressure of 5. The driving-pinion being pulled round by the chain in the direction of the arrow 7, will press on b , and finding less resistance there, it will move b ; but if 7 moves faster than 5, 5 will drive c with less force. The amount of force with which 5 will drive c , will be the pressure of 5, less the resistance of c ; or, the sum of the driving power of 5 and the resistance of c will equal the total pressure of 5 on c . If the resistance of c is equal to the power of 5, then c will not be moved at all, and it will be similar to the case already supposed, in which the machine is turning in a circle, and the inner wheel does not rotate at all: for if c will not move, 7 must still press on b , and so move the outer driving-wheel.

When running straight, and with greater road resistance on the wheel attached to y than on the one attached to x , the resistance of c against 5 checks the wheel on that side, but there being no resistance of b against 7, the side x will revolve faster than y , and the machine would not go straight but for the steering.

it to run straight by offering a equal to the road resistance on y . y revolve at equal speed, which en the machine is running straight, id must press equally on b and c . ents x from revolving too quickly; offers resistance at b equal to the x . For if x drives faster than y , ould describe a curve, for the cannot slip, as they have the he rider's weight on them. Then, e machine runs straight? Clearly the speed of y being accelerated; because x is retarded. There is no n this side; then there is nothing er to produce this effect. Com- wheels meet with equal resistance, d and the other an equal amount

Charles F. Steel.

SAR W. Moody Bell will hardly asing his power by such means as bands. I conclude he alludes to cumulator" *à la* doorspring. But re, or as much, power out of any than he has previously put into it. way he could help himself would his surplus power when running uphill in springs, and utilising it on oral plans have been suggested for assisting of some arrangement of ke powerful clock-springs, to be he down grades, and the accu- plied to assist the rider when hey all involve three things led in cycles—space, weight, and nstruction. I have never heard of ns proving of any practical value, ve showed great ingenuity and y.

oad tires, though doubtless they t ground then narrow ones, they or push aside a greater amount of e, which comes practically to much. Very large and wide tires were "Beck" bicycle, and riders of that achine have told me that, though and free from jolting over rough streets, &c., they were very hard mud. Curiously enough, they to run remarkably well on sandy, The extra weight and cost also section.

Challenge" tricycle, alluded to by a modification of the same firm's le. I tried one of them once; but the large wheel behind made them steer and very uncomfortable to could do nothing with it, though s one of my best points of riding. se I so hated getting down and re- rather force myself up any hill at ting a bloodvessel than go through rocess, which I never could master n with years of riding. Hence my ments with "Safeties," "Ponies," y" I found a very useful steed, treadles or took my feet off going said treadles used to whirl around most unmercifully. So I took to st, and after many experiments, lvo"—and never repented. I am at present, but at the first oppor- another "Salvo," balance gear and traction. Whatever the theoretical al peculiarities of differential gear ice it works to perfection, whether in zig-zags, and beats every single- er seen for real work.

s had a great opinion of the th its fore-and-aft steering. The it of a good brake—the ground- supplied being an abomination. er be devised? Though a strap- -driver is usually a failure, owing el "taking charge," I fancy the age would control the machine e of the driver being checked. I o hear if the plan has ever been hat result. Treadle.

ARY MATHEMATICAL PTICS.—XIII.

Supplementary).

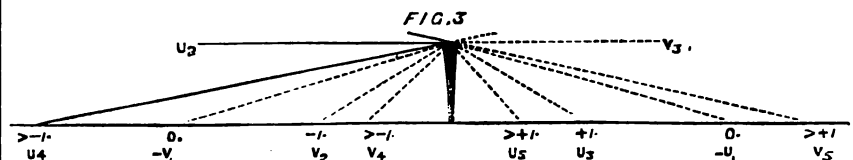
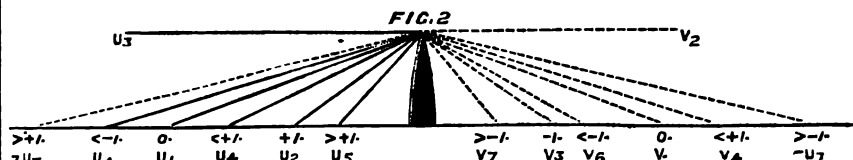
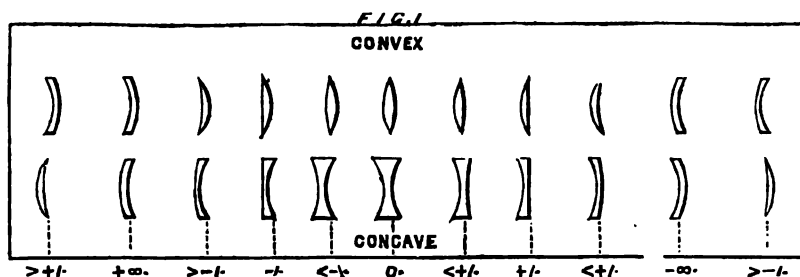
reading over section XII., with to conclude my series of letters ject, it occurred to me that some ight arise in selecting a proper io of the first curvatures; or in root of the quadratic was most econd pair of curves. I have showing the form of lens denoted e equation, when its value cor- reaches to the value attached to bus, if $x = +1$ it denotes (for a) a convexo-plane lens, or (for

negative refraction) a concavo-plane lens. Or, if we have assumed a form for the first lens, the diagram shows between what limits the root of the second equation should lie, in order to give suitable combination curves. Thus, if the first lens be plano-convex, in which $x_1 = -1$, the root of the second should be about $+1$. I have also drawn two diagrams showing the limits between which the values of (x) should lie, for different positions of the conjugate foci. The line drawn from the points $u_1, u_2, \dots$ is the direction of the incident ray, and that from $v_1, v_2, \dots$ the direction of the re-

Substituting this in our equation of condition, there results—

$$\frac{1 + 4x + 4x^2}{1.733 + 3.466x + 1.816} = \frac{4.549 + 7.466x + 4x^2}{6.33x^2 + 1.81x + 6.216; \text{ or, } 2.33x^2 - 5.666x = -1.667; \text{ or lastly, } x^2 - 2.42x = -.716.$$

The solution of this gives $x_1 = 2.54$ or 0.28 , and since $x_1 = -(1 + 2x_2)$, its values are -6.08 and -1.56 .



fracted ray. The points marked o , are at distances equal to twice the focal length, and those marked $+1$, are half this distance.

It must also be noticed that (a) can be expressed in terms of the dispersive ratio. For we have $1/d = (1 + a)/2f$, (f = focus of second or flint lens); but d = focus of the front or crown lens, which must be taken with the negative sign in combination with the second lens; so that $2f/F$ or $2/\delta = (1 + a)$ or $a = (2/\delta - 1)$. If the concave or flint lens is in the first place, this becomes $a = (2\delta - 1)$. From these considerations it is evident that we can find what ratios of curvatures are suitable for different refractive and dispersive powers, without taking any special values for the foci.

As a further illustration of Coddington's rules, let us take the second example given in section XII., and find suitable forms for the lenses, when the flint is in the front place. (Flint index = 1.6 , crown = 1.5 , $\delta = 0.6$).

In this case we must have $A_1 \delta^2 = A_2$, (A_1 is coefficient of flint, A_2 that of crown.)

By reference to equation table we have:—

Coefficient of flint for parallel rays = $.78$ ($x_1^2 - 1.733x_1 + 1.816$) $\times 0.216$.

Coefficient of crown for vergent rays = 1.166 ($x_2^2 + 1.428x_2 + .464x_1^2 + .964$).

But in this case $a = (2\delta - 1) = (1.2 - 1) = 0.2$. Substituting this in the second equation, we get ($2x_1^2 - 1.733x_1 + 1.816$) = 6.33 ($x_2^2 + .286x_2 + .982$).

Let the second lens be convexo-plane, then $x_2 = +1$. This gives $x_1^2 - 1.733x_1 = 12.64$, from which $x_1 = +4.3$ or -2.56 .

Applying these values to the particular lenses used in example 2, we have, radius of convexo-plane crown = $3/2 = 1.5$.

Flint lens ($x = 4.3$), $r = -6/5.3 = -1.13$, $s = -6/3.3 = +1.82$. ($x = -2.56$), $r = -6/1.56 = +3.84$, $s = -6/3.56 = -1.68$.

The first value gives the form (Fig. 4), the second (Fig. 5), which latter is alone suitable.

We will next find a ratio, which shall give coincidence in the two interior curves.

The flint being first, we have, $1/s_1 = (1 - x_1)/2f(\mu_1 - 1)$; $1/r_2 = (1 + x_2)/2f(\mu_2 - 1)$; $\therefore (1 + x_2)/(1 - x_1) = (\mu_2 - 1)/(\mu_1 - 1)$.

Replacing μ_1, μ_2 and δ by their values, we obtain, $-x_1 = (1 + 2x_2)$.

Applying these values as in the previous example:—

Flint-lens ($x_1 = -6.08$), $r_1 = -6/5.08 = +1.18$, $s_1 = -6/7.08 = -0.84$.

Crown-lens ($x_2 = +2.54$), $r_2 = 3/3.54 = +0.84$, $s_2 = 3/1.54 = -3.9$.

These values give the form (Fig. 6).

Flint-lens ($x_1 = -1.56$), $r_1 = -6/0.56 = +10.7$, $s_1 = -6/2.56 = -2.34$.

Crown-lens ($x_2 = +0.28$), $r_2 = 3/1.28 = +2.34$, $s_2 = 3/0.72 = +4.16$.

These values give the form (Fig. 7).

With one more example, I conclude this series of letters.

Taking the refractive indices of Chance's hard crown and light flint to be respectively 1.52 and 1.58 , and their dispersive ratio as 0.67 , find approximately the best ratio of curvatures, to give interior coincident surfaces.

Here we have:—

Crown equation for parallel rays 1.07 ($x_1^2 - 1.488x_1 + 1.503$).

Flint equation for vergent rays $.841$ ($x_2^2 + 1.67ax_2 + .634a^2 + 1.102$).

$a = (2/\delta - 1) = 2$ (very nearly), and $\delta = 0.3$.

Substituting for a , and multiplying $.841$ by 0.3 , the second equ. becomes $.2523$ ($x_2^2 + 3.34x_2 + 3.638$).

Hence we have:—

4.24 ($x_1^2 - 1.488x_1 + 1.503$) = ($x_2^2 + 3.34x_2 + 3.638$).

And from the formula given in section XII., when the interior curves are alike, $x_1 = (4 - 6x_2)$.

Substituting this in the first equation, we finally obtain—

$x^2 - 3.02x = -1.695$, whose roots are 2.27 and 0.75 , which are the values of x_2 . And x_1 is found to be -0.96 or -0.05 . The first or larger value in each is inapplicable; the second gives, for the crown $r:s :: 21:19$, and for the flint $r:s :: 1:7$.

Let us apply these to a combination whose compound focus is 50 in. The focus of the flint will be 24.627 , and of the crown 16.5 , and the curves are found to be:—Crown 18.06 and 16.34 , both convex; flint 16.33 and 114.4 , both concave. The slight discrepancy between the values of the interior radii, is caused by taking two places of decimals only in the value of x , instead of three, which should generally be the least number allowed.

If, instead of finding contact curves, it is merely required to find one lens to match another of

given form, the operation is much less complicated.

Thus, if the crown is equiconvex, to find a suitable flint lens: in this case, $\phi_1 = 0$, and the equation of condition is easily found to be $\phi_2^2 = 3.3172$, the positive root of which = 0.66. This gives for the flint curves 17.19 and 33.93, and the crown, being equiconvex, each curve is 17.16.

These results show, that with these kinds of glass, a good objective ought to be made, with an equiconvex crown lens and a concave flint, having one side in contact with its neighbour.

Orderic Vital.

THE RIGHTS OF INVENTORS.

[1868.]—In his letter (18636) in your last issue, at page 476, Mr. J. Brown compares the finding of a diamond or a coal-mine on one's property with the finding of an invention in one's brain. Later on he adds, that "the mere fact of having first invented anything should legally constitute ownership in it, and the sole right to all profits derivable from it," presumably in perpetuity. The analogy I hold to be false, and the statement to be unjust.

If I possess a field which by the law of the country in which I live (that is, by the general consensus of opinion of the people of that country) is my own absolute property, then it is evident that any treasure which I may find in that field is also my own absolute property, and that any person trespassing therein in search of treasure—still more if he find and remove it—is guilty of a fraud upon me. But the field in which I seek invention is the accumulated experience of millions of thinking and working beings. It is the sum-total of all previous inventions—of all previous discovery. It is the birthright of all the world. My brain is a mere tool—the spade with which I dig: I need not use it unless I please; but if I do I must take it out to the common land and work side by side with all who choose to come. If I find anything of value, surely it does not, for that reason merely, become mine thereafter and for ever. If I did not find it, it is very certain that no long time would elapse before someone else did. It seems, therefore, that my merit consists not so much in finding it—for that many others would do if I did not—but rather in finding it so long a time (or so short a time, before any other. This merit is justly mine, and for this I should be rewarded. In an ideal state of existence the man who would have found the invention if I had not done so would, when his time came, receive his share of the reward; and so with the third, and the fourth, and fifth, and many more. But in this very un-Utopian world of ours, such a proceeding is manifestly impossible: the second, the third, the fourth, and the fifth, therefore, combine with others lower down the scale, and agree to give the first finder of the invention its sole benefit for a term of years, after which his private interest to entirely cease. Thus rough justice is done.

The indirect share that previous discoverers and inventors have had in any fresh invention is too frequently ignored. A Hughes discovers the principle of microphonic action, and gives the monoplane to the world. Half a hundred little people rush to the Patent Office and get protection for trifling "improvements," and then loudly proclaim that *their* instruments are for sale, and at a price, too, which would seem to assert that none but they had had a hand in them. A Cooke and a Wheatstone possibly squabble as to which of them "invented" the telegraph, while the claims of the Humberdons are not thought of.

I cordially endorse Mr. Brown's concluding words. To place inventions and gin-drinkers upon the same level, to class them together as fit objects of heavy taxation, is a shame on an otherwise civilized country. It is killing the goose that lays the golden eggs.

Jan. 21.

Alfred W. Soward.

[1868.] In discussions on this subject, which is of a very serious practical importance, it is desirable to avoid exaggerated claims on the part of inventors. I think both "Aliquando" (19556) and J. Brown (18650, page 476) fall into this error. It is the general opinion that the present law errs chiefly in making patents too costly, more especially in the early stages while success is being struggled for. But to claim them as more right, without payment at all is, I consider, a very great mistake. In the first place, it is foolish to claim anything which is quite certain will not be granted. I think, too, that the present patents would be an evil far greater than the present costly ones. The one legitimate argument against patents is that they obstruct science. It is true that a movement and other obstacles are to be seen, and they prevent the progress of science. But the main argument is that the present law is a great mistake. In the interest of science, it is necessary to have a more reasonable system. The present law is a great mistake. In the interest of science, it is necessary to have a more reasonable system. The present law is a great mistake. In the interest of science, it is necessary to have a more reasonable system.

The analogy drawn by J. Brown is a common one, but is it not a false one? In what way does an inventor resemble the man who finds a diamond or a coal-mine on his own property? The analogy seems rather to one who makes such a find upon property common to the public. An inventor does not give to the world something it could never obtain otherwise, because many others might very probably make the discovery; almost certainly would when it concerns a matter of general interest. Unfortunately for me, I can prove this from my own experience. I have many important matters which I cannot put before the world because of the expense of the patent, so illustrating the disadvantage of the present system. But among them are some relating to a subject much studied nowadays, that is to say secondary batteries. I have experimented a great deal, in fact with pretty nearly every form which has been suggested, and a great many never heard of. I made one some months ago, and have been in treaty with certain parties to patent and work it with me, when meanwhile Mr. Sutton, of Ballarat, publishes pretty nearly the same thing. But for the expense of the patent, the world would have certainly possessed this knowledge, and earlier, and my work might have received some recompense. On the other hand, it is evident I should have appropriated, to some extent, what another has now given to the world.

Therefore, in patents, we have not merely to deal with an absolute right in the inventor, but with his claim to a presumptive right upon something he takes from the common stock. The public has a right here as well as the inventor, and the whole question resolves itself into one of the utmost advantage to the whole community.

The practical requirement is a system which shall encourage every one to bring forth his ideas, but also discourage the more lie-in-wait, the parasite upon the true inventor. I think the fair thing would be a small fee, say, five pounds, to cover five years, and then an annual growing tax to weed out useless things, and restore them to common stock. A fair examination as to novelty, to be charged extra, but not an absolute rejection by examiners, would also be very useful.

Sigma.

THE DANGERS OF OXYGEN MAKING

[19670.]—FROM the correspondence of the past few weeks on the above subject, there would seem to be a rather singular, as well as lamentable, ignorance of the danger attending the process. Apart from the question of the adulteration of manganese dioxide, perhaps the following method of procedure in oxygen manufacture may interest some of your readers. Although somewhat rough and ready, it is efficient, safe, and, as regards the apparatus, inexpensive.

To begin with, my retort is an old mercury bottle having the throat bored out to 1½ in. diameter, and slightly conical. To this is fitted a short length of ordinary lead pipe of about the same diameter, turned taper at the ends so as to fit the throat of the retort, and to this is soldered a foot or so of ½-inch gas pipe, which takes the indiarubber connection to the wash-bottle. The conical fitting of the retort and lead pipe need only be roughly done, as during the process of gas-making the joint is luted with a paste made of whiting and water, with a little salt. Should there be any under-pressure in the retort by the choking of the emission-pipe or otherwise, the short lead connection is at once blown from its seat, thus forming a very efficient safety-valve.

I have never had an explosion, or the semblance of one, although I have made large quantities of oxygen, and even admitting the occasional adulteration of the manganese dioxide, such need very rarely occur if the following precautions are taken: Carefully examine the manganese for any small particles of foreign matter, paper, straw, sawdust, as mentioned by "A Fellow of the Institute of Chemistry" (19650); thoroughly mix the ingredients, so that every crystal of the chlorate is blackened by the manganese. Wash the gas in a solution of caustic soda as it comes over. Do not hurry the process.

With regard to Mr. Drinkwater's suggestion of moisture in the retort after dissolving out the residue, it should be placed on the fire until all moisture is driven off. I might mention that a mercury bottle may be made red-hot any number of times with impunity—in fact, as an oxygen retort, it is all but indestructible.

21st January.

A. E. Viney.

[19671.]—IN reference to the means of detecting carbonaceous matter in samples of oxide of manganese, W. J. Lancaster says (letter 19635) that "the test-tube method given by A. W. Soward is not satisfactory." With pure manganese it sometimes occurs that the evolution of the gas at the bottom of the tube is great enough to blow the whole or nearly the whole of the compound out. With a test-tube of iron barrel this may be so;

but with an ordinary one of thin soft glass it will, I think, be found that long before this point is reached the tube shows signs of collapsing.

In support of the method referred to in my letter (19579) I adduce the following experiments:—Twenty-four thin soft-glass test-tubes as nearly alike as possible were selected and were numbered consecutively; into each of the first six were placed a few decigrams of pure black oxide of manganese; into each of the next six a like quantity of a mixture of pure black oxide and powdered chlorate of potash; into the remaining twelve, the same quantity in each, mixture of black oxide, chlorate of potash, and carbon (the carbon ranging from a mere trace in the first to about 10 per cent. in the last). The tubes were then mixed, and afterwards successively heated, without reference to the numbers they bore. It was found that six of them lost shape before giving off any very appreciable quantity of oxygen, that six gave off oxygen quietly without suffering deformation, and that twelve, by exhibition of one or more of the signs mentioned in my former letter (19579), gave evidence of the presence of carbonaceous matter. On examination of the numbers it was seen that the tubes which had lost their shape were those into which had been placed pure oxide; the tubes from which oxygen had been quietly evolved were those which had been supplied with pure oxide and powdered chlorate, whilst the other twelve had contained the intentionally adulterated specimens plus powdered chlorate. I, therefore, conclude that if this method should prove to be unsatisfactory, it will not be for the reason stated.

Involving, as it does, the use of a domestic appliance alone, W. J. Lancaster may, as a practical lanternist, prefer the fire-shovel method; but for my own part, I must confess to a preference in favour of a test-tube—for the equal accuracy attending its use, for the greater ease and rapidity.

January 21st.

Alfred W. Soward.

[19672.]—IN further reference to this matter, I feel sure that the readers of your valuable journal will agree with me that this discussion has been most interesting, and that the evidences adduced by your various learned correspondents decidedly support my contention that the actual miller and preparator of manganese for oxygen *does not* adulterate or sell an adulterated article; that when explosions have happened, they have been, in great part, the result of mechanical defects of apparatus, carelessness, or by procuring the manganese from sources where accidental admixture could and did arise.

Even Mr. Lancaster, in his graphic description and triumphant finish, unwittingly, but clearly, confirms my contention; whilst Mr. Drinkwater and the "F. I. C."—both professional chemists—places the crucial point beyond dispute. For the future, probably Mr. Lancaster will also appreciate the advantage of direct supply from "producer," whose special province and experience has long been and is to produce and supply manganese for oxygen-making of guaranteed purity. I happen to know a case which also throws some light on how inadvertently detrimental admixtures arise. A large house in the drug trade ordered from another firm a parcel of mineral (not manganese). Some months after its receipt, they informed the sellers that one of the casks contained manganese in error. Sellers sought a sample, which, on analysis, proved to be ground coal; and as the senders never ground an ounce of coal in their mills, it was a simple impossibility for it to come from them. If, in this belief, the said drug-house had sold the contents of this cask for manganese, how disastrous would have been the result! Such a mistake is practically impossible where manganese is milled as a speciality.

Geo. G. Blackwell,

Manganese Merchant, 26, Chapel-street, Liverpool.

Jan. 23.

[19673.]—I quite agree with Mr. Drinkwater (19652, page 475), that the cause of most of the explosions in oxygen retorts is more mechanical than chemical. I do not mean thereby that a sample of manganese should ever be heated in an oxygen retort, without being previously tested in an iron ladle, when mixed with a few grains of potassium chlorate. Where there is danger to life, as unfortunately has been the result far too frequently, too great precautions cannot be adopted. I also agree with him, that it is a fallacy to think that manganese is intentionally adulterated with coal-dust. I have a better opinion of our manufacturers than to think they would try to swell their receipts by having recourse to such sordid devices; besides the fact that such a proceeding would lay them open to a charge of manslaughter, if it could be proved against them in any particular instance. That there may be explosions, even when pure manganese is used, seems, at first sight, to render the performance of the experiment with perfect safety from an explosion almost hopeless. Now, I see most of your correspondents agree that the frothing of the mixture of potassium chlorate and

manganese dioxide, is the main cause of what may be called mechanical explosions; therefore, the first thing to guard against is this frothing. For that purpose I recommend finely-powdered glass, or well washed and dried sand, along with the mixture of manganese dioxide and potassium chlorate. Mr. Blackwell seems to undervalue the non-conducting property of these two forms of silica in the hands of amateurs; but what does it matter if ten minutes or a quarter of an hour longer is taken, and if all the oxygen is not evolved, when this has to be weighed against the chance of being sent by express into the next world, or, worse still, of being left a cripple in this. The "slow action" is just what I should recommend to non-chemists. Remember, "slow and sure." If the simple frothing of the mixture were all that took place, there would be little danger, but the froth carries up solid particles with it and lodges them in the tube, unless the tube is at least an inch in internal diameter, and these accumulating in the tube ultimately block it. There will doubtless be also a short interval of time before the pressure of the gas within the retort will amount to the pressure required to burst the retort, and it is just at this critical point that the simple device I described in the previous No. (19650, p. 475) comes into action. There are three ways in which the gas can free itself, either by forcing the plug through, by bursting the retort, or by bursting the thin india-rubber tube, and I don't think a vulcanite tube, even when thick, can long compete with a stout iron oxygen retort in resistance to pressure. I have not, so far, mentioned the oxygen purifier; but I presume everyone who wishes to make oxygen with economy uses a purifier. I have on occasions obtained oxygen from potassium chlorate and manganese, for the exhibition of the lantern, microscopes, and polariscope, two or three days each week for a period of twelve weeks. I always use the oxygen purifier, and I am able to detect, by the bubbling through the liquid in the purifier, the slightest change in the evolution of the gas. If I hear it coming off too fast, I either remove the retort from the source of heat, or moderate the heat. Here is another safeguard, so that it seems wonderful, if experimenters take these precautions, how it is possible for them to meet with accidents. Of course, if I heard the bubbling cease, I should either retreat round the corner, or pull the retort off the fire by means of the vulcanite tubing, 20ft. of which I use between the purifier and gas-bag, and 10ft. between the retort and purifier, so that I am tolerably far off under any circumstances. Unlike Mr. Drinkwater, I prefer a grate for the oxygen retort, a deep grate, if possible, filled with glowing (not blazing) coals. My reason for this is that a deep grate has three sides protected. I put the retort as far back in the grate as possible, and there is only one side open to its "fire"; whereas when a Bunsen burner is used, and the retort bursts, it may be said to "radiate" its destructive influence all round. I never use water to clean out my retort, because, being made of iron, it would induce rust, and I believe, though I have not seen it anywhere mentioned, that several explosions may be traced to holes in the bottom of the retort, caused by the iron being worn through. In this case the oxygen mixture and the carbon of the coal are brought together under such conditions that an explosion is almost inevitable. I use a blunt iron rod, or, when the residue is hard and thick, a rail-hill file. I even remove the residue from glass retorts in the same way when I wish to use the manganese dioxide on a second occasion, and this brings to my mind the fact that, as manganese may be used any reasonable number of times with different portions of potassium chlorate, that an amateur having once used a portion for the generation of oxygen, may rest assured that he is safe from impurity, and that he may, with a calm mind, proceed to make as much more oxygen as his heart desireth. I should say that any reasonable being would be "more than surprised" on reading Mr. Lancaster's letter (19635, page 471) to hear him calmly state that, after a "terrific explosion"—and "terrific" means that which fills one with terror, and "terror" means exceeding great fear—he actually on two succeeding occasions, if not on more—I cannot make out from the letter—succeeded in performing a similar exploit, not profiting by the "first terrific explosion." It is fortunate for Mr. Lancaster, for had he continued to neglect testing the samples in this way, he might have been found (let us hope not in half) four "gardens" away, but in whole in the beautiful "gardens" of Elysium. "E. M." could badly spare him.

A Fellow of the Institute of Chemistry.
Jan. 20.

THE ARMSTRONG LATHE.

[19674].—"O. J. L." is by no means offended at Fred. Carre's strictures, and only hopes his details of Gilray's lathe did not affect other readers "ad nauseam," and still more does he hope that if any readers have in their possession lathes or machines of novel and ingenious construction, they will risk

the "ad nauseam" and give us full details. No purchasers may come to the fore, perhaps, but many will be interested and may possibly adopt parts of such machines or receive hints which may lead to valuable improvements. "I would have every one write what he knows and as much as he knows, &c." Fred. Carre and others will be gratified to find J. A. Armstrong's own letter in this week's "E. M.," with "Orderic Vital's" objections. As a metal-working lathe alone, I have no objection to Armstrong's combination lathe other than applies to all similar tools. Major Armstrong, as R.E. and Special Engineer to the Kashmir Government, is probably well qualified to design a lathe, and any contribution of his to the pages of the ENGLISH MECHANIC deserves attention. But I still think the lathe in question far less suited for wood and ornamental turning than for metal, and I cleave to my opinion that a lathe well suited for the lighter work cannot be made equally suitable for the other. We can use a 5-inch Holtzapffel with traversing mandril, and costly geometric apparatus for light metal-work no doubt, and may add to it shaping machine and such like; but nevertheless, it is not suitable for such additions nor intended for them, and a back-gear lathe intended for metal-turning is not well adapted for ornamental apparatus, nor would an ordinary wood-turner accept it. Moreover, I repeat that a lively and rather light fly-wheel, which can be easily stopped and started is generally preferred for wood and ivory, and a heavy one for metal. But I suppose all do not think alike upon this point. I find from a private letter which gives directions in detail for making the lathe, that a heavy fly-wheel is specially alluded to, and that it should also be fitted to slide upon its axle, upon which it is to be clamped at varying distance from the standards. I will not go quite so far as Fred. Carre has done with the Gilray, and ask, "who would buy such a tool?" but, although each individual apparatus is good and would, I have no doubt, prove perfectly efficient, I doubt if even Fred. Carre would find it altogether a convenient machine for his workshop. As to cost, compared with that of separate machines, I think it would be absolutely greater, there being various technical difficulties in constructing such a lathe. O. J. L.

ORNAMENTAL LATHE-THREADS.

[19675].—In answer to "J. E., M.D." relative to the expression in articles upon lathe-making concerning the taps used, the J and N are simply finer and sharper threads than are used in general engineering. There is no practical reason why a Whitworth thread should not be used, and one of the great features with regard to the latter is, that you can get them any and everywhere. The above J, N, and many others, are looked upon somewhat as private property, and I believe, can only be had from myself or from Messrs. Holtzapffel, who use the same threads as I do in such work. I shall be happy to show them all to "J. E., M.D." or lend him what he wants, if he is making any work from my articles; or reader any other assistance. J. H. Evans.

LATHES AND LATHE-MAKING.

[19676].—THERE is one part of Mr. Evans's article on "The Ornamental Slide-Rest" which seems to me to require a little further elucidation. How is the nut of the main screw held by the "two steel screws," and how is it cut or grooved so as to admit of the screw being covered? Referring to "backlash," Mr. Evans speaks of the nut being cut in two "the other way," and drawn together "endways." I cannot clearly understand how this is managed, if the nut is securely fastened to the top carriage by the steel screws before mentioned.

I observe, in the current issue of the ENGLISH MECHANIC, Dr. Edmunds asks for some particulars respecting Mr. Evans's screws. As referring to a somewhat similar matter, may I respectfully call Mr. Evans's attention to a suggestion I made in letter 19519, page 351?

In the last volume mention was made of a lathe in which the saddle of the rest was fitted in front instead of on the top of the bed. As no particulars of it have yet appeared, may I ask "O. J. L." to give a sketch showing the best arrangement of the V-faces of the bed and saddle, and also the general plan of the rest? Orderic Vital.

GLUCOSE ANALYSIS—TURPENTINE—RESIN—SODA ASH—SHALE—TEST FOR ARSENIC IN COPPER—SALICYLIC ACID.

[19677].—I MUST apologise to "Brewers' Chemist" for leaving his query addressed "To Mr. A. H. Allen" (p. 337, No. 45486), so long unanswered. 20 grammes of the sample having been dissolved in water, and the solution diluted to 150cc. (instead of 100cc. as recommended by me), have been found to have a density of 1.0437.

Then $43.7 / 3.85 = 11.35$; the weight of solids in 100cc. This will be $11.35 \times 150 / 100 = 17.02$ in 150cc., and hence the sample contains 85.10 of solids, and 14.90 per cent. of water.

The observation of the solution density and optical rotation do not alone give sufficient data for calculating the percentages of maltose, dextrose, and dextrin in the sample. It is necessary to ascertain the cupric oxide reducing power in addition, and the ash ought not to be ignored.

As the solution of the sample showed an optical rotation of $+13^\circ$, and a 20 per cent. cane-sugar solution, at 63°F . gives $+40$, the specific rotatory power of the sample is evidently $13 / 40$ of that of cane-sugar. Assuming that the querist employed his Mitscherlich's instrument with sodium light, the specific rotation of the sample was $13 / 40$ of $66.5 = +21.61^\circ$. With a Mitscherlich's polarimeter, and no record of the ash, it is useless to make any correction for the temperature; but the proper way is to make the observation at $+59^\circ\text{F}$. When the querist has determined the cupric-oxide reducing power, the data I have given him will, I think, enable him to ascertain the percentages of maltose, dextrose, and dextrin.

"Turpentine" (query 45512, page 338) is difficult to detect, much more so accurately determine, in essential oils. The most hopeful plan is based on the limited solubility of turpentine in alcohol. As the details of procedure vary with each oil, and even with the age of the oil, it is impossible to describe them here. "Perfumer" will find the information in a series of articles by Dragendorff in the *Pharmaceutical Journal* [3] VI., pages 541, 581, 641, 681, and 731.

"Resin" (query 45513, page 338) may be dissolved in alcohol or wood-naphtha. Surely "Jos" does not regard these as being of a "greasy nature," and many would think that description inapplicable to benzoline.

"Soda Ash" (query 45835, page 483) may be assayed for the contained percentage of soda by titrating it with standard acid in the manner to be found in any book on quantitative analysis, and repeatedly described in these pages.

The query headed "Shale" (No. 45731, page 435) I am unable to answer satisfactorily. Not being either a practical shale distiller or gas-engineer, I am not competent to "give particulars of the most suitable and inexpensive plant for distilling five tons of the shale daily."

I am afraid the reply of "F. I. C.," on page 456, to "Arsenicum's" query headed "Test for Arsenic in Copper" (No. 45678, page 434) will scarcely give the required information. When a sample of refined copper contains 99.5 per cent. of copper, and perhaps 0.05 per cent. of arsenic, it is scarcely a practical plan to determine the copper as a way of getting at the arsenic, though "F. I. C." is doubtless in the right in saying it is "the easier of the two operations." Besides, if the querist employs but "two or three grammes" of refined copper, as recommended by "F. I. C.," he will find it hard work to detect the arsenic, to say nothing of determining it. "Arsenicum" will find the following a good method of determining arsenic in refined copper:—From 15 to 20 grammes weight of the sample is dissolved in nitric acid, and the solution diluted and mixed with a solution of nitrate of lead containing about 2 grammes of the metal. Excess of ammonia and some carbonate of ammonium are next added to the mixed liquid, when a precipitate is produced consisting of hydrate and carbonate of lead, arseniate and antimoniate of lead, and hydrate of bismuth, practically the whole of the copper remaining in solution. The precipitate is filtered off, well washed with ammoniacal water, and then treated with a strong solution of oxalic acid. Oxalates are thus produced, those of lead and bismuth remaining insoluble, while the arsenic and antimony pass into the solution. The filtered liquid is diluted to about 300cc., treated with a moderate excess of ammonia, and thoroughly saturated with sulphuretted hydrogen. It is filtered from a small quantity of sulphide of copper, and treated with a slight excess of hydrochloric acid. Any large proportion of arsenic or antimony will occasion an immediate precipitate, but if only a few milligrammes be present the precipitation will be complete on keeping the liquid at about 70°C . for a few hours. The precipitate may be dissolved in a solution of bromine in hydrochloric acid, and the arsenic precipitated as ammonio-magnesium arseniate in presence of tartaric acid, any antimony being precipitated from the filtrate as sulphide.

With a few modifications, which will suggest themselves to "Arsenicum," the foregoing method is applicable to copper precipitate, and it is equally suitable for the determination of arsenic in nickel and its alloys.

In query 45399, page 266, "Housekeeper" called my attention to the fact that the French Government are reported to have prohibited the employment of "salicylic acid" for the preservation of food; and the querist asks me to reconcile this with my previous statement (page 287), that I was

not aware that salicylic acid had an injurious effect in the small proportion in which it is necessary to employ it. I can merely repeat this statement; but may add, that I presume the French regulation is based on reasonable, good evidence, and hence, I am perfectly open to conviction in the matter.

Sheffield, Jan. 21.

Alfred H. Allen.

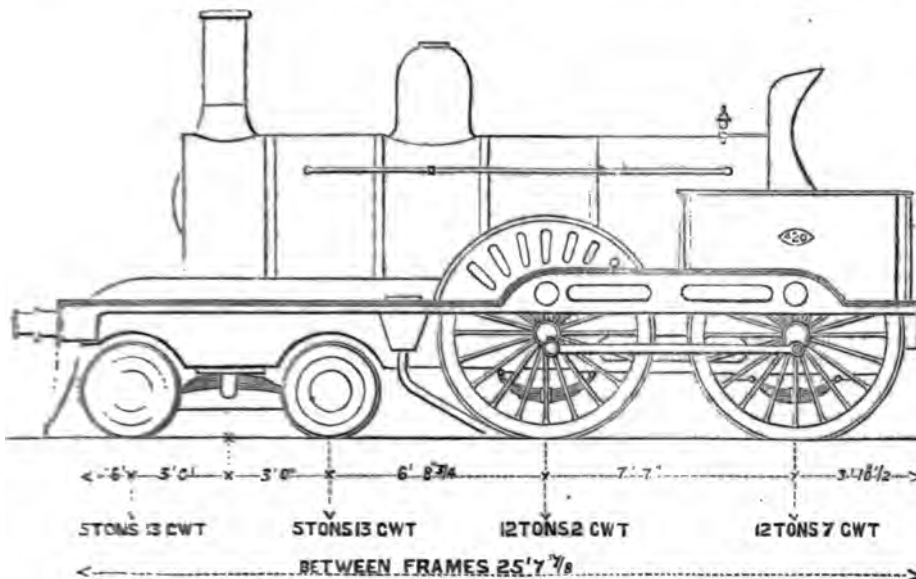
NORTH BRITISH ENGINES.

[19678.]—I enclose a sketch of a bogie express engine of a class which was built, about 1873, by Mr. Wheatley, late locomotive superintendent. One of this class (224) drew the ill-fated train which was precipitated into the Tay by the fall of the bridge. This engine is still running; and I may also mention that the N. B. E. engine No. 178 (which most of our readers will remember as the one in the Marshall Meadows accident) has been out again for several months running express trains between Newcastle and Edinburgh. But to return to the N. B. engines. The sketch may also serve to illustrate the difference between the two

The writer gives details and diagrams of the brake apparatus, and also the results of the experiments which were conducted upon that railway; but I will not here refer to this information, as it has already appeared in the columns of the *ENGLISH MECHANIC*.

M. Morandière has now had the Westinghouse Brake in actual service for several years, and it becomes interesting to know the facts which have been obtained from its daily working.

It should be mentioned that upon this railway the intercommunication system in addition to, and in conjunction with, the brake apparatus is in most successful operation. By pulling a cord or handle placed in each compartment, alarm whistles are sounded upon the engine and in each van, by the use of compressed air, and at the same time a whistle on the top of the vehicles indicates from whence the alarm was given; therefore, by means of the automatic brake an excellent communication is provided between passengers and servants, as decreed by the Act of 15th November, 1846, and by the Ministerial Circular of 13th September, 1880.



classes of 6ft. 6in. coupled bogie engines—one of the more recent class being illustrated on p. 627, Vol. XXIX. The engines used in the brake trials on this railway, in 1876, were of this class, one for the vacuum, the other for the Westinghouse automatic experimental train. The trains consisted each of about 10 vehicles, or, including engine, about 170 tons. These engines, whose tractive force is 33, failed to exceed a speed of 56 miles per hour; and even that was on a falling gradient, 1 in 960. These engines are much used for running express and slow trains in turn between Glasgow and Edinburgh, and vice-versa. Nos. 420, 421, 422, 423, 224, 264 are of this class; 264 differs in having dome on firebox end of boiler. Nos. 418, 419, 425, 426, 427, &c., have 6ft. wheels and cylinders, 16in. by 24in., and no bogie. Nos. 154 and 151 have no domes and Salter's valves over firebox; their splachers are same as bogie class. Nos. 349—356 are E. and G. Ry. engines, double frames, side rods carried on outside cranks. No domes, cylinders 16in. by 24in., wheels either 6ft. or 6ft. 6in. Nos. 382 to 393 have 6ft. wheels and no domes. These and 474, 475, and 476—477, &c., classes which have been already described, are the principal classes which run the express service between the two principal cities of the North. The trains are on an average much heavier, and the speed as a rule steadier than on the Caledonian, but the comparison is hardly fair, seeing that the E. and G. line is practically level, while the Caledonian route is very steep. The 421 class I gave the leading dimensions of on page 163, and will only add that distance from rail to top of chimney is 13ft.; rail to boiler centre is 7ft. 0ftin. and length over buffers 44ft. 10in. Carstairs.

THE CONTINUOUS-BRAKE QUESTION IN FRANCE—PAPER BY M. JULES MORANDIERE.

[19679.]—At a time when the subject of railway brakes is receiving so much attention in this country, it is most useful and instructive to have the results obtained and opinions expressed by foreign engineers placed before us for consideration. M. Jules Morandière read a very interesting paper before the *North des Ingénieurs Civils*, a Paris, giving the results obtained from the use of the Westinghouse Automatic Brake on the Western Railway of France.

Several cases, the report tells us, have occurred in which necessary and satisfactory use has been made of this communication.

In an appendix a list is given of accidents which are known to have been avoided by the use of the automatic brake upon the Western Railway, and includes—one collision, five persons walking on or crossing the line not at stations. Five persons crossing the line in stations. One case of an obstacle unexpectedly found on the line. Two cases of vehicles standing, or being shunted and not removed from the main line in time.

The great advantage of an efficient brake is clearly shown from the fact that, in several instances, the trains were pulled up within a very few metres of the obstruction or person.

The report also furnishes evidence that the brake works efficiently, and is also cheap to maintain.

In conclusion, I will briefly call the attention of your readers to the very great progress which the French railway companies are making in the adoption of efficient brakes, especially since the Minister of Public Works issued the celebrated circular of 13th September, 1880.

Many systems of continuous brakes have been tried and tested in France, and their engineers have had the great advantage of inspecting those in use in other countries, especially England, Belgium, and America; and from the following extract from the latest official list, your readers will see that the Westinghouse Automatic Brake has been almost unanimously adopted for the French railways:—

Statement showing the amount of rolling stock fitted with the Westinghouse brake, including that portion in course of being fitted:—

FRENCH RAILWAYS.		Engines. Carriages.	
Western Railway	552	3,960	
Ceinture Railway (Paris)	—	108	
Eastern Railway (Paris)	80	490	
Paris, Lyons, and Mediterranean	441	1,447	
Orleans	280	880	
Midi	45	290	
State Railways	12	108	
Rhone	6	—	
Total	1,416	7,193	

The Ceinture Railway Company does not possess

any engines, and the locomotive power by the Western Company.

The fact that in a very short time 1 and 7,193 vehicles will be in daily use brakes which fulfil the conditions laid down by the Minister of Public Works, is most

Clement E. Saxe Coburg-street, Leicester, Jan. 2.

THE DESFORD ACCIDENT: ASSIZES, CASTLE.—Jan. 24th, 5.30 p.m.—Signal has just been ACQUITTED. C. E.

REPLIES TO QUERIES.

*** In their answers, Correspondents respectfully requested to mention, in each the title and number of the query asked.

[44632.]—Propane (U. Q.)—Also called hydride and methyl-ethyl (C₃H₈, or CH₃CH₂CH₃). This compound occurs amongst the gases from the petroleum springs in Pennsylvania; also dissolved in the crude petroleum, prepared from propyl or isopropyl iodide by action of hydriodic acid, or of zinc chloric acid. C₃H₇I + HI = C₃H₈ + I₂ is a gas which, at a low temperature, condensed to a colourless liquid. Alcohol about six times its volume of the gas. of chlorine on propane gives rise to the mono-chlorinated substitution compounds (a) chloro-propane or propyl chloride (CH₃CH₂CH₂Cl), and (b) chloro-propane, or chloride (CH₃CHClCH₃), besides the chlorinated products.—F. BARKER CO.

[45049.]—Carmin Paste (U. Q.)—In reply to "F. H.'s" query, I overlooked the fact—viz., how to dissolve the carmine not dissolve in water except with great but when a few drops of NH₄ are added at once a splendid red solution, with crimson tint. Carmine can be prepared by, and is then soluble in water. The insects are boiled in ether to separate the dye. They are then boiled in alcohol until saturated with colour, and from the solution the carmine is deposited on cotton wool which is soluble in water, forming a rich red which is heightened by acids, and changed to deep crimson by alkalis.—F. BARKER CO.

[45338.]—Preservation of Iron.—I have an oxide-iron ore, half silica, half iron, which, years ago, was tried with success, as paint on iron ships and buildings in Australia. It was said to be to iron as to be cleaned off with great Should a correspondent desire to experiment and will advertise his address, I will sample.—COLONIST.

[45338.]—Preservative for Iron.—Some years ago, the officer command the *Teaser*, iron screw vessel, informed me that the bottom of that vessel was always attributed to the galvanic action set the bottom of the vessel and the copper pintles. He was stationed on the coast. The writer of this was in H.M. brig the *Sheep* had Muntz metal, which proved as we had oysters as large as natives, 2in. long, in clusters. The Kroomen were employed diving and scraping the bottom of the vessel; very often, to their discomfort, attended very closely to them. Two of Congo would relieve us of our shell-fish. The secret appears to lie in some way will set up a current of electricity with ment to the iron.—JAMES D. CRYSTAL, C.

[45458.]—Pumps.—I have got an a lent me to get air into my air-vessel. it fixed, and can get plenty of air it does not stop the noise. I am going valves less lift. I hope "Sunlight," or "L. O. V." will oblige by telling me to give the size of valves I gave on JAN. 1900.

[45502.]—Geneva Watch.—Bern not explicit in his question. If the bar supported at back by a bar, then a flat square hole opened on to winding-up that is needed; but if a suspended bar nothing for it but an entire new arbor, quires some experience to turn in proper however, endeavour to explain the arbor. The arbor can be obtained at any Clarke shop, rough-turned and with teeth cut place, turn down the part to be the square ratchet to proper thickness, then the pivot; next, pivot to fit in top part of the part to be tapped will screw by the bond should be hardened and let down colour. Then put in the vice, holding sliding-tongs. When tapped, turn show to be just above boss of barrel. The bond; turn pivot for other part of these pivots must fit tightly; then hold it

tongs at extreme end, file up the winding-screw on filing-block, first putting a washer of tin-plate or roll over ratchet to guard it from a. If you intend to have a stopwork on the end must be squared to receive it, and drilled. screw on bond, harden the whole in oil, or to pale blue, or what is better, flare off in oil all the parts, and out off to length. Open to fit exactly.—PEGANREDSTUFF.

105.]—Watch Jewels.—"TRYING TO R."—A jewel-hole contains a hole that the comes through. The cover is a flat stone, on the top of that, so that the pivot abuts on the ends. An endstone means the same thing. A slip is an endstone set in a dovetail, slides into a recess cut to receive it. This ally is used in the potence or lower-balance hole, which is also called the foot-hole.—PEGANREDSTUFF.

506.]—American Clocks.—"TRYING TO R."—Single or double o.g. means a single or moulding on case.—PEGANREDSTUFF.

548.]—Useful Drilling Apparatus.—is some error in this query, as there is no g apparatus to be seen on the page mentioned.—T. P.

150.]—Slow-Combustion Stove.—It is able to answer the question unless some more definite is supplied. Cannot "In-" give some idea of the construction and rangement of the parts?—NUN. DOX.

66.]—Warped Wood.—"Wess" might obtained a better reply if he had stated of wood the lid of the box is made, and how it trusted as regards grain and edges. Very warped wood can be straightened by heating it of a fire, with the convex side to the heat. ing and pressing would correct the fault, ight do more injury.—NUN. DOX.

67.]—Musical Box.—I have read this several times over, and send the following, if nothing better reaches the editor. I do uite understand the action, in which the e is said to stick to the cement filling of the s, but the cause is tolerably obvious—it is the heat of the climate. The remedy is to harder cement, probably sulphur would do, a last resort, plaster of Paris, as a filling.—DOX.

180.]—Sea-Wall.—My sincere thanks are o "Jack of All Trades" for his elaborate n. I have studied it carefully, and beg to the following remarks. Old, but sound s were pointed and driven by hand-power s they would go; but they seem to meet r stones, and a heavy tide shakes them out; afraid they cannot be driven far enough. all whose foundation is to be protected is 15ft. high and 30ft. long. When the sea is h, the lowest tide just reaches the foot of the a height of 1ft.; the highest tide is 7ft. The of a rough sea strike in a line parallel with all. At what distance from the foot of the ould the new structure begin? I mean it at an angle of 45deg., as I find that the loses its power greatly when it has to run incline. Could not the whole work be done r with stones of, say, one quarter to one n weight, set in cement? I must also add oney is a great consideration; the wall is ing private property.—INGLX.

92.]—Automatic Musical Instruments. l "W. H. H., Brixton" (page 431) answer llowing queries:—1. Are the cards put in by and or by the machine? 2. Are they strung er with strings like the cards in weaving s work? 3. What length of cards will be ed for a tune such as "The Old Hundredth," a glee with a hundred bars of common time, a dance-tune be played as fast as a fiddler y it on a fiddle. 5. Is there no danger of ds going in faster at the one side than the and so spoiling the harmony? 6. Can any y MECHANIC, who understands music, cut ds? I have been working at machines for g pianos for nearly twenty years, mostly on xrel principle, and I think "Brixton" is too far when he asserts that time can be more correctly by the pianists than by a with blocks.—ENQUIRER.

27.]—Winter's Ring.—TO MR. LANCASTER. he centre of prime conductor and on the top older a brass tube 1in. diameter and 2in. then get a piece of mahogany 5in. long (a) round, and slightly taper. The bottom of ould fit into the tube on the top of the prime stor; the top of it goes into ball (b), into the two ends of the ring (c) are glued. The t the bottom of a should be continued all c to within one inch of the other end of the The ball (b) is to be turned out of mahogany, is ring (c) should be made up in sections, t course in two halves, so that the wire can in the middle of the two parts. In glueing t one piece on one side be glued over two

pieces on the other side, and so on until ring is finished.—W. J. LANCASTER.

[45647.]—Circular Cistern.—Thanks to "Bricks" for his notice of my query. The rolled iron joists will be 6ft. apart, and the centre of the cistern will be 9ft. from one wall and 12ft. from the other. The metal pillars and the girder, as before stated, will be equidistant from each wall.—H. G.

[45663.]—Music.—Allow me a small space to thank your correspondents, especially G. L. Pearce, who has set me to work again with fresh vigour upon Banister, where, unassisted, I have made in-different progress. I can answer unhesitatingly that I am not deficient in musical ideas; but let me put my difficulty in another way. A familiar hymn-tune, in which I should detect a slight change of harmony, I can scarcely reproduce without book, except mechanically. Will Banister help me to this?—J. M. B.

[45678.]—Test for Arsenic in Copper.—I am greatly obliged to "F. I. C." for his detailed reply to the above. I am afraid, however, my query has not been sufficiently clear. What I want to get at is a quick, and, at the same time, accurate method of determining the percentage of arsenic in metallic copper, and also if the same method can be applied to determine the percentage of arsenic in copper precipitate. It is only the quantity of arsenic present in each case that is wanted.—ARSENICUM.

[45689.]—Names and Proportions of Rivet Heads.—A full-page illustrated list of rivet-heads, and their proportions, is given on page 36 Calvert's "Mechanic's Almanack" for this year, as advertised in ENGLISH MECHANIC. The price is nominal, and would well repay your correspondent who requires this information.—J. JOHNSON.

[45712.]—Continuous Brakes.—Could not "E. P." give further particulars of the steam-brake he illustrates? The Smith Vacuum is the only continuous brake I know of on the G. N. R. The appliances somewhat resemble those sketched by "E. P."; but, of course the working is entirely different, the "main" pipe never at any period of the manipulation containing steam, and the "large pipe" on the smoke-box being the ejector.—VIAJANTE.

[45713.]—Trigonometry.—The formula referred to last week gives correct results only when the connecting-rod is of great length; but, for ordinary lengths, a trifling modification of the formula should be made. Thus (see diagram, page 478), produce the horizontal line OA, to some point near the left-hand side of the page, and call this point P, join PH; this line PH may be taken to represent the connecting-rod in its position when the steam is being shut off. In the formula, AF is taken as being the travel of the piston from the end of the cylinder, but this is not strictly correct; for, if we suppose the connecting-rod to be unshipped at H, and allowed to fall into a horizontal position, the end H will meet the horizontal line at some point, say Q, a little to the right of F. Now it is evident that AQ, and not AF, will represent the travel of the piston; hence we must add the small quantity FQ to the value of AF already found. If we call the length of the connecting rod C, and the angle that it makes with the horizontal A, the small quantity FQ will be represented by C (1 - cos. A); the angle A will seldom be more than 5° or 6°, and as the cosines of small angles vary but slightly, it will hardly be worth while calculating accurately the angle A; but it can be found near enough by drawing a diagram to scale. Suppose, then, that our connecting-rod is 15ft., or 180in., the other diagram measuring the same as before: I find that the angle A is 6° 45'; the cosine of this is .993. Subtract this from 1, and multiply by 180, and we get FQ = 1.26, say, 1½in.; this, added to the value of AF, or 35.4, gives 36.66in. as the correct travel of the piston.—M. I. C. E.

[45725.]—L. C. and D. B. Tank-Engines.—"Centaur," "Dorothy," and "Meteor" have each supplied particulars of two classes of tank-engines on the above line, and each contain some slight discrepancy, which they will not object to my pointing out perhaps. "Dorothy" mentions the cylinders of Iona, No. 81, as 16½in. by 26in. Unless this engine has recently been rebuilt (in which case the name and date would have disappeared) the cylinders are 16in. by 22in. "Meteor" puts the diameter of the leading and driving-wheels (coupled) of this class of engine at 5ft. 3in.—should be 5ft. 6in. These are possibly mere clerical errors. "Centaur" does not agree with "Dorothy" as to the heating-surface of Kirtley's tank engines. More detailed information concerning this class, together with further particulars of the dimensions, &c., of the Scotchmen, from which "Centaur" appears to have culled his information, will be found in Vols. XXVIII. and XXX. of the "E.M." All that has been said regarding these two types will be found set forth in a more complete and clearer manner in the last few back

volumes of this journal. Therefore, I recommend your correspondent to look through the indices of these volumes. He will, in addition, find much information that will interest him regarding this company's locomotives. By doing so, he may possibly be saved the trouble of asking for particulars of engines which have already been given. I may mention, as a little piece of information that may interest him, that No. 69 of the Scotchmen class, formerly named Kelvin, has undergone at Longhedge Works, in 1880, some alterations. It has been fitted with a new boiler, with flush firebox. The steam dome is now placed on the middle of the boiler, while the modern Ramsbottom safety-valve has replaced the other valve seen in the other engines. The cylinders have been enlarged in diameter, and they are now 17in. by 22in. "Centaur," "Dorothy," or "Meteor" would, no doubt, oblige many a reader if they would throw some light upon other classes of tank-engines on this line. The following, the dimensions of which have not yet appeared in the "E.M.," would be a fair field open to them should they be in a position to work it. Thanet, No. 96, No. 60 (rebuilt), No. 145 (rebuilt), and Vulcan, No. 73.—G. L. P.

[45725.]—L. C. and D. Engines.—The only class of L. C. and D. tank engines, of which I possess details, are the large trailing bogie engines which run between Snow-hill, Ludgate, Denmark-hill, and the Crystal Palace. I forget their numbers—somewhere about 106 to 112, and also 162 or so—but I cannot be certain. Some of them are built by Neilson. Once, at Victoria, I saw one named the "Comus," different from 106 class. Can any one give any information about this class? It did not look so old as the "Scotchman" class, but might possibly be a rebuilt. In passing from the underground to the high-level line, there is an incline of 1 in 38; so it will be seen that engines to work such a line must be very powerful indeed; these engines are the 106 class, and possess a tractive power 126.3. A few dimensions are:—Boiler: Length of barrel, 10ft. 11in.; diam. inside, 4ft. 3in. Tubes: Number, 202; diameter inside, 1½in.; diameter for 3in. at smoke-box end, 1½in.; total heating-surface, 1,148 sq. ft.; cylinders, diam., 17½in.; stroke, 2ft. 2in.; inclined 1 in 10½; steam ports, 14in. by 1½in.; exhaust ports, 14in. by 3½in.; wheels: bogie wheels, 3ft.; leading and driving wheels, 5ft. 3in.; firebox (inside) width, 3ft. 6in.; depth, 5ft. 6½in.; weight about 50 tons. Never was I more forcibly convinced what a great advantage continuous brakes really are, than when travelling behind one of these engines between Denmark-hill and Peckham Rye. Just as we were leaving the former station a London & Brighton train, drawn by one of Mr. Stroudley's "Terriers" also started. As might be expected, the Chatham engine soon left her little opponent behind, but while she was slowing down to stop at Peckham Rye, the small Brighton engine rushed past, and drew up at the platform, before the larger one had reached the platform. The "Terrier" had its train fitted with the Westinghouse automatic, the L. C. engine had only hand-brakes. Here the Westinghouse figures as a saviour of time. This is a daily occurrence on the suburban lines of the Metropolis, where the lines of different companies run side by side. I am only surprised that no correspondent has (so far as I am aware) called the attention of "ours" to this proof of the superiority of the Westinghouse over ordinary hand-brakes.—CARSTAIRS.

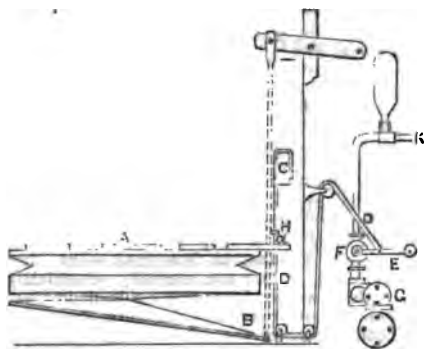
[45735.]—Water in Gas-Pipes.—Take up a board or two in the floor of the room, until you are able to trace the spot where occurs the lowest dip in the pipe, because, at that very spot the water will be lodged. Bore a small hole in said pipe and let the water run out; then insert a very tight-fitting cork or peg into the hole, and lay the floor-boards into place. At future times, if the gas begins to jump, the remedy will be all ready to hand. In the room over my head at this moment such a pegged hole is in the gas-pipe.—H. O'B.

[45738.]—Thermometer.—The very best thing you can do is to spend a shilling on a new thermometer, and give the old one to a poor relation. You would waste time that ought to be worth something in endeavouring to make the scale readable, and the probability is you would make a mess of it in the end. I was really enjoying the answers of "F. I. C." and "E. A. B." in last week's issue, but my enjoyment was cut short by the thought that the "Tenant Farmer" would have followed their instructions and have burst the bulb of his thermometer tube. Whoever heard of boxwood thermometers used for boiling purposes? It seems a great pity to me that really earnest correspondents should commit blunders so palpable and so annoying to the querist. Here we have a querist whose thermometer, in all human probability, runs from 0° to 120° Fahrenheit, and two correspondents tell him to put the tube in boiling-water! Just fancy the poor fellow putting a mark with a file at the point to which the mercury rises! If "Tenant Farmer" has not spoiled his thermometer by bursting it, he has saved himself a sad disappointment, even if the

thermometer was only a common one, and the only advice I can give him is, as I said above, buy a new shilling one and give the old one away.—W. J. LANCASTER.

[45739].—**Cattle Barking Trees.**—Paint the trees with coal-gas tar. Effectual and wholesome all round.—H. O'B.

[45742].—**Hydraulic Organ-Blower.**—Thanks to "Sunlight." I send sketch of my arrange-



ment for cutting off feed when bellows is full. A, air-chamber or bellows; a, piece of lath screwed to top of bellows, with hole in same, through which cord D runs, to regulator-valve F, on engine G. H is a knot on the cord, which does not pass through hole in a, and should cut off all water when bellows is full, but does not, and the water keeps hissing very loudly and unpleasantly through only a very small space. The valve F is only a plain gland cock. I have added an air-vessel on the supply-pipe K, and it has taken away the thumping noise. I have heard that this hissing, as the water is being cut off, is common to most organ-blowers where there is high pressure. I have between 70 and 80 lb. per sq. in., and fear I shall have trouble to avoid it, if I can do so at all.—AMATEUR ORGAN-GRINDER.

[45747].—**Platinum Amalgam.**—Don't use anything but pure platinum. You want thick wire, with one end turned down to allow of a shoulder, and then the smaller part riveted over. For large coils have wire about $\frac{1}{16}$ in. diameter, and have $\frac{1}{16}$ of it outside the contact-breaker towards screw. A little extra platinum well repays its cost by its duration. The thin pieces just riveted over soon wear out, and help to spoil a good coil. Whatever you do, do it well, and you will then get a good result.—W. J. LANCASTER.

[45749].—**Gases.**—Air containing two constituents, viz., oxygen and nitrogen, in the proportions of, by volume, 21 per cent. of the former and 79 per cent. of the latter, is respired by men and horses. A portion of the oxygen contained in the air combines with carbon in the lungs, being exhaled as carbonic acid gas in equal volumes, and a quantity nearly four times as great is liberated as free nitrogen. In round numbers, a man inhales 1-5 of a cubic foot per minute of air; 7 per cent. of this is converted into CO_2 , which, with 4 times as much N, he expires, together with 65 per cent. of the air he has inhaled in its normal condition. The explosion of gunpowder generates carbonic acid and oxide, nitrogen and steam, and small quantities of CN, and NH_3 . About 720 cubic feet of air would be required to remove the gases generated by one pound of gunpowder.—T. E. J.

[45749].—**Gases.**—To briefly answer your question on general facts, the action is this:—First, however, let me tell you that the body of both men and animals contains carbon in one form, and in a state of fine division. So, also, does a candle, a lump of coal, or other combustible bodies. The air around us as it is drawn in by the act of respiration passes through the mouth and nose, and down the throat. From there it passes into the lungs—these being really a mass of small tubes, with blood on the outside of them; and the walls of these tubes being extremely thin, the moment the air passes in, the oxygen of the air passes through the walls of these minute tubes, and combines with the carbon in the blood. The combination of oxygen and carbon will now produce carbonic acid; therefore, the blood absorbs the oxygen, and is replaced by carbonic acid gas, which is respired. So that we may briefly state matters—(1) that both men and animals first take the oxygen into the lungs in the form of the ordinary air; (2) that once there the oxygen is absorbed by oxidating the blood; (3) that the oxygen so absorbed is utilised in the production of heat by acting on the waste particles of carbon of the body, thereby forming carbonic acid, which is thrown out by respiration.—SUNLIGHT.

[45751].—**Zinc Battery Plates.**—Zinc differs very much. You may, now and then, get plates that will retain a very nice surface, and other samples will, in a day or two, discolour. This is owing to impurities in the zinc. The best way to keep plates is to amalgamate them, wash them, and well rub them with a piece of rag; then dip them in hot water, and, when dry, put them into a box containing dry sawdust. You can take them out any time quite clean.—W. J. LANCASTER.

[45752].—**Softening Hard Iron.**—You may soften iron by heating it red-hot, and keeping it red-hot for some time; then put it in an iron case full of burnt sawdust, close the case, and allow to cool slowly. Then, if you want the iron thoroughly soft, repeat the process. You can soften iron sufficiently for all ordinary work by putting it in the fire at night, and leaving it there all night; in the morning it will be sufficiently soft for an electro-magnet.—W. J. LANCASTER.

[45753].—**Taking out Piston.**—Thanks to "Labor Omnia Vincit." The engine in question is horizontal. We want to take out, clean, and then put the piston in again. We have the clip band—how do we use it?—QUESTER.

[45761].—**Medical Coil.**—To Mr. LANCASTER.—You can make the coil 4 in. long, the reels $\frac{1}{4}$ in. diameter, the core out of 22 iron wire, say $\frac{1}{16}$ in. diameter when tied together, the primary No. 18 silk-covered, the number of layers 4 to 6, each layer insulated from next one. The second wire should be No. 30 silk-covered, then a third wire No. 32, fourth 34, fifth 36, sixth 38, about 102 of each continued throughout, but with terminals to each wire-end. You can in this manner have a series of as many terminals as you like. The draw-tube should be opposite to the contact-breaker. Shall be pleased to give you any further information.—W. J. LANCASTER.

[45767].—**Comparative Light of the Moon and Planets.**—(1) and (3), I am much obliged for the information furnished by "F. I. C." (2). It is surely a mistake to say that we receive no more light from a planet enlarged to the apparent size of the moon, than from the same planet seen with the naked eye. The office of the telescope is to collect and concentrate light of which the unaided eye would receive but a small fraction, just as heat is concentrated and focussed in a burning glass. Is not "F. I. C." (if I may say so), confusing, for the moment, light with brightness—the quantum of light yielded with the sensation of brightness produced? which are very different things, and governed by different laws. Brightness is often intensified by distance; light always increases by the inverse square of the distance, and it is the same thing whether the distance is diminished by motion in space or by the telescope, provided, in the latter case, that proper allowance is made for absorption in the lenses.—S. H.

[45768].—**L. and N.W. Engines.**—1. Atlas, 2150; Councillor, 981; Elwy, 1167; Wyre, 1166. 2. Baltic, Nov. '74; Caractacus and Commodore, Oct. or Nov., 1880; Centaur, May, '79; Dalton, May, '66; Hercules, May, '77; Hecla, '61; Kestrel, May, '79; Medea, May, '79; Moberly, May, '61; Mastodon, May, '79; Talisman, Feb., '65; Tubal, Aug., '61; Cambrian and Sulphur were both built in '79, but I cannot say what month; Pegasus, Nov., '80. 3. Atlas (10), Auric (8). I think Burmah is scrapped, Caractacus (15), Commodore (15), Canning (16), Herald (12), Latona (8), Mammoth (8), Marlborough (10), Petrol (12), Pegasus, 1810, have been scrapped a long time. Pegasus, 482 (8), Sir Alexander Cockburn (8), Mastodon (12). The small figures in brackets are the shed numbers: 8 is Rugby, 10 Birmingham, 12 Derby, and 15 Crewe.—FOLTON.

[45771].—**Air-Pump.**—I have had bucket out, and I find it has got three steel, I think, rings. I gave them a little more spring. I can get 20 in. vacuum very unsteady. I will have new rings at Easter. What should I get them made of—steel, iron, or brass? The pump-barrel is in good condition.—M. C.

[45772].—**G. E. Engine.**—No. 251 is a 7 ft. 6 in. single engine; weight, 43 tons. Designed by Mr. M. Bromley; stationed at Stratford.—DOROTHY.

[45775].—**Glueing Steel to Wood.**—Buy a little of Warman's solution, price twopenny; you can obtain it at any leather-cutters. Now rough the piece of steel and wood the sides you wish to join with a small file. Then cover the places with the solution, and let them dry. When dry, the solution will turn a white, creamy colour. Be sure you let them dry, for, if you do not, they will not adhere together. When quite dry, warm them, i.e., the sides you have covered with the solution, before the gas, and, if that is not practicable, light a candle and hold the flame to the parts to be joined; but do not burn them. Now press them together, and let them cool. Try this, and I think

it will suit; if not, inquire again. Be sure and follow the instructions, and I have no doubt you will be satisfied.—YANKEE.

[45776].—**Screw-Cutting.**—With this contrivance you can cut inside threads as well as outside—in fact, by using it you convert your lathe into a simple self-acting one. Of course, for inside threads you will want a tool of a different shape from that used for outside threads; and it will also have to be set differently in the tool-holder. If "S. M." requires any further particulars, and will advertise his address, I shall be happy to help him in any way I can.—R. HENDLEY.

[45777].—**Paraffin Lamp Reservoirs.**—You should have the ring into which the lamp screws cemented with plaster of Paris and alum. The ordinary plaster of Paris is porous, and allows the oil to permeate it and run outside. With microscope-lamps I found it a nuisance. You could put a layer of shellac varnish round the part where leakage arises.—W. J. LANCASTER.

[45778].—**Cold Chisel.**—I think if "J. S. G." would heat his chisel in the usual way, about $\frac{1}{2}$ in. to $\frac{1}{4}$ in. from point, and dip it in water with the chill just off, about $\frac{1}{2}$ in. or $\frac{3}{4}$ in. up, then rub it on a piece of dry stone and watch it gradually colouring till it assumes a light purple shade on the cutting edge, it should stand after immersing in the water at that colour; if not, do not bring it down so low, but dip it at a dark straw-colour. The colour from light straw to dark blue gives the temper: the lighter the colour the harder the temper; but much depends on the steel, some being very much harder than others. These should be first put in the water at only a blood-red, while mild steel requires a greater heat; but with your chisel be careful not to overheat.—LORDE.

[45780].—**Engine for Launch.**—I do not think any amount of boiler proportion would enable you to propel your launch with such an engine.—LORDE.

[45783].—**Faint Photograph.**—You can copy the photograph easily with a camera and lens, and produce good prints with care; or you can send the photo to a photographer, and get him to copy it for you. You cannot do anything to the photo. to make it bolder.—W. J. LANCASTER.

[45785].—**Sp. Gr. of Glycerine in Jordan's Barometer.**—1-26. I should say at Messrs. Negretti and Zambra's, Holborn Viaduct, who manufacture these instruments.—F. I. C.

[45791].—**Galvanic Action on Screw-Propellers.**—The iron and copper would form a voltaic couple, and would, in time, considerably affect each other. It seems rather strange that so much action should take place. One would expect a cast-iron propeller to last considerably longer than a few months, even attached to a copper-bottomed launch. Still, I should certainly recommend metals nearer alike, and a gun-metal propeller ought to work very effectively in place of the cast-iron one. I should very much like to see a sample of the old propeller.—W. J. LANCASTER.

[45793].—**Ginger-Tea.**—"C. T." will make ginger tea (1) by bruising a piece or two of ginger, putting the bruised ginger into a tea-pot, and pouring upon it boiling-water, precisely as if making ordinary tea. (2) By dropping into a tumbler of hot-water a little essence of ginger, or a small quantity of powdered ginger. In an emergency, a little powdered ginger, moistened and stirred with hot-water, answers perfectly, though this is not quite so nice as the regular ginger-tea.—JAMES EDMUNDS.

[45794].—**Bunsen Photometer.**—The Bunsen photometer is one of very easy construction—it consists of a wood frame carrying a sheet of tightly strained tissue-paper. In the centre is a grease-spot, produced by applying a fraction of oil or tinted paraffin wax. The use of this instrument I presume you are acquainted with; if not, a query will command my attention.—SUNLIGHT.

[45794].—**Bunsen Photometer.**—Consists of a screen of white paper with a grease-spot in its centre. The lights to be compared are placed on opposite sides of this screen, and their distances are so adjusted that the grease-spot appears neither brighter nor darker than the rest of the paper, from whichever side it is viewed. When the distances have not been correctly adjusted, the grease-spot will appear darker than the rest of the paper, when viewed from the side on which the illumination is most intense, and lighter than the rest of the paper when viewed from the other side. In practice it is usual to fix the lights one at each end of a scale with a sliding screen between them, the whole being placed in a box so arranged that no light can pass from one side of the screen to the other except through the screen itself. On either side of the screen, and inclined to it at an angle of 45° , is fixed a small mirror, so that the reflection of both surfaces can be viewed at once. The screen is then shifted until no difference is discernible between the images, when the scale is read off.

The intensities of the lights are inversely as the squares of the distances separating them from the screen.—ALFRED W. SOWARD.

[45794.]-Bunsen's Photometer.—A circular spot is made on a paper screen by means of a solution of spermaceti in naphtha; on one side of this is placed a light of a certain intensity, which serves as a standard. In London it is a sperm candle of six to the pound, and burning 120 grains in an hour. The light to be tested, a petroleum lamp or a gas-burner, consuming a certain volume in a given time, is then moved in a right line to such a distance on the other side of the screen, that there is no difference in brightness between the greased part and the rest of the screen. By measuring the distance of the lights from the screen by means of a scale, their relative illuminating powers are respectively as the squares of their distances from the screen. By this kind of determination, the degree of accuracy which can be attained is not so great as in many physical determinations, more especially when the lights to be compared are of different colours—one, for instance, being yellow and the other of a bluish tint. It gives, however, results which are sufficiently accurate for practical purposes, and is almost universally employed for determining the illuminating power of coal-gas and of other artificial lights.—F. I. C.

[45794.]-Bunsen's Photometer.—You can make a Bunsen's photometer in five minutes. Take a piece of thin, white blotting-paper, cut it to fit on any frame you may have, such as a small slate-frame without the slate, then put a round disc of grease, say, lin. diameter in the centre. Now, when a light is put behind this, you will, of course, see the grease-spot brilliantly illuminated, and the other part dark. Now mark on a piece of wood from each side of the frame a scale of inches, and place a standard candle 12in. from one side of the photometer, then bring the light to be tested along the opposite scale—e.g., a gas-burner, and there you see the grease-spot has disappeared, and, strangely enough, we find that the gas-burner is just 4ft. from the screen; then the intensity of the gas-light is inversely as the square of its distance from the screen when compared to the candle. The candle is 1ft. away, one times one is one; but the gas-flame is 4ft. away, then four times four is sixteen; so the gas-light is equal to sixteen candles. There are a great number of different photometers—Wheatstone's, Rumford's, Ritchie's, &c., &c., and I invented a simple photometer in which the two lights could be examined side by side, and described it in "ours" some time ago.—W. J. LANCASTER.

[45798.]-The Telescope.—I should have continued the articles on above, but I thought it did not seem to interest our readers. However, if there is only one to benefit, I will go on with them. You shall read another one, if all's well, before long. I will not keep you a moment longer than I can help. I often wish I could write as quickly as I can think; but I cannot, nor can anyone else who thinks at all.—W. J. LANCASTER.

[45800.]-Jet Brooches.—Use shellac for cementing the pins to the back; nothing better.—ALBERT SMITH.

[45800.]-Jet Brooches.—For preparing "black goods," such as jet, vulcanite, &c., nothing is better than good "unsulphurated" shellac. If desired, it can be made nearly black by holding over the smoky flame of a lamp or gas. To insure a better job, warm the article before applying the shellac.—ALFORD.

[45801.]-Blueing Mainspring.—Dip in melted lead until the required colour is obtained.—ALBERT SMITH.

[45801.]-Blueing Mainspring.—On heating steel gradually over a flame it will acquire a light yellow colour when its temperature reaches 430° F., from the formation of a thin film of oxide; as the temperature rises, the thickness of the film increases, and at 470° a decided yellow colour is seen, which assumes a brown shade at 490°, becomes purple at 520°, and blue between 530° and 570°. Use a large Bunsen flame, and the blow-pipe, if necessary.—F. I. C.

[45801.]-Blueing Mainspring.—To "ALFORD."—As this query stands, I am led to suppose that it is desired to know how to "blue" a spring in its entirety—i.e., to make it blue all over. I must premise, then, that the querist is making his spring from either white, straw, or purple-coloured steel. It is not absolutely necessary to be provided with a blueing-pan, such as used in the trade, as an ordinary fry-pan, or a saucepan, will serve all purposes for an amateur. An old one will suffice; a good one might be spoiled by burning. Proceed in this way. Carefully wipe all grease or finger-marks from the spring to be operated upon, half fill your pan with clean and dry silver-sand, and place on a clear fire. Heat the sand in the pot until, by testing with a bright needle laid upon it, the correct colour can be got. At this point make

the surface of the sand quite flat, lay the spring on it, and press evenly down until partly imbedded. Now replace the pot on the fire, and watch very closely the changing of the colours on the spring, which, if it was previously white, will pass through the various shades of yellow, orange, and purple, to dark blue. As soon as the desired shade has been got, remove the spring with a pair of tweezers, previously warmed, and whirl it about in the air for a few seconds. Do not take the spring out of the pot and lay it at once on a cold surface, or it will cool unevenly. You are possibly aware that the various shades of colour are, in many instances, taken as indications of the "temper" of the metal. If a previously hardened piece of steel is brightened and then "let down" by heat, the colours will appear in the order I have stated. Blue necessarily representing a softer state than purple, and so on. The inner and outer ends of the spring must be made softer than the other part. Springs are coloured in other ways, but the mention of them here is immaterial.—ALFORD.

[45803.]-Boiling Linseed, &c.—This seems altogether out of my way; but I thought as I glanced at it that I might help "J." When we boil water in a clean polished vessel, we can raise the temperature above 212° before ebullition commences, but if we put small shots into the vessel, the ebullition commences long before boiling-point is reached. Now then make an experiment—collect a few dozen (according to size of vessel) of the sharpest-cornered stones you can find, put them into the pot, and then boil a lot of linseed, and see if this does not at once help you over the stile.—W. J. LANCASTER.

[45805.]-Electromotor.—You had better use a Gramme ring or a motor like the Brush dynamo; but you must use wrought-iron field-magnets, as you will require the least weight possible for a boat propeller. All magnetic engines act very much alike when properly proportioned. Jacobi and Davenport engines are as good as any modern form. The most important thing is the battery; you must make it very light and use Grove's only; if you were to sail with a bichromate you would perhaps have to row back in five minutes, and even if you kept charging the acid and salt continually, it is unsatisfactory. You may get some idea of the engine power by making a small machine first, and you will find four or six magnets of round iron 1½in. dia., with 30lb. or 40lb. No. 20 silk-covered wire, and 40 to 50 cells in the battery, will drive your boat; the speed would be much under five miles an hour, unless you were very fortunate in the action of the machine.—J. SUTCLIFFE.

[45808.]-Erasing Letters from Leather Bag.—"Ignoramus" will most likely succeed in removing the letters if he rubs them with a piece of rag soaked in benzine. Should this not succeed, try washing with dilute hydrochloric acid, and then rubbing with bleaching-powder.—DABLER.

[45808.]-Erasing Letters from Leather Bag.—"Ignoramus" will find it rather difficult to remove the letters as he wishes, and probably not at all satisfactorily. The best method of procedure will be for him to procure a little methylated spirit and a soft sponge. Then bathe the letters nicely with the spirit until the paint becomes quite soft. Afterwards get a paper-knife, and carefully scrape off the paint as desired. Do not use a steel knife, as there would be danger of damaging the leather. This he will find as effectual as anything I know of. Of course there will be an outline of the letters left, because the paint will have penetrated the leather.—A. MANOCK.

[45811.]-Comets.—Personally, I don't believe there is a solid particle in a comet, and if "W. C. E." can bring proofs of his meteoric comets he will do what I am unable to do. Now, to me comets are merely an accumulation of molecular gases, particles of hydrogen and nitrogen, and also of carbon, the tails merely a repulsion—an electrical repulsion; it may be just the same that we can so easily produce in a long vacuum tube, exhausted to one twenty millionth of an atmosphere. In space I believe matter is everywhere present, and I don't hold that such matter should be in an ultra gaseous condition, but simply in a gaseous condition in which the particles are very much further asunder than we can get them with our most perfect pump. How does "W. C. E." account for the swinging round of a comet's tail during perihelion?—W. J. LANCASTER.

[45811.]-Comets.—When stars are seen through the heads of comets we must suppose the size and mutual distance of the fragments are such as to admit of this. "To appear as comets, there need not be many of large size," or, indeed, any; but if there were some the temporary eclipse of a star caused by one of these (if the comet were not too near the earth) might only endure during the fraction of a second. Guillemin, in his book, "Les Comètes," says there is no authenticated instance of a star being seen through the actual nucleus of a comet except one, and that was over one hundred

years ago. In 1828 a star of the 8th magnitude was eclipsed by Encke's comet, observed by Wartmann. We are continually, as is well known, passing through thin meteor streams, of which those meteors stopped by the earth fall to the ground either in the form of an impalpable powder or as aerolites of some magnitude occasionally; but we may conclude that it is at least many thousands of years since the earth has collided with what may reasonably be called the head of a comet.—W. C. E.

[45812.]-Combustion.—I take the standard candle, which in London is a sperm-candle of six to the pound, and burning 120 grains in the hour; consequently, this candle, being entirely protected from currents of air, and kept stationary, would continue to burn for about 9 7-10th hours. If the composition of this candle be pure cetene $C_{15}H_{32}$, and there be perfect combustion, all the hydrogen may be supposed, for simplicity of calculation, to unite with the oxygen of the air to form aqueous vapour. The hydrogen contained in 120 grains of this sperm will be 17 1-7th grains, which, when united to the oxygen of the air, will give 154 2-7th grains of water. Calculations of this kind, right in theory, may be a long way from what is actually found to be the fact from experiment. The sperm may be, if not commercially, chemically impure, which would vitiate the result of a calculation based on its purity. I am not aware of the exact composition of the sperm of the standard candles, so called; but unless they were all of the same chemical composition, no accurate calculation could be made, unless after numerous experiments an average was taken. If you calculate the number of grains burnt by your "tallow" candle, it will be easy to tell the weight of water, the composition of the tallow being also known.—F. I. C.

[45813.]-Liability for Damages.—"Sigismund" is certainly liable to make good the damage done to his neighbour's glass roof by the falling of slates or of a chimney from off his own house; unless, indeed, he could prove (and the onus of so doing will be upon him) that the chimney and slates were secure enough for ordinary weather, and only fell because of an unusually high storm. In such a case, the damage being done by an *actus Dei*, he would have a defence; but in England, such storms rarely occur. Of course, if the landlord is liable to repair, &c., "Sigismund" might have a right of action over against him for the damages paid.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall, E.C.

[45815.]-Legal.—I really cannot quite understand the question put by "Lumen," which I shall be glad to answer if he can put the point more precisely. If a railway company buy a field they must, generally speaking, buy all rights of way over it; but, of course, this must depend on the bargain made at the time between them and the vendor, as to which I can say nothing until I know more of the matter.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall, London.

[45816.]-Euglena.—It is not at all clear that the onward movement of this plant is caused by the flagellum, if that is the right name for it. You will see that Euglena's principal motion in its three best known shapes is spiral around its longer axis, and that the action of the front cilium causes this spiral motion to deviate to either side instead of following a straight line, so that its effect cannot be the same as that of an oar. There are other unicellular organisms that sail straight on with a single lash stretched out in front—a most marvellous sight when the substance of that lash is considered. Euglena has other motions—rotation on a centre, which seems to point to a circumferential clothing of cilia, and also a curious bulging at the front end, into which the posterior part, all but the bristle, is gathered, and from which the anterior with the red spot and cilium is again protruded; this operation repeated gradually takes it along in a manner of progression similar to that of a looping caterpillar. It would be interesting to discover the real cause of the screw-like motion, which is the general method of progression with Euglena.—C. J. B. F.

[45817.]-Telephone.—Possibly you speak too loud to the microphone, or else the loose contacts in it are too loose.—J. BROWN, Belfast.

[45817.]-Telephone.—The difficulty is evidently with the microphone. If "Electrician" will say what kind of microphone he uses, I dare say the cause of his trouble may be explained. In the mean time, he should try the effect of speaking in a clear voice at distances of from six to eighteen inches from the microphone. The hurring sound in the microphone is often caused by the effect on the plate of the mechanical power of the air as expelled by the lungs, which sets the plate in vibration, and overcomes the vibrations of the sound-waves, which alone are required for the transmission of speech.—H. B. T. S.

[45825.]-Bichromate Batteries.—These never keep in action long, but with an arrangement by which fresh solution is supplied, ~~running~~

in at the bottom and out at the top, they will keep in action for a long time.—ALBERT SMITH.

[45825].—**Bichromate Batteries.**—"W. R. C." must not expect a bichromate battery to last more than about half an hour when the circuit is closed. A simple and cheap stand for vacuum tubes consists in a board of any size and shape that may be fancied, and covered with black calico. The tubes can be suspended on wire hooks which can be carried through the board to the coil, which may then be placed out of sight behind the board. In this way the tube may be arranged according to any design.—H. B. T. S.

[45825].—**Bichromate Batteries.**—It is quite impossible to say how long "W. R. C.'s" cell should remain in working order. It depends upon its size and upon the frequency and duration of his experiments. If only used for the occasional illumination of vacuum tubes, and if care were taken never to have the zinc plate in the solution except when the battery was in actual use, it might last for months. To half a pint of bichromate solution add about seven fluid drachms of strong sulphuric acid, and when the current fails (beware of a mere temporary failure which may be remedied by shaking the cell), add a similar quantity. When it fails a second time take fresh solution.—ALFRED W. SOWARD.

[45825].—**Bichromate Batteries.**—How can anyone answer such a question? It is like asking how long a ton of coals is likely to last a householder. If the querist reads the chapter on batteries in my book he will learn all about it. The answer depends on the size of battery, on the resistance of the coil, and on the rate of motion of the vibrator. That is to say, a given quantity of bichromate can only maintain a given rate of current for a certain time. It is a question of rate of consumption of materials supplied. One pint of the solution will support about four vebbers or amperes of current. As to acid, the best way is to add it by instalments, altogether about one-sixth of the measure of bichromate solution; add one-third at a time, which will reduce waste by local action.—SIGMA.

[45826].—**Cryptogamia.**—Having waded through four lexicons in search of the word "cryptogamia," and without success, I presume our querist means cryptogamia, and endeavour to give the desired information accordingly. The word cryptogamous is from the Greek "kryptos"—concealed, and "gamē"—marriage, and cryptogamous plants are those which have no true flowers, and no known male and female organs of fructification. The name was invented by Linnaeus, and the Cryptogamia form a class of his Sexual system, very distinct from all the rest. Perhaps it would be useful to state that cryptogamous plants are the lowest in organisation of the vegetable kingdom, and are divided into ferns, club-mosses, horsetails, and mosses. Reference to a work on botany would furnish any other particulars that may be wanting.—A. MANOCK.

[45827].—**Marking Ink.**—This is merely nitrate of silver and ammonia mixed with sap green and gum.—ALBERT SMITH.

[45828].—**Xerotine Siccative.**—This is a petroleum spirit, and is used in paints to make them dry quickly; it gives off vapour at less than 100° F., and when mixed with air forms a very explosive compound, the same as coal-gas and air.—ALBERT SMITH.

[45829].—**Portable Engine.**—I should not rivet on a piece of plate in the way you name, because that would be simply adding useless weight. If the angle-iron is in good condition, it would be far better to take out the stay-bars, and then cut and shut them up, say, 3 in. shorter. If this was done, so that the pins would not quite drive in, and the rods heated so as to expand them, the pins would slip in, and the rod would then be in tension. As the boiler expanded in getting up steam, the rods would also extend, but would always keep just a least tension against the pins. I should decidedly see that the pins were a good fit in the holes at starting; and to prevent corrosion, well paint them, when hot, first with boiled oil, and when in place, with Brunswick black or coal-tar.—SUNLIGHT.

[45830].—**Transparencies.**—I do not tone mine at all by a separate process; but get a pleasing tone by the use of the following bath and developer. For the bath use nitrate of silver 4oz., nitric acid 3 drops, acetic acid 12 minims, water 10oz. In making it up, add the silver to the water, and well sun and filter; then add the nitric acid, and last the acetic. Coat the plate with old collodion, and keep in the bath for, say, five minutes. Develop with pyro. 30gr., citric acid 1ldr., acetic acid 2dr., alcohol 2dr., nitric acid 7 drops, water 10oz. Fix with hypo. The developer acts very slowly, so that it is handy to develop in a small dish; but has the great advantage of needing no toning. At one time I used another plan, using sulphuret of potash as the toning agent; but prefer the formula stated, as the simplest. I make mine in a Riley's

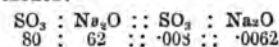
"Universal Combination" camera, which gives far sharper prints than when printed by contact.—SUNLIGHT.

[45830].—**Transparencies.**—"Meme," in his query, did not say if his plates were gelatine or collodion. If they are gelatine, he will find the following formulae a capital one. If he has developed his plates with the alkaline-pyro, or ferrous oxalate, well wash and flood the plate with acid pyro. and silver; the pyro and silver is only used to give a bite to the gold in toning. Again well wash after the pyro. and silver. Don't spare the water on any account. Now flood the plate with a 15-grain solution of gold in water, gold 12 drops, water 1oz. Keep this moving over the plate until the required tone is obtained, again wash and pour over the plate a very weak solution of cyanide of potassium; wash and dry. If the cyanide be not used the plates will after a time present a very beautiful pinkish tint in the transparent parts, which in some subjects has a very pretty effect. After the first fixing in Hypo all the rest of the operations may—in fact should—be carried on in the light, as in that case you can see exactly what you are about.—YANKEE.

[45833].—**Watch Query.**—"FINSBURY."—The jewels are what the "sape-wheel and pallet-staff act in, instead of brass in commoner grade of watches.—PEGANREDDSTUFF, Jan. 23.

[45835].—**Soda-Ash.**—"Micro." asks for a simple method of estimating the quantity of soda in soda-ash. If he will say exactly what it is he wants to estimate, whether soda (free hydrate), soda (carbonate), or soda (total alkali calculated as such), I shall be happy to assist him.—ALFRED W. SOWARD.

[45835].—**Soda-Ash.**—The soda in this can be quickly and accurately estimated volumetrically. First make a standard solution of sulphuric acid. To do this, add to 1 litre (1,000cc.) of pure distilled water 8grms. of pure sulphuric acid; each cc. of this will contain .008 of SO₂ (or .0098H₂SO₄). This, of course, must be standardised by estimating the amount of SO₂ by precipitation with barium. Knowing how much SO₂ each cc. contains, the amount of soda (Na₂O) that it will neutralise is easily reckoned:—



Then you have your solution:—Each cc. equals .008 SO₂, or .0062 Na₂O. Now weigh out a known quantity of the soda-ash (about 1grm. would do), dissolve in water, and add a little litmus solution; then add carefully, drop by drop, the standard solution of sulphuric acid. Carbonic acid will be given off, which will turn the litmus red; boil, and the litmus will resume its neutral colour, add more standard acid, boil, and so on, until all the CO₂ being driven off, one more drop of standard acid will make the solution permanently red. Read off how many cc. you have used, and multiply that number by .0062, and the answer will give you the amount of soda (Na₂O) in the 1 grm. taken. Multiply this by 100, and you will have the percentage of soda in the sample.—F. BARKER COOKE.

[45838].—**Photographs—Finishing.**—Surely you would find it best to give the prints the finish after mounting, rather than before. You might, perhaps, give them a collodio-enamel face, if that would do; but the mounting, except very carefully done, would be likely to injure it.—SUNLIGHT.

[45838].—**Photographs.**—Paper prints usually receive a highly-polished surface after mounting by being passed several times through a machine (obtainable from any dealer in photographic apparatus) called a "burnisher." If you work in metal-turning you could easily make one. A less brilliant surface, but preferred by many, is got by heavy pressure beneath a roller upon a polished steel plate, or by heavy pressure between two polished steel rollers. To give a high gloss before mounting, enamel them with gelatine, or send them to some professional enameller, and in mounting gum or glue about a quarter of an inch of the back of the print all round the edges, not damping the general surface of the back, or the gloss is greatly deteriorated. The stains from alkaline pyro. can be removed without fear of damaging the skin by soaking the fingers in dilute hydrochloric acid. If, however, the stains arise from pyro. and silver, make up an aqueous solution of iodine; the strength is immaterial, but about the colour of dark sherry will be found the most serviceable. First soak the fingers in this, and then soak them in a solution of hyposulphite of soda.—W. T. BASHFORD.

[45838].—**Photographs—Finishing.**—In 1876 I was printing in carbon by the Lambertype process in Dublin; and experimenting with silver prints, I obtained very pleasing results, proceeding as follows:—Get a plate 12in. by 10in., thoroughly wash it in nitric acid and water, after which place under a tap of water and rinse well. Now dry and

clean with a chamois-leather as you would if you were going to prepare for a negative coat the plate with plain collodion, taking care to have no creases, and place it under the tap, which should have a rose on it the same as a watering-can, such as gardeners use. Wash your plate till all greasiness disappears; now take your silver prints out of the water, after all hypo. has been washed away, and place them face downwards; take a sheet of indiarubber cloth and cover the plate; take a squeegee and remove all superfluous water and moisture; take care not to disturb the prints from the original position, or they will be spoiled. After removing all moisture, place in a rack for a short time, and place them in a warm room, within the course of 24 hours they will leave the plate by themselves. The result will be a fine glossy surface, nearly equal to gelatine enamel prints. On no account assist them in peeling off the plate; if you do you will certainly spoil them. Mark, do not claim to be the first to obtain these results by this process; but I certainly found it out myself. You will be able to obtain the result you wish for if you follow the above directions carefully. I was very nearly overlooking your query. To remove pyro. stains, try cyanide of potassium. This is very dangerous, but a safe plan is to wash in hot water and rub the finger with a piece of pumice-stone. I have found this answer very well.—YANKEE.

[45840].—**Protecting Paper Labels.**—"F. I. C."—A friend (Mr. Arthur L. Fisher) recently showed me some bottles, the labels of which he had brushed over with melted paraffin. The effect was very fine. They looked more like made of white enamel than paper, and I suppose were effectually protected. The paraffin should not be put on very thickly, and care should be taken in the selection of the labels, as some kinds of paper seem to take more kindly to the process than others. I trust "F. I. C." will not think me too courteous in answering a query addressed to himself.—ALFRED W. SOWARD.

[45840].—**To "F. I. C."**—Though addressing "F. I. C." in particular, I have ventured to reply to this, having only lately done all the labels in my own laboratory. Put solid paraffin in an evaporating dish, and heat on sand-bath; when melting and almost smoking, with a brush (a small "saw tool" will do nicely) coat the labels with the melted paraffin; this must be quickly done, as it solidifies almost instantaneously; never mind going on the bottle. When cold, carefully wipe off the extraneous paraffin, and trim up the label afterwards polishing them with a soft cloth until the surface shines. The effect, in appearance and wear, is well worth the pains taken.—M. J.

[45840].—**To "F. I. C."**—There are many receipts for making transparent glazes, which are used in the porcelain manufacture, and which, acted upon, to any extent, only by hydrofluoric acid, which acid being kept in a leaden bottle, this account—viz., that it dissolves glass—will enter into our category of acid kept in glass bottles. (1) Litharge and ground flint in the proportion of 10 parts by weight of the former to 4 of the latter. Cornish granite is sometimes used instead of the flints in the proportion of 8 parts by weight to 10 of litharge. (2) Mr. Rose's recipe: 27 parts of felspar, 18 of borax, 4 of Lymington, 3 of nitre, 3 of soda, and 3 of the china clay of Cornwall; the ingredients are melted together and ground to a fine powder. This is a printing frit. (3) Take 13 parts of the lead and add to them 50 parts of red lead, 40 of the lead, and 12 of flints, the whole having been ground together. (4) Glaze for red ware: Common salt 13 parts, carbonate of potash 30 parts, dissolve them in water and dip the articles in the glaze.—F. I. C.

[45842].—**Pressure.**—I would not undertake to say more than that the gun-metal part should be safe up to nearly 700lb. on the square inch. But that the real limit of safety would be dependent on the holding-power of the clamp and on the pressure to escape long before the tension would be nearly the bursting-point of the gun-metal barrel. With the small quantity of water present in the ruculianiser, I question if a very high pressure could be reached, say, beyond 300lb. to 400lb.—SUNLIGHT.

[45844].—**Life Policy.**—This question is what complex; but I presume that "A." "Photos." are the same person, and "C." deceased donor. The Assurance Office is contending that there is no legal assignment under their Act of 1867 or under the Act, and I do not see how the administrator is compelled to give any assent. But I am of that by delivery of the policy to "Photos." was an equitable assignment to him which made as complete as he could by giving the office. The proper, and indeed, the only to be pursued, is for "Photos." to see the Assurance Office for the amount of the policy, which

action that it should be declared to be his. The office will then pay the money into and abide by any order that is made. As far as sea, this action would be perfectly successful, after declaring the trust as he seems to have acted upon it himself by delivering actual policy to the person he wished to. It is hardly possible for me to advise more without knowing all the facts and seeing the case.—FRED. WETHERFIELD, Solicitor, 10, Gresham-buildings, Guildhall, London.

945.]—Metal-Planing and Shaping.—You studied the description of the Armstrong lathe, which has been fully described in pages of this journal? Would such not suit requirement?—SUNLIGHT.

946.]—Employers' Liability Act.—This is not retrospective in its action. It came into operation on the 1st January, 1881, and can affect accidents that happened on or after that date. But even before this statute, employers are in some cases, and if W. Cahill agreed his workman a weekly sum to compromise in, he might have some right of action in continuance. In no other way can he compel attention; but to answer for certain I should all the facts.—FRED. WETHERFIELD, 10, Gresham-buildings, Guildhall.

947.]—Concrete Colouring.—I saw some specimens of coloured concrete by Lascelles & Co., Drake and Co., at the last Building Exhibition. I should recommend "Khoda Bux" & the works of both firms—the latter is better. Their address is Railway Works, London; they are making even doors of concrete, there seems to be hardly a limit to applicability of the material.—KAPPA.

948.]—House Well.—If J. Kyle will erect one in his back-yard capable of doing more than is done upon it, he will be able to get it up the 4ft. with his hands in his pockets. A must first invent a "perpetual-motion" machine. A plumber once suggested to me, one that the pressure was not sufficient to carry up to a high-level cistern that we might get by taking the pipe a long way round. Coax as it were—or, perhaps, confuse it in the age of the pipe, and get it up before it knew it was. I have not yet tried his method.—W. SOWARD.

949.]—Orchestration.—If you wish to alter existing arrangements and have steam-power, why not use that as the motive power? You could do by an arrangement of shafting, and other plans, amongst which I should include a wire rope to transmit the power. Compressed air would not, in my opinion, be a good idea; first you would need power to compress it; and then why not use the engine itself to be the instrument? To the question of electricity, same would also apply, as being a round-way of doing what may be done directly with loss of power and first cost.—SUNLIGHT.

950.]—Orchestration.—I think this instrument might be made to perform from the steam by means of light iron shafting. Perhaps in gas-piping would do running in plunger secured to the walls or any other convenient cement at about 8ft. to 10ft. apart. Would "Orchestration" kindly give a description of this? I have seen some very fine ones on the sea, and have had a great wish to make one, but have never been able to obtain details of construction. What I most wish to know is the use of notes and arrangement of the notes on the soundboard, so as to give effects of so many different instruments at greatly increasing the number of notes by the barrel, and thereby greatly simplifying the latter. Also, how the different notes are drawn and shut off. I think a description, few sketches if possible, would be of great benefit to many readers besides myself.—A. ALL, Swansea.

951.]—Midland Engines.—To "E. P."—There are 30 bogie express engines on the Midland. Nos. 1312 to 1321 were built by Kitson & Co., 1876-7, and have four coupled wheels, 18 in. diameter, cylinders 17 in. by 26 in. Nos. 1346 were built at Glasgow by Dübs and Co., 1877; the coupled wheels are 17 in. diameter, cylinders 18 in. by 26 in. These engines are used chiefly between Liverpool, Manchester, and Leicester. Fast Midland trains run between Manchester and Liverpool, 34 miles 4 chains, minutes, or 51 miles an hour. The express between London and Nottingham, via Ketton and Melton, and also the Newspaper Express London to Leicester, run at a high speed. 0 a.m. express from St. Pancras is due to Bedford, 49 1/2 miles, in 59 minutes, or an average speed of 50.6 miles per hour.—CLEMMENT SEXTON.

952.]—To "Sunlight."—Let me ask you a question before I deal with the matter. Are the two

boilers you now have deficient in steaming power, and hence, that with the throttles wide open, the boilers cannot maintain the volume of steam required by the engines? Or, is it that the boilers are ample as far as heating-surface goes? but that the load pulls up the engines with steam full on. If the former is the case, then a third boiler would be the best thing. If the latter, it is plainly a case of the engines being too small for the work they have to do. If they are insufficient to deal with the load, then an extra 5lb. pressure would not do much. To enable the engine to do what is wanted, I should advise at least another 15 to 20lb. additional pressure; but, in that case, would the existing boilers be safe at 50lb., and are the engines sufficiently strong to take the extra steam thrown on them if the steam pressure is raised? As to safety-valve, you do not say the size of area of valve against which the steam acts, tending to lift it.—SUNLIGHT.

[45855.]—Apparatus for Controlling the Flow of Liquids.—If "Vossevangen's" cisterns are always to be used in the manner described, and are not yet constructed, they might be made with areas in the ratio of the quantities of liquid to be run from them. The sectional areas of the delivery pipes (unless considered desirable to make correction for difference of friction) should be in the same ratio. If filled to the same height and the taps equally opened, the liquids would flow out in the required proportions, and as the head of water would decrease equally in both cisterns, would continue to do so until supply exhausted.—ALFRED W. SOWARD.

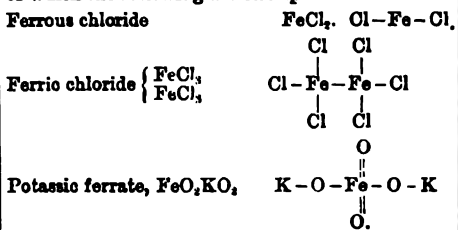
[45856.]—Measuring Globes.—The rules given in Molesworth's formulae for calculating the solidity of a globe is:—Multiply the cube of the diameter by 0.5236. The answer is the number of cube feet. In the example given of a globe 30ft. diameter the number of cube feet would be 14137.2000 +, not 16654.950496908, as given by "P. W.'s" calculations. The cube of 30 is 27,000 and 27,000 multiplied by 0.5236 = 14137.2000 +.—T. R. SEXTON.

[45856.]—Measuring Globes.—I am perfectly ignorant as to the method which "P. W." employs in his calculation of globes, and certainly cannot reconcile his result with the results obtained by the following rules:—Suppose, for instance, "P. W.'s" globe is 30ft. in diameter, let him cube that diameter, and it will = 27,000; next multiply it by 0.5236, and it will = 14137.2, which will be the cubical contents of the sphere, not 16654.950496908 as given in his result. The next rule is to multiply 3.1416 by 4, and the product of that by the radius of the sphere cubed, and then divide by three, which will give the result as above. Any other information which may be desired will be found in an elementary work on mensuration.—A. MANROCK.

[45857.]—Chemical Formula.—FeCl₃ is undoubtedly the correct formula for the perchloride of iron, as has been shown by experiments upon the vapour density of this substance.—DABLER.

[45857.]—Chemical Formula.—The formula for perchloride of iron is FeCl₃. For the best work on chemical analysis get Fresenius. Crookes's select method of chemical analysis for some things is excellent. Mr. Allen has published a first class work upon commercial analysis.—ALBERT SMITH.

[45857.]—Chemical Formula.—Sesquichloride, or perchloride of iron, or ferric chloride used, 14 or 15 years ago, to be represented by the formula FeCl₃. Since then chemists have changed their ideas with regard to the number of atoms in the molecule of iron, or to its combining power. The atomicity may be represented ii., iv., and vi., of which the following are examples:—



If we wish fully to represent the alterations which occur when a chemical change goes on, we must employ molecular formulae; but, for the sake of simplicity, chemists frequently use atomic formulae. Thus, FeCl₃ is sometimes written for FeCl₃; just as NO is written for N₂O₄, when it is desired simply to show the ratio of Fe and Cl atoms in the salt. "Quantitative Analysis," by C. Remigius Fresenius, edited by Arthur Vacher. Seventh edition. Vol. I., with 106 engravings, 8vo, 16s. (Churchill, New Burlington-street). "Handbook of Volumetric Analysis; or the Quantitative Estimation of Chemical Substances," Francis Sutton, F.C.S. Third edition, with 74 engravings, 8vo, 16s. (Churchill).—F. I. C.

[45858.]—Japan Wax.—This is a vegetable wax obtained from the fruits of Rhus succedanea,

and is imported from the East Indian Islands, Japan, the West Indies, and Brazil for use in candle-making. It is imported in large round cakes, about an inch thick, arched and forked on one side; when exposed to the air it becomes covered with a white film. It is yellowish white, has a somewhat rancid smell and taste, producing irritation in the throat; softer and more unctuous than wax, but more friable, and may be distinguished by its property of crumbling to a coarse powder when chewed. Specific gravity 0.98, has an acid reaction; when warmed, it first becomes tough, and then melts, the East Indian variety at 50°, and the West Indian at 49°; the former solidifies at 42.5°, and the latter at 45°. The East Indian contains 70.00 per cent. C, and 12.07 per cent. H; and the West Indian 71.88 per cent. C, and 12.03 per cent. H. When saponified it yields glycerine and palmitic acid. It is easily bleached by chlorine, but the chlorine cannot be subsequently quite removed from it. It dissolves in 3 parts of boiling alcohol of 96 per cent., but not in the same liquid when cold; the solution solidifies on cooling to a white fine-grained mass. The solution in hot ether deposits flocks. When oxidised by nitric acid, it yields succinic, but no other acid.—F. BARKER COOKE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last F. Barker Cooke has replied to 44632, 45049.

- 45299. Tale of Man, p. 364.
- 45300. Shoeing Young Horses, 215.
- 45303. Numismatic, 265.
- 45308. Fuel Oil, 215.
- 45313. Air-Gun, 215.
- 45318. Copper Wire, 245.
- 45326. Hoarse Finishing, 265.

- 45525. Injectors, p. 361.
- 45526. Bicycle Route, 361.
- 45529. Bone Mill, 361.
- 45543. Electrical Terms, 361.
- 45547. Legacy, 361.
- 45552. Tait's Thermic Ventilator, 361.
- 45553. To "Clerkenwell Clockmaker," 361.
- 45554. Russian Vapour Bath, 361.
- 45564. Speed Indicator, 361.

QUERIES.

[45800.]—Viola.—Will someone kindly inform me what are the dimensions of a full-sized viola, and how to judge a good one?—POOR MECHANIC.

[45861.]—Trigonometry.—Will someone have the kindness to explain, with a worked example, Rankine's formula for slide-valves, S.E., page 495?—POOR MECHANIC.

[45862.]—Lens.—I have an achromatic lens, 3 in. diameter, 2 in. focus, and I shall be glad if any of "ours" can suggest a use to put it to. The pair is unmounted, and appears to be plano-convex; but I find the back to be very slightly concave instead of plane. Can I use it for a telescope, or photography? If so, what other lenses shall I require, and what would be the probable cost of them?—A. M. Z.

[45863.]—Drilling and Rifling small Arms.—I wish to drill and rifle a barrel of 210in. diameter, but I have never seen it done. I should be glad of any information (with sketches, if possible) with regard to form of rifling head-drills, &c., which would enable me to proceed with the job. I have a good screw-cutting lathe.—RIFLE.

[45864.]—Universal Joints in Shafting.—Will someone kindly state the greatest angle at which a universal joint can be successfully worked? Also, please state the increase in power by driving water-power machinery with shafting and universal joints worked at different angles of from 6° to 30°! Can a universal joint be worked at an angle of 15° each way (horizontally and vertically) at the same time?—IGORAMUS.

[45865.]—Medical.—I should feel very much obliged to Dr. Edmunds if he could advise me the best thing to do with a child eighteen months old. Its eye has a white speck moving about, arising from a slight inflammation caused by cutting her teeth. I have taken it to the doctor here for a month, and it does not seem to get any better; the doctor speaks very lightly of it. I am anxious to know if there is not some lotion I could apply to it to remove it, as I am afraid it will injure the sight.—A TEN YEARS' READER.

[45866.]—The Spectroscopes and Meteorology.—Will any astronomical correspondent give me some information respecting the use of the spectroscope for meteorological purposes? I how to manage it mechanically? or tell me of some work which would give the necessary instructions? One of McClean's, or otherwise; a pocket spectroscope is the one I should wish described.—F. GARTSIDE TIPPING.

[45867.]—Throttle-valve—Model Locomotive.—Would "Meteor" or some kind reader oblige with a drawing of throttle-valve for horizontal engine—bore, 3in. stroke? I would also thank "Meteor"

description of G.W. Railway engine, spoken of in query 45690, page 457.—THROTTLE VALVE.

[45698].—**Bending Model Boiler-plates.**—Wanted to know the best means of bending two flanged plates for model boiler (vertical tubular), 6in. by 1in., one plate for top tube-plate, and one for fire-box crown, 6in. and 5in. diameter; 14 gauge iron, common.—THROTTLE VALVE.

[45699].—**To Mr. Dresser.**—Do you, as a rule, always tune every stop in the organ from the Principal? I can lay the bearings very well, and then tune up and down, and after that tune the Open to the Principal. What procedure next? Can I tune all the 8ft. stops from that same Principal, or from the already-tuned Open? Then again: where there are three reeds—two of 8ft. tone, and one 4ft. clauson—are they to be tuned from the Principal or from each other? I mean do you tune the Oboe from the cornopion, and then the clarion to the cornopion? Why I ask is, that sometimes if you tune, say C in Open with C Principal, and then the octave to that C, it may be perfectly in tune on the Diapasons, but not with a lower note on Principal. Then, again: if you tune Oboe with Principal, it may give a beat when played with the Open in 8ft. Then I am told you tune the twelfth in octaves on itself up and down. Why? Then the Doubles are tuned to the Principal. Why not to the Diapason? Then the Gambas and Dulciana—are the bearings laid strain on them, or will they be in good time if tuned to the Principal? or should they be made in unison with the open? I shall also thank you for any other information towards tuning a large organ. The pedals seem to me to be always in tune. Open, 16ft.; wood, mahogany.—TAY AGRA.

[45697].—**Waterwheel.**—Having command of a river passing on an average about 2,000 cubic feet per minute over a 14in. fall, in which I wish to place a wheel that will give out the greatest duty, I shall be greatly obliged if "Sunlight," or any other reader will kindly inform me the most suitable dimensions for same; also, what shape the floats should be!—C. W.

[45691].—**L. and N. W. Engines.**—Will some correspondent kindly give me the dates of the following engines:—Albion, General, Ida, Canning, Duke, Duke of Edinburgh, Penguin, Nightingale, Maseppa, Princess Alice, Outram, The Queen, Prince Alfred, John O'Grat, Shakespeare, Byron, and the numbers of Yakob Khan. If Y. K. is 869, then there are two numbered 869. I saw 869 (a good engine) bring a train in from Sutton to Birmingham, some weeks ago.—FORTUNA.

[45672].—**Larch Leaves.**—I am supplied with water for domestic use from a brook which has for at least 100 years supplied a grist mill with water. I bought the mill and watercourses some years ago, and have exercised so far an undisputed right to clear the various spring courses which supply the brook. The springs rise on another person's property adjoining mine, and as that person is planting larch trees about 100 yards above the brook, I am very anxious to know whether the water will not be poisoned by the leaves when they fall? I know the water must suffer from the introduction of decayed matter, but I particularly wish to know whether there are not some poisonous properties (strictly speaking, in larch roots or leaves. Will some of our learned friends kindly answer and oblige.—LARCH LEAVES?

[45673].—**Cotton-Spinning.**—How many pounds of yarn, say 80's to 40's, ought 40,000lb. of good American cotton to make? or, that is to say, what ought the loss per cent. to be?—BLACKBURN.

[45674].—**Removing Burnt Clay from Castings.**—I am obliged for "Cast Iron's" offer to aid me in removing the clay from castings. The castings that I am producing are small, and highly finished, of iron, steel, and softer metals, and to produce the finish, clay moulds only will answer the purpose, so far as my experience goes. Common moulding-sand will not do; hence, you will please not confound the two ideas of moulding, thinking to overcome the difficulty in the way you propose.—FORDEN.

[45675].—**Bleaching Hair.**—Being desirous of bleaching some hair, feathers, &c., I thought of doing it by means of peroxide of hydrogen, which I have employed at two different strengths—viz., at 10 vols. and 12 vols. I immersed the hair in the solutions, and left it there for 24 hours, but in both instances quite unsuccessfully. I can only imagine (as I know the material is large employed nowadays for this purpose) that I am at fault in the method employed. Will one of your readers enlighten the ignorance of—DEALERS?

[45676].—**Science and the Civil Service.**—Is there any Civil Service Appointment for which a thorough knowledge is required further than what will suffice to get one through the examination? If so, kindly state salary attached thereto.—BRANELLIA.

[45677].—**Trochoidal Cutter.**—On page 377 of the ENGLISH MECHANIC, Mr. C. W. Bourne described a new form of trochoidal cutter. I am much interested in this matter, and would attempt to make one if your correspondent would kindly give me some idea as to the dimensions of the steel frame.—C. E. L.

[45678].—**Mr. Goyen's Lathe.**—In Vol. XIV. of ENGLISH MECHANIC, on pp. 350 and 361 are drawings of a lathe with overhead, by Mr. Goyen. Will he kindly state what is the use of the bevel wheel arrangement on the overhead, and how it is attached to the mandril for spiral turning?—F. W. MACKENZIE.

[45679].—**Engine Query.**—Would "Sunlight," or some other reader kindly give me the size and weight of the flywheel for an engine, with two oscillating cylinders, 1in. bore, 2in. stroke? and also what size boiler it would require? An answer in these columns would oblige—SIGMA ZETA.

[45690].—**Gravity Escapement Clock.**—I have one of these clocks made by a professional, but which has not worked so well as it might. At first it went irregularly, and by watching it I observed that at times it "lagged," that is, the pendulum moved but the seconds hand did not. I oiled the movement, and I think this defect has been remedied, but now it "skips" when I am winding it. It has maintaining power, and the maker told me, before commencing to wind, to press the key the reverse way until I heard a click, and then

commence to wind. I do this, but it skips two or three seconds at a time, and sometimes a good deal more, but apparently goes correctly when the winding is finished. Can anyone tell the probable cause of this, and the remedy? The driving-weight seems an enormous size—its weight about 38lb., on three cords. Is this too large for a hall clock, with a face 14in., beating seconds? It stands about two yards from the street door, in a fair current of air. Would a more sheltered spot be better?—GIMEL.

[45681].—**Hard Skin on Iron Castings.**—Will "Sunlight" please give information as to means adopted to get off the hard skin from iron castings—such as pulley wheels and rollers—to be finished in lathe? I have several to do; my tools are of the finest steel, well tempered. In addition, I use Musket's steel, but to no purpose. The terrible skin grinds my tools out of cutting shape in no time. After the skin is off, it's play; I have tried steeping in sulphuric acid and water; also soap-suds, and using hard steel brush. Have also placed article in forge fire, and left it to cool in the ashes for the night, but no result; have tried fine feed and deep cut—but am foiled. The side of tool is destroyed. Is there any means of dissolving the sand out in skin of cast iron? How is it managed in shops where iron castings are always in the lathe?—OMEGA.

[45682].—**Automatic Arrangement.**—Would some of your readers kindly suggest some mechanical or electrical arrangement for the following?—I have a set of drawers with a small slot cut in each, and also a slot in back of frame to correspond with slot in drawer, so that a workman can put his check into the slot corresponding to the time he comes in at. These slots require closing at a certain time—viz., 6 o'clock, 6.15, &c. What I want is an automatic arrangement that would effectually close the slots at the required time, locking itself, so that it could not be pushed aside, and a check inserted after the slot was closed. The slots are about 2in. by 1in.—MORVS.

[45683].—**Finding the Moon's Position, &c.**—About a month ago, "Pioni Almon," and "F.E.S." kindly assisted me in finding the position of the moon with regard to the earth at certain times, and although I failed perfectly to understand by the rules given at the time, I have since solved the question in the following manner, which gives the position of the moon at given times, with sufficient accuracy:—Having a circular map of the Northern Hemisphere, I have placed over it a sheet of tracing paper; on this I have ruled meridians to correspond to those in the map, with hours from 1 to 24 along the equator. Thus, if I bring the hour of new or full moon to the meridian of Greenwich, the position of sun and moon at these times becomes known. If the moon is on the equator, it is necessary to bring round the hour marked on the tracing paper to the meridian of Greenwich; then find the time of the transit of Arles (which item of information in the *N. Almanac* had before escaped my attention), and count the right ascension from this point of Arles, when the position of the moon on the equator is in a longitude corresponding to it. This seems to me a very simple manner of finding the position of the moon with regard to the earth at any given time, if it may be considered sufficiently accurate. By having a circular piece of tracing-paper simply fixed at the pole by a pin, and the meridians ruled to correspond with the map underneath, all that is required is to turn the tracing-paper to the hours of full, new moon, and other times; find the time of the transit of Arles, and count from W. to E., the amount due to right ascension. The declination is easily found from the *N. Almanac*. There are two or three other points upon which I shall be much obliged if your correspondents will enlighten me. What is meant by the "angular distance of the sun and moon," and how is it counted? I wish also, to know the longest and shortest time that eclipses can take, from the moment of contact to the disappearance of the moon's disc? I have been much puzzled to understand upon what principles the lines shown upon the diagrams of eclipses in the *N. Almanac* are drawn, for I can make nothing out of them.—W. L. O.

[45684].—**Compressing Gas—Gas from Mineral Oil.**—I live in a small town where the gas shares are in the hands of a few private individuals who are, of course, more anxious to secure a good dividend than to consider the pockets of the public. Gas is 5s. per 1,000. Is it not possible to compress gas in portable cases so that we could be supplied from some town where the gas is a reasonable price? In one of the northern towns I notice that it is only 1s. 9d. per 1,000. Surely this would leave a paying margin if supplied to consumers here at, say, 3s. per 1,000. I have noticed that for scientific experiments other gases can be bought in a compressed form, although I am unacquainted with the quantity that is so supplied in the small cases used for that purpose. I have tried experiments with benzoline, and find that if I place a small ordinary sponge lamp over the flame of another lamp, and by means of a tube soldered in the bottom of the sponge lamp, force a current of air through the sponge, having previously soldered on an ordinary gas-burner, I can get a good light. Cannot this be done on a larger scale? Would it not be possible to construct a case, divided into compartments, filled with cotton, kept saturated with benzoline, and by forcing air through, thus manufacture gas to supply my house? To procure the necessary evaporation of the benzoline I would surround the case with water kept at boiling point.—COUNTRY JOHNSY.

[45685].—**Yellow Wash for Yacht Funnel.**—Can anyone inform me through your valuable paper how to mix yellow wash for a yacht funnel, so that it will stand the heat of rain and spray, and at the same time not discolour with the heat.—ENGINEER.

[45686].—**Ice.**—Will any correspondent kindly inform which is the simplest, cheapest, and best process known for making artificial ice in the tropics—the ether process or the compressed-air process?—J. W. H.

[45687].—**Polaristobrometer.**—Will someone kindly give me a description of Wild's polaristobrometer, and directions how to use it? A sketch would oblige—CANE-SUGAR.

[45688].—**To "Sunlight."**—I have just finished making a model vertical boiler, 6in. diameter, by 12in., with angle tube, 14in. diameter from inside, fire-box,

6in. diameter by 6in., with 4in. water-space all round. The tube-plates are 3-32 brass plates; the plates used for boilers and inside fire-box crown is 1-16 copper, well riveted together, and all the joints well filled with soft solder. I may state the tube is well secured with back nuts to each plate. It has been tested by water pressure, calculated at 40lb. to the sq. inch, and gave good coal or coke fire with very little trouble, and the steam is getting up, the jet acts on the fire with good effect. Will you kindly inform me what size of engine such a boiler would drive, including force-pump, to which I could use warm water? I may say it has driven an engine 14in. bore, but not with this pump connected, which I know makes a great difference when the heating surface is limited.—DAVINA.

[45689].—**Cheese.**—Would Mr. Allen, or some correspondent give the process of making a rich easy cheese from an old milk cheese? I know it is made, a method I know of, but I want to know how Americans do it.—ACONITE.

[45690].—**Induction Coil.**—I propose to build a large coil on the disc system, and wish to know if there any objection to winding the wire in the divisions in a manner that the free ends can be joined outside the coil?—H. A.

[45691].—**Photography.**—Should the developing, and fixing solutions be thrown away during use once? How are positives taken on dry plates?—IGNORAMUS.

[45692].—**Gases.**—Will any of "ours" kindly give the following:—Given a certain number of units of fuel, which would be given off from the combustion of the fuel, say olefant gas, with the temperature of the before combustion, and the quantity of air necessary to consume the gas, to find the temperature of the products of combustion.—T. R.

[45693].—**Object-Glasses.**—To Mr. HINDS.—Many thanks for your reply (p. 42, No. 6) to my query (and for your suggestion) on p. 41. Will you kindly inform me—(1) What should be the length of the plano-concave lens for my telescope of focus of o.g. being 14ft. 5in.? (2) How can I verify the length of focus of the plano-concave lens? Some London opticians are not very reliable in this respect, exactly the length requested? (3) Will the elements have to be either shortened or lengthened if the plano-concave is inserted? (4) Will the extra magnification increase or diminish the magnifying power with the Huyghenian eyepiece formerly described, is the about 118 diameters.—E. T. J.

[45694].—**Aene.**—To Dr. EDWARDS.—Will Edmunds kindly give a method of curing sun face?—INQUIRER, Providence, R.I., U.S.A.

[45695].—**Wrought-iron Pulleys.**—Having to use pulleys, should be glad if my fellow readers give me some information as to wrought-iron pulleys which are considered the best make.—G. J. C.

[45696].—**Fumigating Oak with Ammonia to Darken its Colour.**—How is this process, and what appliances are required? Is it done by finishing off finally?—D.

[45697].—**Artificial Indigo.**—Will some one give me the name of the compound used in manufacture of indigo, and from which indigo is obtained by treatment with potash? It belongs, I think, to cinchona series. Is artificial indigo much used in country? and what is its price as compared with natural substance?—DABLER.

[45698].—**Vacuum Tubes and Coil.**—In vacuum tubes with the coil, I find that one end of tube is not nearly so brightly illuminated as the other, although everything seems to be working with perfect length of spark, &c., quite up to the mark. Can anyone kindly suggest the cause and remedy? I guess it has been written about making coils. I think we would be better off a few articles on the use of them when W. R. C.

[45699].—**Valve Pressure.**—Will someone give me what load to put on a safety-valve of 4in. diameter weight to be direct, so that it shall open when the boiler is subjected to a pressure of 120lb. per sq. inch. A valve of 7089901 area, under the same conditions pressure as the above?—CRAIG ET ALDRAE.

[45700].—**Limelight.**—Is there any method of making artificial limes (or blow-through) lime experience considerable difficulty in cutting them into lime shells, as the Colonial article seems to lack the whiteness of home lime. Would a composition of Paris, or Portland cement, with alkali lime be of service? If so, what proportions would be best? Will some of your readers be able to give me a name? WILLIAM DOUGALL, photographer, Invercargill, N.Z.

[45701].—**Defective Iron Gas-stove.**—Will someone kindly say what would be best to do with a gas-stove which has been in use about seven years, to make it less gas and give more heat? It is made on the late Belmer's patent. Stands about 2ft. high, 14in. in diameter. It contains three burners on the point of a sheet-iron cone (the burners being truly open to the open air). Over the burner is a cone, which warms the air in the chamber above. Would it be well to inclose the burners with mica? or would it be more economical to replace whole affair by a more modern contrivance?—JANUS.

[45702].—**Dungeness Beach.**—What is the extensive collection of shingle at this place? Is accumulation still in progress?—PASCAL.

[45703].—**Artist's Copying Camera.**—Is it possible to utilise a portrait lens, 6 inches in focal length for copying plans, &c.? If image were made as an object, loss of light might be fatal. Again, distant objects were focused, there would be no thrust head and hand with pencil into camera. If image were thrown upwards through paper on glass lid, great loss of brightness. Any advice?—R. H.

[45704].—**Coloured Glass (Various).**—To obtain and register the variations of shade of specimens, 4 inches square, the weight of each specimen being known.—C. SUMMERS.

its for Air and Water.—What are the methods of ascertaining the impurities in air and water, so as to obtain comparative results? and also a similar means for determining the condition of air?—H. S.

umbrella Making.—Can any kind of a description of machine or lathe used by us for cutting the springholes, and drillings, &c., of umbrellas?—OSK ANKTON

Automatic Musical Instruments.—Some of your readers are interested in some of the automatic kind, and most of them are interested in your columns. Can any of them tell me whether anything in the guinea was described prior to Needham's on illustrated in 1878. Dawson, so long entered the use of the perforated strip of a valve, but he used a pressure bellows. People seems to me the best, and I should rather that had been used in combination with Needham, or whether the suction bellows in this country before the American organ?—NUS. DOK.

Electro-Deposition of Iridium.—I am how to deposit iridium by the voltaic method, as completed it, according to Gore, says that Wöhler says osmium is as anode in a solution of caustic soda.

Oxygen and Hydrogen.—Will any one tell me if oxygen, prepared from air, is as effectual for limelight purposes as the ordinary way? And what treatment for the gas from chloride of lime to a retort and gas-holder? What purpose "wash-bottle" and cannot hydrogen be economically from hydrochloric acid than?—H. RICHARDS.

For Sketching on Terra-Cotta.—I have a receipt for a black ink to dry with a ring on terra-cotta with pen and ink—if it is!—A MECHANIC'S APPRENTICE.

Sealing-wax.—Will some reader send me a recipe for making ordinary bottle D. B. and SON.

Mathematical.—Would any of "ours" following, as I have been unable to find on them in any work?—(1) Show how are root of a vulgar fraction, so as to staining it in a finite form, if it has one. her the square roots of the following are not:—

$$\begin{array}{r} 14,641 \quad 329 \quad 89 \\ 243 \quad 81 \quad 1,331 \end{array}$$

at least integral multiplier which will

$$68x^2y + 102x^2y^2 - 68x^2y^3 + 17xy^4$$

—J. H.

Mr. Lancaster.—Referring to your drawing and description of your dissolving very glad to avail myself of it, and I am sure of this journal, as well as myself, who in the lantern, will be equally obliged to ornament.—LANCERN.

ed-pump.—Would "Sunlight" please wings, and how to make patterns of feed-by tin cylinder, and what stroke, as needs back?—TOMY.

trates.—Would "Analyst" or "F.I.C." test they have given for com. nitrate of plied to all the nitrates? If not, kindly are done.—A CONSTANT READER.

AND SCIENTIFIC NOTES.

ographic Pen.—Many people dis-tylographic pens recently introduced by us, because they alter, to a consist, the character of the handwriting of ing them, and because in the cheaper durability has not yet been secured. Dickson, of 257, High Holborn, has a specimen of his "anti-stylographic" is constructed on quite a new prin-er on the old principle of the ordinary e like it better than any stylograph d. It is very cheap—only half-a-he pen, when worn out, can be re- holder and another substituted at g cost. We fancy most people will s in our preference for the "anti- pen.

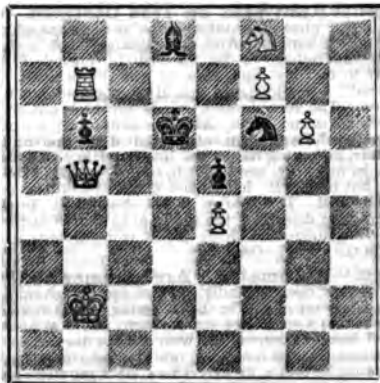
er Machinery.—Messrs. Barnett of Forston-street, N., send us a copy catalogue, which in reality is a small ng with all the appliances used in the of aerated waters and other popular A glance through its pages shows genuity has been expended in devising the manufacture of the carbonic acid harging the bottles; but it contains ount of the various details which go e complete "soda-water" factory— " being the trade term designating lerable industry. In this catalogue have everything, from steam-engines bers, and counter-fountains to show-

CHESS.

All Communications for this department must be addressed Chess Editor, 22, Chancery-lane, W.G.

PROBLEM DCCXXVI.—By C. PLANCH.

Black.



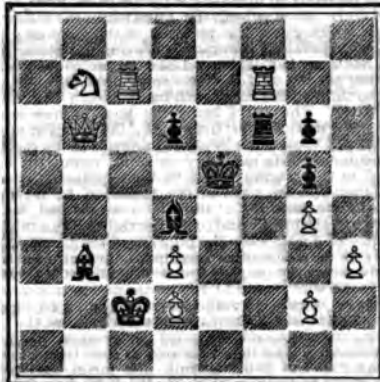
White.

White to play and mate in two moves.

PROBLEM DCCXXVII.—By V. AMANO, Jamaica.

First Prize Problem in Jamaica Journal Problem Tourney.

Black (8).



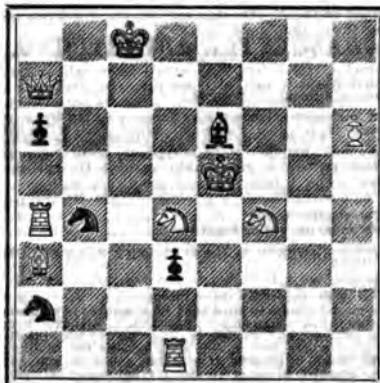
White (11).

White to play and mate in three moves.

PROBLEM DCCXXVIII.—By Miss F. F. BEECHY.

Second Prize Ditto.

Black (5).



White (9).

White to play and mate in two moves.

CHESS ITEMS.

The Chess Players' Chronicle is informed that Mr. W. Steinitz has challenged Heren Zukertort and Hoffer, joint editors of the Chess Monthly, to a match of eleven games, two games to be played a week for a stake from £100 to £250 a-side. Mr. Steinitz proposes to play against these two masters in consultation, and conceding them the odds of two games. This is a kind of sensational startler to the Chess World. We hardly think the editors of the Chess Monthly will accept the challenge; but Mr. Steinitz offers, in the event of his challenge not being accepted, to play them level, or receive the odds of two games—the same as he offers to concede.

The Brighton Guardian intends starting a Solution Competition, which will last during the publication of its Tourney Problems. There are numerous prizes, and we shall be glad to send full particulars to anyone desirous of competing.

ANSWERS TO CORRESPONDENTS.

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, Tavistock-street, Covent Garden, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 25, and unacknowledged elsewhere:—

GEO. PEARSON.—J. and T. Greeves.—W. Granger.—Char- rington, Nicholl and Co.—H. Pattison.—Capt. Du Boulay.—Albo Carbon Light Co.—H. Watkin.—E. A. Fishbourne.—W. P. Kelly.—Capt. St. George Gore.—J. Wilks.—J. T. Chapman.—C. Anthony.—M. Cohen.—M. W. Bennett.—T. C. Molesworth.—F. J. D.—One in a Fix.—J. W.—Ellis and Co.—Angulus.—G. Cruise.—T. J. Scott.—Edward Jackson.—W. M.—J. W. A.—Duplex.—E. Meldrum.—Anxious.—N. W. E.—W. B.—X. X. X.—Oilman.—Treadle.—An Old Subscriber.—F. Rowe.—Amateur.—A Subscriber.—Val-tudinarian.—J. Kendall.—H. H.—A. B. R.—Meteor.—Jas. Gale.—Water Motor.—No. 170.—Sweetapple Cottage.—G. D.—A Two Years' Reader.—F. B.—R. T. B.—Country Smith.—W. T.—W. R. H.—Enquirer.—R. Wright.—H. A. Wassell.

THE SOLAR ECLIPSE OF JULY, 1878.—It may possibly be inferred, from an expression in our article on p. 462, that the light by which the Corona image was impressed on the plate in Mr. Hanyard's heliographic spectroscopic camera, was monochromatic. This is not the fact. It proceeded from a continuous spectrum extending from G to H. By "the region of the H line," we intended to indicate the neighbouring part of the solar spectrum; but the words, as they stand, seem liable to the possible misapprehension to which we have referred.

KNOWLEDGE IS POWER. (We cannot find a resistance coil "drawn" in the book to which you refer; but at any rate it will be nothing more than a means of sending the current through longer or shorter lengths of wire, as may be required. The proportion of copper to zinc will vary with the construction of the battery. In the ordinary Daniell the cell itself is of copper, and a zinc rod is inserted in a porous jar; but in the flat plate form the copper may be bent so as to surround the zinc (2 to 1), or the plates may be equal in size and be set up in pairs. As the zinc is worn away, it is obvious that the size is not of much importance. See back numbers.)—H. A. B. ("Sails and Sail-Making," 2s. 6d., Lockwood and Co., Stationer's Hall-court, E.C.)—A. H. ("Glass Embossing and Sign-Writing," 5s. For others, see Calvert's Catalogue, Great Jackson-street, Manchester.)—G. C. F. (Messrs. Novello, Berners-street, W., publish a number of cheap books on music. Send to them for a catalogue.)—J. O. LINDSAY. (Thanks; it is scarcely news.)—A SUBSCRIBER. (See articles in back volumes, p. 471, Vol. XXX., for instance; or procure the specifications of Balmain's patents.)—R. MOORE. (See p. 497, Vol. XXXI., and the indices generally.)—PAUL. (You will probably find some in the Transactions of the Meteorological Society, and in the columns of Nature.)—E. GREATOR. (Thanks; but what is there to notice?)—RAILKUR. (See p. 229, Vol. XXX. It is made simply by mixing a baking-powder intimately with the flour. "Baking-powders" made up of phosphates are the best for the purpose.)—D. B. (Good recipes of the kind are difficult to obtain. You will find some in Cooley's "Dictionary of Receipts," and Gould's "Book of Receipts," published by Barrett and Sons, Scething-lane, E.C., may be useful.)—ANGLO-ITALIAN. (It is used for many purposes nowadays, including fireproof paint. Yours is a fine sample, and you would probably best get at those who can utilise it by advertising the fact that you will send samples. There is a company in this country, but they own mines in Italy, and have offices in Turin. The great demand is for the commoner qualities; but a very important use of the longer-fibre samples is the manufacture of packing for steam-engines.)—R. M. (They require repolishing, and you had better get some one who understands the work to do it, if they are of value. 2. We know of nothing but warming gently before a fire.)—T. P. (Gent and Co., Leicester, make a good one. An ordinary coil answers, the size depending on the length of line wires, &c. See pp. 387, 492, Vol. XXXIII.)—YOUNG ENGINEER. (You should get some textbook on the steam-engine, such as God-eve's, published by Longmans. The steam is cut off at a certain point of the stroke, and its final volume, as compared with its volume when the admission valve closed, gives the number of times that volume has expanded.)—AN ENGLISH MECHANIC. ("The Gas-fitter's Guide," published by Mr. Eldridge, 54, Murray-street, Hoxton, N.)—YANKEE. (The rubber is prepared with sulphur, and is forced into a plaster mould, under the influence of pressure and heat, where it is vulcanised. See p. 81, Vol. XXXII.)—L. H. (No.)—M. H. (Simply debility; plenty of fresh air, good food, and proper sanitary surroundings will effect a "cure.")—EVENING. (Yes, they are what you suspect. If you don't look for them you will soon fail to see them, especially if you put

your stomach, &c., into good order.)—JAMES LANG. (See p. 285, and other replies, 45/92.)—WORKING OUT INDICATOR DIAGRAMS. (See the indices of the last three volumes.)—EXPERIMENTALIST. (The tube is heated, and the open end dipped into mercury, some of which is driven in by the atmospheric pressure; the process is repeated until sufficient mercury has been introduced. The bulb is then heated, and when the mercury fills the tube the end that was open is hermetically sealed in the blowpipe flame. There is no such thing as a "perfect vacuum.")—D. B. AND SON. (Why should the pipes require "repairs"? There is nothing better than Leroy's composition, advertised on front page.)—F. W. H. (Will not dipping in melted paraffin wax do? If not, see p. 220, Vol. XXXII, and the indices generally.)—CALC. (A thorough study of Colley's "Handbook of Practical Telegraphy" will help you; but you should also obtain some practice in the workshop.)—WAG-HEIL. (We referred to "back numbers" because there are so many giving information of the kind. We do not remember what is the object of your question; but you may refer to pp. 101, 178, 346, 565 in the last volume.)—J. HISTOR. (If you will look through recent back numbers you will find answers to your questions.)—VULCAN. (The best way of obtaining such information is to write to the secretaries of the societies you wish to join.)—STOCKING. (Such a query should be inserted in the "Advertisement" column, under "Wanted.")—POACUPINE. (Take the average of the preceding fifty years, and modify it according to the state of the weather. That is about all. How do you imagine a thermometer registers the "mean" temperature?)—CANADIAN PLUMBER. (You should consult your back numbers for details. Get a catalogue from Messrs. Gent, of Leicester. It contains a great deal of information about electric and pneumatic bells.)—RXP BRONZE. (The brass is cleaned by dipping in the usual way, and the waters used for washing first are preserved as the solution. The brass is bound round with iron wire and laid in the solution, which is nitric acid and water. We believe a similar effect is produced by means of sulphuric acid in the same way.)—C. E. L. (You should apply to some of the large lamp-dealers; but we doubt whether you will find many lamps of the kind except the small ones. Many people object to benzoline.)—SEYAN. (Is it the fault of the diamond? If it cuts the glass, that will break in the line, though you will have to use some force. As to silvering, see recent back numbers and volumes.)—M. C. H. (Pick off all you can, and remove the remainder by the aid of warm spirits of wine.)—WHITE KING. (Will you explain exactly what you mean by "setting up"?—W. J. F. (The danger is that so small a pipe will quickly become incrustated and reduced in diameter; besides, is there room in the flue? When flue is specially arranged for the purpose, feed-water heaters are preferably placed there; but larger pipes are used.)—MANUFACTURER. (Much would depend on the way in which it fell—that is, in pieces or in bulk. Anyhow, we hardly think an inquiry of the kind worth its space.)—J. T. BROWN. (F. W. Breary, Maidenstone-hill, Blackheath.)—OCCASIONAL READER. (About a farthing a pound, we should think, for waste paper.)—DUBIOUS. (How can we say! A post-card to the publishers would settle the question at once.)—SKETCHER. (At Rowney's, or Winsor and Newton's, we should think. If not you had better advertise in the "Sale" column.)—R. WILLIAMS. (The fees vary with different lodges. Introduction by some member is all that is necessary. Read an article and some subsequent correspondence on the "Secrets of Freemasonry," on pp. 480, 509, 544, and 574 of the last volume of the *Building News*. The four numbers can be had post free from this office for 1s. 6d.)—SIGMA Z-TA. (We have not the space to spare, but there are half a dozen good cheap volumes published which will serve you. Any good bookseller will select. For instance, buy a cheap edition of the "Ingoldsby Legends.")—CAPT. CURTIS. (The principle of the fire you sent is not new, though good. It has been described long ago in these columns.)—VULCAN. (If the property was left only to the mother for her lifetime, we do not understand how she can dispose of the stock. It would be absolutely necessary to see the will under which the mother became possessed of the property, and we think you had better consult a solicitor personally.)—T. K. (We know of no such guide.)—A. B. (Dates of executions are beyond our province. Consult a file of the *Scotsman*.)—T. PAR-Y. (We do not know; we never saw the systems; possibly an advert. in the "Address" column might bring a reply.)—INQUIRER. (Had better inquire locally, or advertise in a *Manx* paper. We should not expect much good from the speculation.)—E. NUNN. (Have the carpet cleaned at one of those establishments where they employ steam, and well beaten when dry; nothing else that we have tried ever proved effectual.)—P. W. R. (1. Yes. 2. Napoleon I. was, but, speaking from memory, it has not been invariably so.)—C. L. (We cannot devote all our space to brakes and railway accidents, and we have no space to spare just now for discussions on the opinions advanced by Mr. Stretton—with which, however, we thoroughly agree. We do not see that your idea would work in connection with the brake referred to, and we quite agree with you that "there are other objections to its use.")—C. R. T. (Tar and sand alone will be of little use. Cover first with asphalted felt roofing, Engert and Rolfe's is as good as any, and costs 1d. per square foot, and then give a dressing of tar and sand. If the dressing of tar and sand is repeated annually—or even seldom in some situations—the felt will last ten or twelve years.)—ENQUIRER. (A Tradesman's Token, worth scarcely anything. 2. Worth from 2s. to 6s. per cwt., according to colour and quality.)—CHEMIST. (Must ask such questions privately of the correspondent he names, or advertise his requirements in the "Sale" column.)—DAN LEE. (Write B. T. Bateford, 52, High Holborn, London, W.C.)—IRON HORSE, AND SEVERAL OTHER CORRESPONDENTS. (Our space really will not hold out against the repeated demands for information respecting brakes, names, numbers, stations, &c., of individual locomotives.)—X. (Oil would be no use; try some of the Silicate paints. See advertisement pages of the *Building News*.)—OBOAS. (We do not know why the articles are not completed; but we fear Mr. Dresser is ill. We agree with you that their absence is a calamity.)—E. S. C. (People in the colonies do not care for assistants whose principal

objects are "travel and experience"; but any one willing to work for a living ought to find no difficulty in the lines you name.)—J. MURRAY. (We must beg to be excused from discussing or giving any opinion about the "P. D." system of astrology. It is a remarkable one, though, judging from your diagram.)—CARRIAGE SMITH. (Nitric acid. Other query next week.)—HARMONY. (Quite possible. We know better players than you are ever likely to be who have overcome worse defects.)—QUESTON, F. I. C., BUTTERSHAW, W. G. WENLEY. (In type.)

J. A. OLLARD.—The D. G.—F. I. C., and others have replied to queries already similarly or adequately answered.

Every Workman connected with the Building Trades requiring a notice should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

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Throat Irritation.—Soreness and dryness, tickling and irritation, inducing cough and affecting the voice. For these symptoms use Epps's Glycerine Jujubes. Glycerine, in these agreeable confections, being in proximity to the glands at the moment they are excited by the act of sucking, becomes actively healing. Sold only in boxes, 7d. and 1s. 1d., labelled "JAMES EPPS and Co., Homoeopathic Chemists, London." A letter received:—"Gentlemen,—It may, perhaps, interest you to know that, after an extended trial, I have found your Glycerine Jujubes of considerable benefit (with or without medical treatment) in almost all forms of throat disease. They soften and clear the voice.—Yours faithfully, Gordon Holmes, L.R.C.P.E., Senior Physician to the Municipal Throat and Ear Infirmary."

Holloway's Ointment may be applied to the most sensitive skin with the certainty of its removing pimples, eruptions, and roughness, without producing any inflammation or unsightly discoloration. The balsamic nature of this unguent recommends it strongly to the young and delicate. It will cure scrofulous complaints which have resisted every other treatment.

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

First-class Silver Lever Watches, English, new; Exchange for anything useful. 2 Ladies Gold, and 3 Chronographs.—7, Warrington-road, Prescott, Lancashire.

Books. "Franco-German War," bound, in two volumes. Exchange for Books or Lathe equal value, or offer Mutual agreement.—PARKER, 4, Frederick-street, Caledonia-road, N.

Magnificent carved first quality Meerschaum Pipe, Subject—Red Riding Hood. Massive amber, in splendid case, value £4. What offers?—JAMES SOUTHERY, Esq., Wellington, Somerset.

Powerful Telescope, mahogany body, 24in. object-glass, draws out to three feet. Cost £2 10s. What offers? Mutual approval.—JAMES SOUTHERY, Esq., Wellington, Somerset.

Wanted, good 4th Micro. Objective. Give Ross's "Optimus" lens and camera, or electrical exchange, and adjust value.—EAMES CLOVE, Springfield, Sudbury, Suffolk.

Hurdy-Gurdy, polished mahogany case; nice piece of furniture, 8 tones with bell accompaniment, for really good microscope in perfect working order; must be no trash.—J. B. 22, Brunton-place, Carlisle.

Solid Silver Bangle Coil Bracelet, handsomely chased design, cost 15s. 6d.; what offers? mutual approval.—JAMES SOUTHERY, Esq., Wellington, Somerset.

First-class 10-keyed Melodeon, powerful tone, double bellows, richly ornamented in green and gold, not sold; cost £2, what offers?—JAMES SOUTHERY, Esq., Wellington, Somerset.

Wanted, 50 large empty Cigar Boxes for good exchange.—JAMES SOUTHERY, Wellington, Somerset.

Dynamo Meter, value 15s.; Silver Watch, value 30s.; wanted, Burchett's "Practical Plane Geometry," and other mechanical and engineering books. Give cash to value.—J. A. LOCK, Martock, Somerset.

What offers? Exchange a good mahogany 4-plate camera and lens; 4 plate-glass bath, 2 porcelain floating-baths, printing frame and stand.—WILLIAM ROSE, jun., Mid-street, Keith.

Planing Machine, excellent tool, for hand and power, plans 4ft. by 18in. square. Part cash, only £45.—37, North Cross-road, East Dulwich.

Lathes.—A 4in. and 5in., with iron beds and frames, turned wheels and wrought treads; either for £7 10s. or part exchange.—37, North Cross-road, East Dulwich.

Tricycle, the "Salvo," 48in. half-plated, with saddle, nearly new, £12, or exchange; offers wanted.—37, North Cross-road, East Dulwich.

Bicycle, a splendid 48in. silver-plated machine, the "Woodcock," with all latest improvements, cost £20; only used a few times; offers.—37, North Cross-road, East Dulwich.

Half-horse Horizontal Engine in good working order, will exchange for stocks, dies, and taps, or any useful offers.—TAYLOR, 18, Wakefield-street, Warrington.

Two by four new Engine Boiler, part made, for very good sewing machine; no rubbish accepted.—SMITH, Lower High-street, Tutbury, Staffordshire.

I will exchange pair Belgian Hares, value 20s., for Matthew Henry's complete Bible Commentary; must be cash.—JNO. SCAMMELL, Wilton, Salisbury.

Vols. XII. to XXXI. "English Mechanic," two Nos. wanting in Vols. XIV. and XV., all others complete; also, Newtonian Telescope, metal speculum 3in. diam. 8ft. focus; for combined lathe and (ret saw, Britannia Co.'s, in good order; or offers.—T. COLLINS, 8, North Gully-street, Elgin.

Telescope, 3in. object-glass, 3 eyepieces, brass tube, tripod stand, polished case; exchange.—E. LARSEN, Moor-street, Cheltenham.

English Concertina, by Wheatstone, in good condition (48 keys), for good perambulator with spider wheels and rubber tire.—TARLETON and DAVIES.

Air Pump (single barrel), six inch glass receiver (diameter), what offers?—TARLETON and DAVIES, 9, South-road, Waterloo, Liverpool.

Chest fitted with drawers, lot of various Tools, and 24 centre bench lathe, price £23; exchange good lever watch.—J. JUNR., 15, Woodcross, Bilton.

Cabinet Piano, sound condition. What offers in exchange in musical instruments.—J. KEILBACH, 110, Huntley-street, Bedford-square, W.C.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

For Sale.

"The Night-light Clock." Illustrated and described on page 370, No. 548. Price, carriage free, 5s. 6d.—F. ROSSKOPF, 15, Greek-street, Soho, W.

Band Primo.—A Tutor for all Band Instruments. "A Book which every Bandman should have." Price 5s., P.O.O. T. RAWSON, 114, Hoxton-lane, Stockport.

Elastic Stockings. No makers in London. Made in Liverpool only by SMITH and BONS, Breck-road.

Harmonium, £5; 7 stops, walnut case, full compass, ivory keyboard; bargain.—49, Collier-street, King's-cross.

Lantern Photographs, 10,000, with readings, from 6d. plain, 1s. coloured.—A. FUMPHART, Emily-street, Birmingham.

Lantern Photographs for Hire. List and sample picture for 8d. in stamps.—A. FUMPHART, Emily-street, Birmingham.

Triplex Lantern, Achromatic Lenses, full size, best light, limelight excepted, 25s.—FUMPHART, Emily-street, Birmingham.

Complete Limelight Apparatus, equal to 200 candles, 50s. List of Apparatus 3d.—A. FUMPHART, Birmingham.

Chromatrope, with 5 designs and Eidotrope, complete from the manufacturer, 10s.—A. FUMPHART, Emily-street, Birmingham.

Harmoniums, second-hand; returned from hire. All prices.—VENABLE and Co., 187 and 189, Essex-road, Islington.

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The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, FEBRUARY 3, 1882.

THE CRYSTAL PALACE ELECTRIC EXHIBITION.

ALTHOUGH the international electric exhibition at the Crystal Palace is still far from complete, there is much to interest the attentive observer and to instruct the student, while the public who go mainly for sightseeing will be amply repaid by the splendid effect produced by the Edison incandescent lamps in the concert-room. Amongst the arc-lamps exhibited one or two systems may be picked out as slightly steadier than the others, but no proper comparison of their relative merits can be made until details are forthcoming, which at present are not available. At the beginning of this week, two at least of the most important arc-lamps were unrepresented, and judging by the rather chaotic appearance of the machine-rooms, it is more than probable that the next week will have arrived before all the dynamos and engines are at work. The various exhibits are scattered over different parts of the Palace, and the visitor will need all the assistance the plans given in the catalogue afford to enable him to find the respective dynamo-machines and the lights they supply. In the basement are six of Edison's dynamos, of the type with vertical field-magnets—rather ugly in appearance as compared with the neater Gramme, Siemens, Brush, and with the less familiar Weston and Maxim machines, which are also in working order. Edison's large dynamo, on the horizontal plan, is located at Holborn Viaduct, where it will shortly come into use for supplying current to the lamps in the street, the houses adjoining, and Dr. Parker's chapel. The War Office exhibit is now arranged, and a couple of courteous representatives of the Royal Engineers have been detailed to explain the various articles to inquirers, Mance's heliograph being possibly the most attractive exhibit. The Post Office shows a complete collection of instruments, including many of historical interest; but the most attractive are, naturally, the instruments in operation, which consist of a set of Wheatstone's A B C telegraphs, single needle instruments—one of them with the tin-sounders—duplex direct inkers, duplex double current-sounder set, and the Wheatstone automatic apparatus used for sending the Press messages. In connection with the latter will be found the punching apparatus for perforating the strips of paper, one of which, made into an endless band, is seen passing through the transmitter at the rate of 200 words a minute, the message being received at a neighbouring instrument in the form of dots and dashes printed in ink on paper. A set of these instruments with others, some of which are used in connection with them as repeaters, are also shown as "still" exhibits, so that those who are curious can inspect them while in motion as well as at rest. The arrangements for working pneumatic tubes will not be without interest to many visitors, and young plumbers especially will find something instructive in the means adopted for making joints so as to preserve a perfectly smooth surface in the interior of the pipe. The Post Office exhibit is, in fact, the most complete and perfect collection of telegraphic appliances that could be made, for it includes almost

everything in use from a model with diagram of a cable ship, to a stuffed specimen of the Norwegian woodpecker with a portion of a telegraph pole it has completely perforated in its search for the insects which the humming of the wires led it to expect. Leaving the Government exhibits which are in the north nave, we make our way to the galleries at the southern end, and there we find a number of novelties which have, perhaps, more interest for the general public, as the exhibits are more intimately connected with the business and social life of individuals. Here at the stall of Messrs. Blakey, Emmott, and Co., of Halifax, we come upon a collection of useful appliances, consisting of telephonic arrangements, telegraph relays, galvanometers, graduated wire bridges, and the usual assortment of bells. The telephone system adopted by the firm, which they send out in a compact form, is the Bell receiver with either the Blake or the Crossley transmitter, and they have a simple and ingenious switch-board for accommodating fifty telephone exchange customers. In this arrangement there are a number of brass rods placed in a horizontal position and in electric contact with the line wires, when the plugs are placed as desired. The sender of a message to the central office indicates the number of line he wishes to communicate with, and the attendant places the plugs in the required position. When the line is done with for the time, a signal is sent which causes a small lever with a red disc to drop, and the attendant at the central office then knows that the apparatus is clear for anyone else who wishes to use it. Blakey, Emmott, and Co., also exhibit the Warburton and Crossley relay, an appliance which has been extensively utilised in India, and the patent bell instrument of the same inventors for telegraphing by means of two distinct sounds. In the same gallery, but on the opposite side of the building, will be found one of the most sensitive telephones in the Exhibition, that of M. L. de Locht Labye, of Mont St. Martin, Liège, which has been adopted by the Government of the Argentine Republic, and is used by 600 subscribers at Buenos Ayres. This instrument, which is called the Pantelphone, consists of a simple cork plate suspended by two brass springs and carrying a disc of carbon which vibrates against a metallic peg. A small induction-coil is inserted in the circuit, and there is the usual electro-magnet and bell for signalling. The special advantage of this telephone appears to be its extreme sensitiveness, for the transmitter acts effectively when spoken to at a very long range, much further than is likely to be the case in any business office in which it is fitted. In fact the transmitter is so sensitive that at the Crystal Palace, owing to its position, it cannot be set to its full capabilities, for it transmits any noise which can be heard by the bystander. An indicator signal is attached to this instrument, so that in the event of the attendant at the distant station being absent when a call is sent, he can see on his return, by a red disk being uncovered, that he has been signalled in his absence. The Bell receiver is used with this instrument, as indeed it is with the great majority of telephonic arrangements exhibited, and in this case it is claimed that words spoken at any reasonable distance from the transmitter are heard clearly to distances of 150 miles. In the Southern Gallery, Messrs. Lewis and Son, of Knightsbridge, exhibit a very complete collection of electric bells and alarms, including a neat and handy arrangement of portable bell for use where it is desirable to set up a temporary communication. The whole apparatus is self-contained in a neat box, the door of which carries a reel, on which a flexible silk cord containing the conducting-wires, is wound. This cord may obviously be of any desired

length, but sufficient is supplied with the two sizes of instrument for all ordinary purposes. The battery used is the new form of Leclanché known as the agglomerated, in which two blocks of compressed manganese are held up to the carbon-plate. The flexible silk cord is small enough to pass under doors and mats without inconvenience, and a simple "push" at the end rings the bell. This firm also exhibits an improved form of "pull" for garden gates, which is intended to foil the mischievous gentry who delight in wrenching off knobs when they can do it safely. In this case the spindle is round and turns easily, so that "wrenching" cannot be performed, while any attempt to pull the knob off sets the bell going, and raises an alarm. At the same stall applications of electric alarms to windows, letter-boxes, and doors are shown in working order, and an ingenious arrangement for use in connection with cash-boxes and jewel-cases, which, without requiring any alteration in those articles, rings an alarm when they are moved. Messrs. Lewis and Son also have a rough model of an electric chiming apparatus, which will be shown to those curious in such matters, though it is scarcely a portion of their "exhibit," being in an unfinished state. This apparatus is made to work with a barrel as well as with finger-keys, and can with suitable magnets and battery power be employed in working the largest chimes. Amongst the alarms shown by this firm is a fire-alarm, which acts by the curving of bars compounded of two metals when subjected to heat—the special feature of which is, however, that it answers the purpose of an ordinary signal-bell as well as a fire-alarm. Another and more delicate arrangement is for use in greenhouses and other horticultural buildings; it gives warning in either case, when the temperature falls too low or rises too high. A thin bar, made of two metals, is closely adjusted by means of the thermometer between two stops so as to remain free from contact on either side, while the temperature remains at the required point. The adjustment is readily made by turning the screws until the bell rings on the cold side as well as on the hot: a slight turn back then leaves the apparatus in a sensitive condition, so that a change of a few degrees in temperature on either side will cause the compound bar to curve and make contact, thus ringing the alarm. At Messrs. Blakey, Emmott, and Co.'s stall in the Western Gallery will also be found the exhibits of the Messrs. Mottershead, of Manchester, consisting chiefly of electro-therapeutic apparatus, induction apparatus, improved electrodes, rheophores, &c. The continuous-current Leclanché batteries are specially adapted for carrying from place to place, require practically no attention for a very long time, and avoid leakage and breakage. Each case is fitted with a "current selector," enabling the operator to bring any desired number of the cells into use without causing a break in the circuit; a commutator for opening and closing the circuit, so constructed as to indicate the direction of the current, a set of shunts, and a galvanoscope. The same firm also exhibit Dr. Dixon Mann's uni-direction induction apparatus, from which the current always passes through the patient in one direction. The current can be regulated to the greatest nicety, for there is, first, a current selector, having three studs representing weak, medium, and strong; and, secondly, a sliding-rod, which adjusts the current between those degrees. In view of recent railway accidents, there are two inventions which will commend themselves to the travelling public. In the Eastern Gallery, Mr. Sullivan shows, in working order, an electric fog-signal, brought into use by the lever in the signalman's box.

secondary spectra: of these I have selected such as appear most interesting; the number prefixed to each, corresponds to its place in Brewster's list.

Part I.—Experiments on Secondary Spectra.

In most of these experiments, a prism of the proper angle (determined by the process before explained) is used to balance the dispersion of the adjacent one, but in some few cases, the correctness is effected by inclining one of the prisms. A straight parallel bar is used, in the same position as Fig. 4.

1. The dispersion of a prism of water, angle = 68° , is corrected by a prism of oil of cassia, angle = $8^\circ 16'$.

The bar "has on one side a very broad fringe of wine-coloured light, and on the other a similar fringe of green."

The green fringe is on the same side of the bar as the vertex of the smaller prism.

2. A crown glass prism, angle = $41^\circ 11'$, is corrected by the one of oil of cassia, angle $8^\circ 16'$. The uncorrected fringes are similar, but narrower, than in (1).

The green fringe as before.

3. A flint glass prism, angle = $25^\circ 26'$, is corrected by the cassia prism of $8^\circ 16'$.

The uncorrected fringes are similar, but narrower, than in either (1) or (2).

The green fringe as before.

4. A rock-crystal prism is corrected by the cassia prism. The uncorrected colour is greater than in any of the preceding experiments. The green fringe as before.

8. A prism of diamond is corrected by the cassia prism. The uncorrected colour is nearly as great as in exp. (3); the green fringe as before.

5. A prism of rock crystal is corrected by one of flint-glass. The green fringe is towards the vertex of the flint prism.

11. A prism of crown-glass is corrected by one of flint-glass; uncorrected green is towards the vertex of the latter prism, showing that red and green are more contracted by flint than by crown glass.

12. A prism of rock-crystal is corrected by one of crown glass; uncorrected green is towards the vertex of the latter prism, showing that red and green are more contracted by crown glass than by rock-crystal.

13. A prism of hydrochloric acid is corrected by one of crown glass; uncorrected green is towards the vertex of the latter, showing that red and green are more expanded by the acid than by crown glass.

14. A prism of hydrochloric acid is corrected by one of rock crystal; uncorrected green is towards the vertex of the former prism, showing that red and green are more expanded by rock-crystal than by the acid.

23. A flint-glass prism, angle = 41° , is corrected by a crown-glass one of 69° ; the uncorrected green is "remarkably distinct" and towards the vertex of the first prism.

24. When a red glass prism is corrected by one of crown glass, or (25) by one of flint glass, the uncorrected green is towards the vertex of red prism.

33. A prism of calc spar (1st refraction), angle = $63\frac{1}{2}^\circ$, is corrected by a flint-glass prism, angle = 65° ; uncorrected green is towards the vertex of the latter.

34. A prism of calc spar (2nd refraction), angle = 65° , is corrected by a crown-glass prism, angle = $41^\circ 11'$, or 69° , inclined so as to increase dispersion; uncorrected green as before.

35. A prism of calc spar (2nd refraction), angle = 42° , is corrected by one of crown glass, angle = 69° , the first being inclined so as to increase dispersion; uncorrected green is towards the vertex of the spar prism.

36. The same result is obtained, when the 1st refraction of the spar is made use of.

37. A prism of calc spar (1st refraction) is corrected by one of rock-crystal; the uncorrected green is towards the vertex of the first prism.

53. A prism of sulphuric acid is corrected by one of crown glass: the uncorrected fringes are very great, with the green towards the vertex of the second prism.

54. The experiment being repeated with a rock-crystal prism instead of crown glass, the uncombined colour is still very great, with the green as before.

55. A prism of water is corrected by one of

sulphuric acid; the uncorrected green is towards the vertex of the first prism.

Experiments on Tertiary Spectra.

61. A prism of flint glass, angle = $41^\circ 11'$, is corrected by another one of flint glass, whose angle is $60^\circ 2'$, the first prism being inclined so as to increase the dispersion. The uncorrected colours are distinct with the green towards the vertex of the smaller inclined prism.

62. A prism of flint glass, angle = $38^\circ 51'$, is inclined so as to correct the dispersion of another flint one, whose angle is $66^\circ 2'$. The green is towards the vertex of the first prism. Both prisms were of the same kind of glass.

"The two preceding experiments being repeated with various prisms of flint glass, I always found that the prism with smallest angle had uncorrected green towards its vertex, and what was still more singular, the colourless pencil was still considerably refracted from its original direction by the prism with the largest angle."

63. A rock-crystal prism, angle = $25^\circ 28'$, is inclined, so as to correct the dispersion of another one of the same substance, angle = 70° . The colourless pencil is still considerably refracted.

The experiment being repeated with a second rock-crystal prism, angle = $41^\circ 20'$, the refraction was not wholly destroyed when the combination was achromatised.

64. A prism of plate glass, with a small angle, is inclined, so as to correct the dispersion of a rock-crystal prism of large angle: uncorrected green is towards the vertex of the smaller prism.

(To be continued.)

SOME NEW FACTS ABOUT COLOUR-BLINDNESS.

THE rare cases of unilateral colour-blindness (the defect occurring only in one eye) may be regarded as specially important for the theory of colour-perception. One such case of colour-blindness for red was lately examined by Herr Holmgren, and further by Herr von Hippel, who had discovered it. According to the latter, the spectrum for the red-blind eye does not stop sooner than for the normal eye, and the red-blind eye perceives the colours yellow and blue, as also white, quite like the other. The division between the blue and the yellow part of the spectrum lay between 76 and 77 of Kirchhoff's scale.

Some experiments were made by Herr von Hippel with regard to the negative after-images of the colour-blind eye. With intense pigment colours, first the left normal eye, and then the right red-blind eye, was tested; and the patient was required not only to name the colours which he saw in the after-image, but (to render possible an objective comparison of his perceptions), to indicate directly woollen-fibres corresponding in colour to his after-images. The result was that the after-images of the left eye fully agreed in colour with those of a normal eye, whereas those of the right were quite different.

This is shown by the following table:—

Colour of pigment.	Left after-image.	Right after-image.
Red	Bright green	Bright blue
Cinnabar red	"	"
Orange	"	Blue
Yellow	Bright violet	"
Yellow-green	Bright rose	Bright blue
Green	"	"
Bright blue	Bright yellow	Bright yellow
Blue	"	"

After making these experiments, Herr von Hippel had an opportunity of examining a physicist who was colour-blind in both eyes. He, too, had no curtailment at the red end of the spectrum, and the position of the colourless division-line between the two colours of his spectrum agreed almost exactly with that in the case already described.

On inquiring into the after-images obtained with the same pigments, the result was the same. For red, orange, yellow, and green, the after-images were pronounced blue; and for blue, yellow. At the request to choose corresponding woollen fibres, the same dark-blue was unhesitatingly selected for orange and yellow, as in the former case. For red, cinnabar red, yellow green, and green, this patient selected, indeed, the same bright blue as the other, but also, in addition, the colours bright rose and bright violet, which he also called "blue."

These facts Herr von Hippel considers as difficult to reconcile with the Young-Helmholtz theory of colour perception, and as agreeing well with the

theory of Hering; but he refrains from confident assertion on the point.

The result of a recent extensive examination by Dr. MacGowan, in China, is that the defect is, in that country, either wholly absent or extremely rare. This state of things, taken with what is found among Europeans and Americans, is suggestive, he points out, of the inquiry whether colour-blindness may not be a racial characteristic. Nubians, it has been lately ascertained, are free from the defect. In this connection Dr. Roberts (in a medical contemporary) calls attention to the fact that during the voyage of the *Yega* Dr. Almqvist examined, by Holmgren's method, 300 Chukches, a large tribe living on the extreme north coast of Siberia, which, if not a branch of the Mongolian stock, has very similar physical characters. He found that 9 (or 3 per cent.) were completely colour-blind, and 18 (or 6 per cent.) incompletely colour-blind, or gave uncertain indications. With respect to negroes, Dr. Jeffries found 2 per cent. and Dr. Burnet 1.6 per cent. of colour-blindness among negro school-children in America. Dr. Roberts has observed that colour-blindness is most common among persons with reddish or red hair. At Marlborough College the proportion of boys with such hair is 9.06 per cent., but of the boys who are completely colour-blind, 41.7 per cent. have red or reddish hair. Colour-blindness, moreover (he says), is very prevalent among the Jews, who are the most decidedly red-haired of all the races we are acquainted with. Thus, there may be some correlation of colour-blindness with pigmentation, and indirectly with racial peculiarities, but the data at present collected are insufficient.

AMATEUR MECHANICS.*

(Concluded from page 465.)

Metal Spinning.

THE operation of spinning metals, although exceedingly simple and capable of being practised to advantage in almost every shop, and also by the amateur mechanic upon the foot lathe, is not generally understood. One reason for this is that the artisans who follow this branch of mechanics as a business usually conduct it under locked doors, and it is with considerable difficulty that the amateur in search of information on this and kindred subjects can obtain entrance to one of the establishments. The reason of this secrecy is plain enough, as the "kink" or "wrinkle," or, in plain English, the knowledge required to do the mechanical part of spinning, is so slight that secrecy is the only protection.

The tools required are few. They consist of a lathe; a form or mould on which to shape the article; a tool rest with a series of holes for receiving a pin to keep the tool from slipping, and a few spinning tools or burnishers of different sizes and shapes.

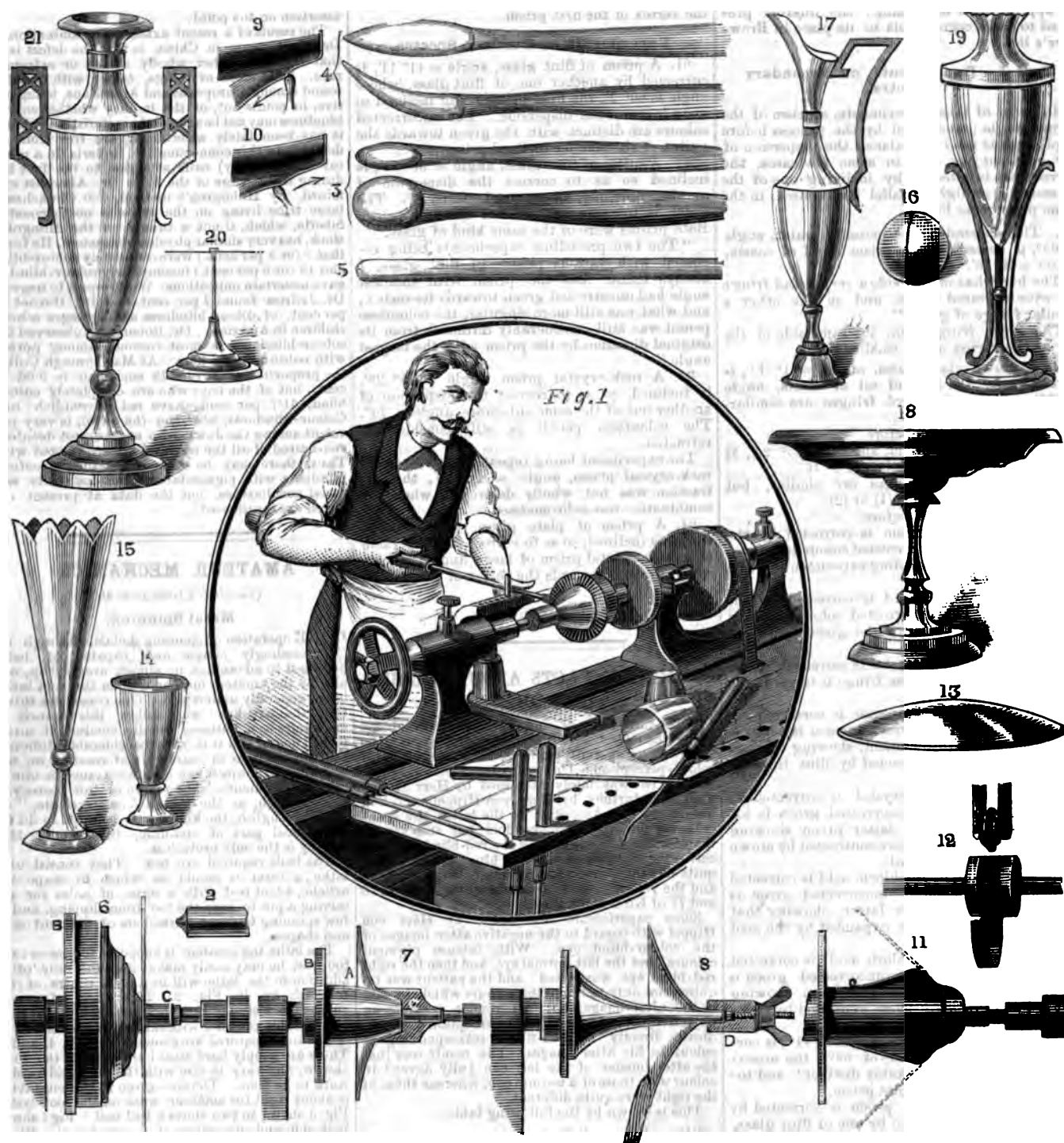
The lathe the amateur is supposed to possess; the tool rest he may easily make; and the only other addition to the lathe will be a back centre of the form shown in Fig. 2. This form of centre answers as a step to the work holder, and will bear considerable pressure without undue friction.

The tools required are shown in Fig. 3, 4, and 5. These are simply hard steel burnishers of the form shown, and vary in size with the size and kind of work to be done. The size given in the engraving is about right for amateur work on the foot-lathe. Fig. 3 shows in two views a ball tool. Fig. 4 shows both side and edge views of a curved tool. Fig. 5 shows a plain round burnisher. In some instances it may be necessary to make tools of different forms. The operator will be guided in the selection of his tools by the particular work in hand, and practice will bring new suggestions as to tools and the manner of using them.

The materials generally used in spinning are brass, copper, zinc, britannia metal, and lead. All of these may be worked on the foot-lathe, but perhaps the amateur will derive the most satisfaction at first by using britannia metal, as it works easily and does not require annealing. Articles in this metal also present a handsome appearance when done, whether simply polished or plated. Zinc must be spun quite hot. Articles of brass, if of considerable depth, must be annealed when partly done.

The form on which the metal is spun may be either hard or soft wood or metal. A good close grained pine answers as well as anything for most purposes, and is very readily turned to the required form. It may be attached to the face-plate, B, and the disc to be spun may be held against it at first by a hard wood or metal piece, C, as shown in Fig. 6 and 7, which is forced against the disc by the tail centre. After the spinning is a little advanced, a cup-shaped holder is applied, as shown in dotted lines in Fig. 7. Sometimes the holder is secured by a bolt that runs through both it and the form or mould, as shown at D, Fig. 8. In some cases a

* From the Scientific American Supplement.



METAL SPINNING.

Little rosin is applied to the form to increase the friction, but this is rarely necessary. The motion of the lathe should be quite rapid, and the disc should receive a coating of grease (lard or heavy oil) before applying the burnisher. A very strong solution or soap may be used instead of oil. The position of the workman and the manner of holding the tool may be seen in Fig. 1. It will be noticed that the pin in the tool rest serves as a fulcrum for the tool, which must be brought with considerable pressure against the surface of the disc. This pin is moved forward from time to time as the work advances. The movement of the tool may be seen in Figs. 9 and 10, and the shape taken by the metal in front of the tool will also be seen. In swinging the tool toward the form it is moved in the direction of the arrow as shown in Fig. 9, and it is carried back as shown in Fig. 10. This last operation is very essential to the proper fitting of the mould, and it also thickens the metal. Too much should not be attempted at a time. A succession of quick movements, as indicated in Figs. 9 and 10, under a moderate pressure is much better than to do a great deal of execution at a single stroke. Should the metal tend to vibrate or buckle, a piece of wood may be applied to the back with the left hand, as shown in Fig. 8.

The method of spinning a cup or pot without a

form is illustrated in Fig. 11. Here the metal is supported by a plain cylindrical mandrel, and is first spun into the form indicated by the dotted lines, and then bringing the burnisher on the return stroke only to the shoulder which forms the larger part of the vessel. For small work on the foot-lathe the handles of the tools need not be as long as represented in Fig. 1. The length commonly employed for wood turning tools will answer.

To spin a ring a mandrel like that shown in Fig. 12 will be required. A plain flat ring placed between the shoulders of the mandrel is pressed upon by the roller seen above the mandrel until the ring assumes the desired form. Napkin rings are made in this way. Fig. 13 shows a concave reflector. Fig. 14 represents a simple cup formed of two pieces. Fig. 15 represents a small vase made of three pieces, the smaller end of the upper or conical part and the upper portion of the base piece being soldered in a spherical connecting piece. The two halves of the ball, Fig. 16, are made upon the same form. The edges are beveled and soldered together. The pitcher, Fig. 17, is made of five spun pieces, a short caak and turned piece that unites it to its base, and a handle made of square wire. The card receiver, Fig. 18, has a spun top and base, and a cast standard. Fig. 19, consists of

uniting the body with the base. Fig. 20 shows a base for a magnetic needle or other small apparatus. Fig. 21 represents a vase composed of seven spun pieces and two handles of square wire. More complex examples of work done by the process of spinning might be furnished.

CHARACTERISTICS OF WROUGHT AND CAST METALS.*

IT is well understood that a wrought article or its equivalent cannot be made by any method of casting. A casting is always a casting, with all the peculiarities and distinctions and differences of structure which make it a separate and distinct thing from a wrought article. And the fact that a thing is made of wrought metal instead of cast metal is of itself sufficient, in most instances, to make it a totally different thing in its structure, in its properties, and in its utility, just as much in very many cases as if it was made of a totally different metal. Another fact is, that it is not possible to cast lead articles of any given superficial

* By T. E. HAZEN, in American Machinist.

area of the same thickness as those articles can be made of the wrought lead: thus, for example, a seamless lead trap—which is formed by forcing the metal through a die—is of necessity a wrought metal trap, inasmuch as the cast or crystalline structure is destroyed by the pressing and drawing action exerted upon the metal while being shaped. And this wrought lead trap may be made with walls of any desired degree of thinness; in other words, the wrought metal may be brought to the precise thickness which combined utility and economy may suggest, whereas with cast lead it is impossible to form a trap of the same size or diameter, with walls less than a given and greater thickness, and this ratio of thickness which cannot be diminished increases with the diameter of the trap, so that in the larger size and to a certain degree, even in the smallest size of cast lead traps, there is a certain waste of metal as compared with the quantity of metal required to make a wrought lead trap of the same size. In other words, the cast lead does not possess the property of being formed in the thin walls, which economy of material demands, while that desirable property is possessed by the wrought lead.

On this head I am speaking from my own experience. I have made numerous experiments in past years in the casting of lead traps, and I find that when the lead is cast in the cored mould (the mould has to be made with a core, otherwise the trap could not be made hollow), to the form of an S trap, the lead will not flow entirely around the core unless there is a certain space between the core and the walls of the mould, proportioned to the diameter of the trap to be made. The reason is that if this space be too narrow, the lead, passing in a thin stream around the core, will chill before it gets entirely around, so that the edges of the metal flowing to and around opposite cores of the mould will either not come together at all, or if they do come together will be so chilled that they will not unite. This lack of union is so common that it has received a distinct name for itself, namely: "cold shot" casting. Such a casting is of course useless, and is only fit to be remelted. If the space within the mould—that is to say, the space between the core and the shell, or outside part of the mould is made sufficiently large to prevent this, then more lead is used to make the trap than is necessary for strength, and this excess of lead is of course just so much waste.

If we try, as has been frequently done, to prevent this "cold shot" casting by heating the mould so that the lead will flow around the core regardless of the narrowness of the space, a new difficulty is introduced; that is to say, the lead adheres to the hot metal of the mould just as tin adheres to the surface of sheet iron in the manufacture of sheet tin, and this, of course, not only spoils the casting but damages the mould. There is, therefore, this important distinction between wrought lead and cast lead in the manufacture of plumbers' traps, that wrought lead can be wrought into traps, having the walls just thick enough for strength and no more, without waste of metal, while cast traps have to have an excess of metal in them beyond what is required for strength, and this is just so much waste of metal.

Before the moulds are filled with the melted metal, they are, of course, occupied by air, inasmuch as it would be out of the question to work the moulds in a vacuum. Lead is more easily oxidised when heated than any other of the common metals, and this oxidation occurs almost instantly whenever a surface of melted lead is exposed to the air. When the lead is poured into the mould it comes in contact with the air contained in the mould, and a film or skin of oxide is formed upon it, and this either remains upon the surface of the edges of the lead and prevents the edges from joining, even when the lead has not cooled enough to form a real "cold shot," or it is broken up and divided into the mass of the melted lead and renders it brittle, just as antimony and many other impurities frequently render it brittle.

Furthermore, this film or skin of oxide may itself sometimes remain intact, and stay in the lead as a foreign body, and make a hidden impurity, corresponding, as we might say, to a chip embedded in the lead, and liable at any moment to make itself manifest by a break in the casting under pressure. No such thing is possible when lead is wrought, by being forced under compression through a die in the more or less plastic condition in which it is subjected to that operation.

Furthermore, cast lead has more or less of blow-holes in it which may vary, from those almost imperceptible to the eye to those so large as to render the casting useless at the first view; but even the most minute of these blow-holes are a source of danger, for they are likely to enlarge by corrosion, and a metal having even these minute blow-holes is a very different metal for the practical purposes of the plumber, as compared with a metal from which such holes or air-spaces are effectually excluded.

There is still another difference between cast lead and wrought lead, as these are employed in plumbers' traps, and it consists in this: that the

greater porosity of the cast lead, as compared with the wrought lead, gives it a relatively spongy texture, which exposes it to a much greater extent to the corrosive action of sewer gases and fluids, it being a truism in metallurgy that the more porous a substance the more readily is its structure attacked by injurious agents, inasmuch as the latter are capable of much more readily penetrating the substance of the metal, just as cast copper will absorb molten tin, or to use a more homely illustration, as a sponge will take up water. Another illustration of this same general truth: if we take a piece of roughly finished cast iron its surface will oxidise at once and to a material depth, whereas if we transmute the surface into even a thin film of wrought metal, it will remain dry and smooth for a considerable length of time.

As concerns the conversion of cast lead into wrought lead: it is most advantageously and quickly performed in proportion as the lead is heated to approach the melting point, for in proportion to the heat the crystals are softened, so that the pressure upon them destroys their shape and character, and the molecules of the metal are cemented together and brought into the peculiar fibrous structure inherent in wrought metal. This conversion of cast lead into wrought lead may be effected by forcing the metal cold through a die; but in so doing much greater pressure is required for the purpose than if the metal be softened by heat. The process is facilitated, if we bring the solid cast metal nearly to the melting point, and force it through the die, in which case less pressure is required, inasmuch as the crystals yield to and are destroyed by a slighter application of force. If we desire to get along with the application of a still less degree of power applied to the metal, we can first melt the latter and then cool it just previous to its entrance to and its passage through the die. In this case the pressure is applied to the crystals, practically, as fast as they are formed and immediately after their formation, and inasmuch as they are in their softest condition at this initial stage, they are the more readily destroyed and the metal brought into a wrought condition, as they are forced under pressure through the die. The result of either of the just mentioned methods is the same—namely, a wrought product in which the crystalline and porous structure is destroyed, and a dense fibrous metal of totally different character in many respects is produced.

The differences between wrought lead and cast lead are so great from a practical stand-point, that I find very few cast traps now in the market. A few may be sold in New York city, but even as far from the place of manufacture as the Pacific Coast, the cast lead traps are seldom seen in plumbing establishments, and they are conceded to be virtually superseded by the wrought lead traps formed by forcing the lead through a die.

Any wrought metal can be melted by a proper degree of heat, and when melted and cooled will assume its crystalline state—in other words, will form a crystalline casting. This is the case with wrought iron as well as with wrought copper, wrought zinc, wrought lead and other wrought metals. And wrought copper, zinc, &c., are preferred by brass founders for making castings where purity of metal is required, inasmuch as the compression and drawing in the production of the wrought material mechanically eliminates foreign matters from the metal. As concerns iron, it is a common practice for manufacturers of sash weights to melt up the sheet iron of waste tin (which is the most thoroughly wrought variety of wrought iron) and other wrought iron scrap and cast it into weights. If the melted wrought iron were cast without admixture of pig-iron, the castings would be too highly crystalline and brittle; to reduce this brittleness of the castings thus made from melted wrought iron some common pig-iron is usually added.

SOME OF THE INDUSTRIAL USES OF THE CALCIUM COMPOUNDS.—IV.*

By THOMAS BOLAS, F.C.S.

(Concluded from p. 492.)

VERY many of the calcium salts possess the property of phosphorescence in a notable degree—that is to say, they absorb light when exposed to its action, and afterwards slowly evolve it in the dark; the secondary or phosphorescent rays being generally of a lower degree of refrangibility than the absorbed rays. Some samples of fluorspar afford a good example of this phosphorescence. Here is some fluorspar which has been exposed to a powerful light, and, although the gas is turned down, you cannot see the light which is evolved. If now the fluorspar is warmed by being placed on this piece of heated iron the phosphorescence will be so far exalted that v

* Being an Abstract of a paper delivered before the Society

see the greenish-yellow phosphorescent rays; the effect of heat being very greatly to increase the phosphorescent energy of any substance charged with light.

Chalk, limestone, shells, and plaster of Paris are generally more or less phosphorescent; but although the evolved light is energetic enough to produce a considerable effect on a sensitive photographic plate, it is not powerful enough to be very obvious to the eye, unless special precautions are taken for its observation.

One of the most phosphorescent bodies known at the present time is the sulphide of calcium, a body which may be readily obtained by heating a mixture of lime and sulphur to bright redness, or by heating sulphate of lime with the necessary proportion of carbonaceous matter. The phosphorescence of sulphide of calcium was observed and studied by Canton many years ago; but it is only recently that the highly phosphorescent sulphide of calcium, which is used in the manufacture of Balmain's luminous paint, has been prepared. Here is a bottle of the sulphide of calcium in question, and, now it has been charged with light by exposure to the rays of burning magnesium wire; you see how brilliantly it glows in the dark, evolving sufficient light to enable one to read moderately large type by its rays. If this bottle were preserved in the dark, the evolution of light would continue without intermission for more than a fortnight, but with a continually diminishing intensity, so that to see the powder in the dark at the end of the fortnight, one would have to rest the eyes by remaining for some time in a dark place. Supposing that the bottle were kept in the dark for a considerable period, say six months, the stored-up light would not be quite exhausted, as, on warming the bottle by immersion in hot water, a considerable evolution of phosphorescent light would take place.

When made into a paint with a suitable oil-vehicle, the sulphide loses none of its phosphorescent properties; and articles which have been painted with the Balmain paint remain distinctly visible during the whole of the night, providing that they have received the light during a portion of the day. This circumstance renders the paint of very great value for such purposes as painting posts or gates in dark lanes, the piers of bridges, boats, carts, hoardings, or other objects which may be the cause of accidents in dark places. More than this: a room which is, in great part, coated with the luminous paint is never dark, provided that it receives the daylight for a few minutes during each twenty-four hours. In such a room, one may always read letters half-an-inch high; and, if no great time has elapsed since daylight was admitted, it is easy to read type, such as Pica. It is also likely to prove of very considerable value for painting the interiors of railway carriages, as the phosphorescent light renders lamps unnecessary when the route consists of alternate daylight and tunnel. In the case of the paint made with oil-vehicle, the sulphide is thoroughly protected against decomposition; but when the powder itself is exposed to damp air, it is slowly decomposed, evolving traces of sulphuretted hydrogen.

Gaslight serves very well to excite the phosphorescent sulphide, and, to illustrate this, let me take a tablet one foot square, which has been hanging behind an ordinary gas-burner. This, when handed round, will be found to give quite enough light to enable one to tell the time by a watch; and such a card kept in readiness behind a gas-jet, to which it, by the bye, forms a good reflector, might be kept in constant readiness as a safe light for fetching gunpowder, petroleum, or other combustible. The tail end of a train painted with Balmain paint has proved to be even more obvious on a dark night than the usual lamp.

The phosphorescent properties of the sulphide are considerably exalted by the application of heat, it becoming more highly charged while warm, and discharging itself more rapidly. Note the effect of slightly warming this piece of painted canvas, and also, notice the curious result obtained when one's hand is placed at the back of the sheet, the heat passing through causing a hand-shaped patch of increased luminosity—in fact, a true thermograph.

Here is another curious experiment. Mr. Barker is sitting in yonder chair in front of a screen or background painted with the sulphide, and on burning a few inches of magnesium wire a little distance in front, Mr. Barker's shadow is cast on the screen; the shaded portions remaining unexcited, while the general surface becomes luminous. Mr. Barker will now move away, and leave his shadow behind him, like Peter Schlemihl, in Chamisso's well-known story.

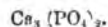
Another calcium product, which now possesses considerable commercial importance, and is likely to increase in value, is the blast furnace-slag, so long a waste and troublesome by-product. It may be regarded as a crude glass, consisting of lime and clay, only it requires a somewhat higher temperature for fusion than is the case with ordinary glass;

but by fusing a varying proportion of sand and soda with the slag, a more useful product may be obtained. The slag, when broken up, makes a rather poor substitute for granite as a road-making material, and blocks or other articles cast of it require a prolonged annealing in order to be of any practical use. A slag product of very considerable interest and importance is the so-called slag-wool, which is obtained by blowing a jet of steam across the liquid slag as it flows from the furnace, the result being a confused mass of fine threads like wool; but these are intermixed with a greater or less number of minute spheres like small shot.

By cooling the molten slag in water it becomes disintegrated, and a kind of sand or shingle is obtained, both these forming an admirable basis for concretes and cements, these uses being illustrated by specimens on the table. When finely ground, the slag sand possesses properties analogous to those of the puzzolana found in Italy, or the trass, which comes from the Rhine districts; and when mixed with a pure lime, it is rendered hydraulic.

The calcium phosphide is a remarkable compound, and it may be readily obtained by passing the vapour of phosphorus over lime heated to bright redness. Here is some of it, and please observe the effect of dropping a lump into a jar of water. The phosphide of calcium becomes decomposed, and the spontaneously inflammable variety of phosphuretted hydrogen is evolved; this gas taking fire on the surface of the water. This evolution of phosphuretted hydrogen is made available as an indicator, to show the whereabouts of a life-buoy, a small cylinder containing phosphide being attached, and this is perforated or pricked just before the buoy is thrown into the water. In the case of the War Department and Admiralty buoys, the cylinder containing the calcium phosphide is torn open in the act of taking the buoy from its peg. The Board of Trade requires every ship to take one of these buoys bearing a cylinder of phosphide of calcium; but here we find one of those strange circumstances which can only be explained by the general fact of the ways of boards and committees being mysterious and past finding out. They do not order these buoys to be painted with the phosphorescent paint, although such a buoy would always be visible to those on ship-board, and each flash of the burning phosphuretted hydrogen would exalt its luminosity, and render it increasingly easy for the drowning person to lay hold of it. The oil or varnish form of the luminous paint withstands the prolonged action of fresh or salt water perfectly. The rough model on the table, consisting of a frame of painted card with a piece of phosphide of calcium tied in a rag at one corner, illustrates this kind of twofold luminous buoy. It is usual to attach a cylinder containing the phosphide of calcium to the nose of a fish-torpedo, so that if the mark is missed there may be a chance of recovering the torpedo. Here, again, the phosphorescent paint might be brought into play, especially as the means of lighting it up is provided. It is curious to note how the phosphide of calcium, and the sulphide of calcium, can thus be used side by side for a similar purpose.

The phosphates of calcium have considerable industrial importance, one of these forming the earthy basis of bones. Here is a bone which has been thoroughly burned in yonder gas muffle, and the mineral matter only remains. You see that it is quite white, and retains the external form of the bone. This mineral matter of bones, the so-called bone-earth or bone-ash, consists mainly of the tribasic phosphate of calcium, its composition being—



Not only is this bone-earth the ordinary source of the important element phosphorus, but it is used for many industrial purposes, as in making certain kinds of porcelain; and my friend, Mr. Emery, of Burslem, tells me that if cremation ever becomes a general practice, he shall take out a patent for working the ashes of deceased relatives, which practically consist of phosphate of lime, into the material of a porcelain vase, instead of keeping them as a loose powder. Soluble super-phosphates of calcium are of great value as artificial manures, and are obtained by treating ground bones with oil of vitriol, and they may be regarded as the tribasic phosphate in which more or less of the calcium has been replaced by hydrogen, as in the following examples:—

- (1.) $\text{CaH}_2(\text{PO}_4)_2$.
- (2.) $\text{Ca}_2\text{H}_2(\text{PO}_4)_3$.

The chloride of calcium is a waste product in numerous manufacturing operations, and notwithstanding that numerous uses have been found for it, the supply is in excess of the demand. It has a remarkable tendency to absorb water from the air, and is consequently largely used in the laboratory for drying air and other gases; and it was proposed at one time to water the streets with a solution of this salt, as, under these circumstances the roads would remain constantly damp; but this brilliant idea came to nothing, as foot passengers naturally

objected to a system which would keep their boots in a chronic state of dampness. Chloride of calcium crystallises with six molecules of water, forming crystals, which produce a considerable degree of cold when dissolved in water, and a still greater cold when mixed with snow or powdered ice.

The so-called chloride of lime, or bleaching powder, is largely manufactured by passing damp chlorine over powdered lime. You may consider that it contains a large amount of chlorine locked up ready for action, the release being readily effected by any free acid. This is well illustrated by the process of discharge printing. Here is a piece of madder-dyed cotton cloth, and Mr. Barker will stamp on it some devices with a mixture of gum and tartaric acid. It is next immersed in this bath, which contains chloride of lime and water, and in a few minutes you will find that a thorough bleaching of the red colour has been effected where the mixed acid and gum were printed on, the general groundwork of colour being unchanged. Either chlorine, or the still more energetic hypochlorous acid, has been liberated on those parts of the fabric which were impregnated with the tartaric acid.

The hardness of water depends on the presence of lime salts, the so-called temporary hardness arising from the presence of carbonate of lime dissolved in carbonic acid; while the so-called permanent hardness is due to other salts of lime. Temporary hardness may be readily removed by the addition of sufficient lime to unite with the excess of carbonic acid, or by boiling; while more complex measures are required to remove soluble compounds of lime in other forms.

USEFUL AND SCIENTIFIC NOTES.

Sulphate of Iron Battery.—M. Wilbrant has constructed a battery, the depolarising liquid of which consists of a concentrated solution of sulphate of iron, the exciting liquid being a concentrated solution of sal-ammoniac. Then negative electrode is a carbon plate, and the positive a plate of amalgamated zinc; the liquids are separated by a porous jar, as in an ordinary Bunsen cell. The solution of proto sulphate is kept up by means of some extra crystals of sulphate. These cells will act regularly after some days' work. At first a reaction takes place, which agitates the exciting liquid and occasions the precipitation of oxide of iron. Once this has been done the ammoniacal liquid is left perfectly clear. It is necessary to apply paraffin to the tops of the carbon plates, and to grease the sides of the porous jars. According to M. Wilbrant, the action in this battery is as follows:—The ammoniacal solution is decomposed, and gives off ammonia; the chlorine and zinc combine and form chloride of zinc; hydrogen reduces the sulphate of iron and forms oxide of iron. Polarisation only takes place in this battery after the circuit has been closed for six hours, and depolarisation at the end of half an hour. The electromotive force is a little higher than that of a Leclanché cell.—*La Lumière Electrique*.

Colour-hearing.—In 1873 Nussbaumer described the phenomenon as he and his brother had it, and Herrea Bleuler and Lehmann, in Zurich, have recently made a more systematic study of the subject. The colours associated with particular notes differ in different individuals. As a rule, the higher notes are accompanied by lighter colours, the lower by darker. Chords either cause the colours which correspond to their notes to appear side by side or give a mixture of those colours. A thorough musician who was examined perceived a distinct colour with each key—*c.g.*, C major, grey; G flat major, reddish brown; A major, blue; A minor, lead colour; F sharp major, yellow; and so on. The same note in different keys changes in colour according to the colour of the key in which it is found. To many persons, too, the same piece played by different instruments appears in different colours. Noises, again, are generally accompanied with colours, these being generally of a grey or brown hue. Increased intensity of sound affects the colour perceived, and more so in the case of noise than in that of musical notes; in the latter the intensity of colour is increased; in the former a transparent effect observed gives way in some measure to opacity. The authors pursue their studies into the colours some minds perceive on hearing consonants, vowels, diphthongs, words, &c., some of which cases seem to be explicable by direct "association." By four persons sound was perceived as a result of sensations of light and colour—*c.g.*, a broad, quietly-burning gas flame led to perception of a sound constructed of *ic* and a light vowel like *e*. When the flame flickered the sound grew similar to *l*. In colour-hearing no essential difference between the two sexes has been demonstrated. Of 76 "colour-hearers," 59 per cent. were males and 41 per cent. females. The percentage of "colour-hearers" in 596 individuals examined was only 12.5. The phenomenon is to a great degree hereditary.

SCIENTIFIC NEWS.

THE death of Sir Robert Christison, Bart., F.R.S., which took place last week, in his 85th year, removes from us one of our most distinguished toxicologists. So long ago as 1811 young Christison matriculated at Edinburgh University, and with the exception of a few years passed in London and at Paris, where he studied under M. Orfila, he has resided in the capital of Scotland. In 1822 he was appointed Professor of Medical Jurisprudence, and ten years later of Materia Medica in Edinburgh University, a position he resigned in 1877. Sir Robert was remarkable for what may be termed his youthful spirit, for so recently as September last he ascended Ben Nevis, and contributed a paper on the geology of that mountain to the Royal Society (Edin.) in December. It will be remembered that when a few years ago coca was introduced to this country as a marvellous stimulant, Sir Robert Christison made some experiments on himself and reported the results, an account of which we gave in the No. for May 5, 1876. The deceased physician was the author of a "Treatise on Poisons" and other standard books, besides contributing a number of valuable papers to the medical journals.

The observatory erected on Mount Etna has now been completed. It is situated some 9,000 ft. above the sea, and from the clearness of the atmosphere at that height we may expect to hear of important observations. The Lick Observatory, on one of the peaks of Mount Hamilton, near San José, California, is at an altitude of 4,220 ft. The latter observatory will, however, if Messrs. Alvan Clark succeed in their attempt, have the largest refractor in the world, the object-glass being 36 in. in diameter.

The views of Dr. Hahn, as to the presence of organic structures in meteorites, have been refuted by Prof. Carl Vogt, who, in a memoir presented to the French Academy of Sciences, affirms that Dr. Hahn has no foundation for his conclusions, and that in no single case do the pretended organic structures present the microscopic appearance of the organisms for which they have been mistaken.

Captain Abney, F.R.S., commenced his series of Cantor Lectures at the Society of Arts this week, and at the same time the Exhibition of Photographic Appliances was opened. The exhibits can be inspected from 10 a.m. to 4 p.m. every day, and on Wednesday evenings from 6 to 8 p.m. in addition. Tickets can be obtained on application to the secretary.

At a special meeting of the Civil and Mechanical Engineers' Society held last week, Mr. Lloyd Wise read a paper on Certain Proposals for Patent Law Reform, in which he criticised the Society of Arts Bill, and put the question on such a footing that the Council agreed to memorialise the President of the Board of Trade. One of the points of the memorial is that the fees should be as low as possible consistent with the proper support of the Patent Office and Museum.

Mr. Otto Hehner, experimenting on the atmosphere of Billiter-street during the fog last week, found in 10,000 volumes of air as many as 10.81, 8.85, 9.63, 8.93, 9.45, 9.56, 4.77, and 7.78 volumes of carbonic acid. The normal quantity of carbonic acid in pure air is not quite four parts per 10,000. The 4.77 given above was obtained from a specimen of air taken after the lifting of the fog early in the afternoon.

M. J. B. Dumas, one of the perpetual secretaries of the French Academy of Sciences, has received instructions from the Minister of the Interior to supply him with a list of scientific men who have died or been wounded in carrying out researches. It is said that some provision is to be made for their widows and children.

An interesting case in agricultural chemistry has been lately described by M. Ladureau. In the North of France there are a number of farmers who are also distillers of beet, &c., and the liquid residue of the distillation, known as *vinasses*, they distribute over their fields. It contains all the nitrogen, salts of potash, and phosphates, which the beet has removed, and by large application of it a good crop of beet can be had every two or three

years. But for the crops grown between, there is no special provision of manure; they have to subsist on the fertilising matters left in the ground. One of these farmers came to M. Ladureau and stated that he had thus grown beet and wheat alternately on the same ground for twenty years, and while the beet crop was always satisfactory, the wheat had gradually deteriorated. On analysing the soil, M. Ladureau found that it contained all the elements of fertility except phosphoric acid; this had completely disappeared in an upper layer about a foot in depth. He advised the farmer to immediately apply large quantities of soluble and insoluble phosphates of lime, and, on this being done, the wheat rapidly improved.

The penchant for ballooning is known to be strong in France. The following statistics have been lately published by M. Rouland. In 1876, there were 79 ascents, 81 in 1877, 82 in 1878, 95 in 1879, 117 in 1880, and 125 in 1881. This is about one every three days. One day near the end of last year, MM. Lachambre and Favre executed an interesting voyage at Southeraine (Creuse), on occasion of the opening of new gas-works. The wind was pretty high at the time of starting, 2.25 p.m., and the voyagers reached earth at Gajoubert, 62 kilometres from the place of departure, at 3.10; the balloon having thus travelled 62 kilometres (say 37 miles) in 45 minutes.

It would appear from a letter by M. Chavée-Leroy to a French journal, that the field-mouse has of late years become a serious plague in various parts of France. Last year, at Clermont in Aisne (a department north-east of Paris), the evil became so great that the farmers met and resolved on measures of poisoning, at common expense, throughout the region. The demand for a brochure M. Leroy published, on field-mice and how to destroy them, proved how widespread were the ravages of this little quadruped (which is remarkably prolific). In the southern departments where the vine has disappeared, the field-mice have multiplied enormously. The Delaplace enfumoir is a simple instrument for asphyxiating field-mice with sulphurous fumes, and has found considerable acceptance. It consists of two tubes, one sliding into the other, and the inner one having at its posterior end a small fan-blower driven by hand by means of a cord and pulley; this forces air through the tube. The outer tube has a nozzle attached and a compartment containing sulphurised rags, which are ignited. The nozzle is thrust into the holes made by the field-mice, and the fumes rapidly kill them in the galleries. In order to smoke only holes that are inhabited, all holes are closed with tallow or the like the day before operating; and the holes newly-formed next morning indicate the places occupied.

Recent observations by M. Metchnikoff, in Japan, prove that (contrary to the general opinion) the high mountains of that country are not entirely volcanic, but from their base to a considerable fraction of 3,000 metres or more, they are formed of granite and ancient metamorphic rocks. The volcanic portions surmount these portions. Schists preponderate in the three great islands of the archipelago; their age is not yet precisely determined. Jurassic and carboniferous formations are rare.

In the Paris Academy the other day, M. de Saint-Venant complained that one could not make marginal corrections and notes with the pen on mathematical works, as now published in France; the paper drank up the ink "pitilessly," making great blots! It was otherwise with older works; the editions of Leibnitz, the Bernouillis, &c., allowed readily of annotations. This practice of making notes on one's books he regarded as very important. "Maltraitez les pages de vos livres, criblez-les de notes!" was the advice which one of his best friends gave to young seekers after truth.

On Austrian railways there were 131 persons killed and 325 injured by accidents in 1880, as against 128 killed and 258 injured the previous year (but the numbers are less than in 1878). The number of passengers had increased by 927,125, making a total of nearly 32 million persons conveyed on the lines. The number of kilometres traversed during the year exceeded that of the previous year by 167 millions for passengers and 19 millions for goods. The proportion of passengers killed was 1 in 15,833,252,

and of injured one in 1,217,942. It is noted that of the 456 persons who were victims of accidents in 1880, 130 were not passengers, but were killed when on the line. Of the accidents in 1880, 162 were derailments, 59 collisions, 294 losses of material, 406 accidents to persons, 57 animals and vehicles injured on the line, and 111 unimportant accidents.

In an interesting lecture on the sanitary relations of the soil, delivered last year by Dr. Von Pettenkofer in Salzburg (and which appears in the *Popular Science Monthly*), the important influence of ground-air is remarked upon; that air being often sucked up into our heated houses as into cupping-glasses, and bringing dust and often germs of disease with it. In respect of leaving houses without protection from a disease-bearing soil, of putting them on the ground bare-footed (as Dr. Port has said), we have fallen behind the most primitive constructions of the childhood of the building art. And we need not look down disparagingly on the pile-dwellings of some foreign races, and the mud-huts of our peasants, for both classes of builders have respected, though in different ways, an important hygienic principle which our architects overlook. In one case, the dwelling is made independent of the ground by admitting a circulation of air below, in the other, by isolating the hut by means of a plaster floor. Some of these mud-huts have been known to enjoy a remarkable immunity in cases of outbreak of cholera. In this connection, Dr. Agnew writes from Florida to the *Scientific American* that cellar atmosphere in that State is (in his opinion) a most prolific cause of disease and death, increasing 75 per cent. the risk from malarial disease all over the country. The native population, as by an instinct, raise their simple cabins three or four feet above the ground, and allow air and light to pervade the space so made beneath the ground-floor. Dr. Agnew advises all travellers to avoid those hotels and other domiciles in the South that are not so constructed.

In relation to the subject of inertia, *La Nature* calls attention to a feat performed by Japanese acrobats in the circus of the Champs Elysées. A five-franc piece is kept rotating on edge near the outer border of a Japanese paper parasol, by rapid whirling of the latter. The feat requires considerable address.

The substance named vasculose is distributed (according to recent researches by MM. Frey and Urbain) throughout the vegetable kingdom; in general it is abundant in those parts of plants which present resistance or hardness. While poplar wood has only 18 per cent. of it, ebony has 35, guaiacum has 36, and in nuts there is sometimes as much as 60 per cent. It may be got best in a pure state from elder-pith, boiled with dilute hydrochloric acid, and then treated with an ammoniacal-copper compound, &c. The oxygen of the air transforms vasculose in course of time into resinous acids, soluble in alkalies. Methylic alcohol is peculiarly produced by vasculose; and in the distillation of wood it is vasculose that produces most of the acetic acid. The composition is $C_{10}H_{10}O_4$. The proportion of the substance in plant-fibres (hemp, &c.) has considerable influence on the phenomena of rotting, dyeing, &c. (Further details regarding this important substance will be found in *Comptes Rendus*, Jan. 16th.)

The following formula of a good varnish for writing on glass is given by M. Crova in the *Journal de Physique*: Ether 500gr.; sandarach 30gr.; mastic 30gr. Dissolve, then add benzine in small quantities, till the varnish, spread on a piece of glass, gives it the aspect of roughed glass. The varnish is used cold. To have a homogeneous layer, pour over that already formed some oil of petroleum, let it evaporate a little, then rub in all directions with cambric cloth till all is quite dry. With ink or lead pencil, lines can be produced on this surface as fine as may be desired. Thus a drawing may be prepared in a few minutes and immediately projected.

A TELEPHONE line between Paris and Versailles is to be erected. If this is successful another will be set up between Paris and Rouen, and towns still further distant.

THE Royal Theatre at Turin is to be lit by the electric light in place of gas. Electric lights are also to be used as an experiment in the town-council meeting-room.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made Payable to F. PASHMORE EDWARDS.

* * * In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pretence of his, will undertake to write the whole body of physics: a vice from whence great inconveniences derive their original."—Montaigne's Essays.

ON THE CLIMATE OF NORTHUMBERLAND AS REGARDS ITS FITNESS FOR ASTRONOMICAL OBSERVATIONS.

[19680.]—IN May, 1880, I became possessed of the telescope, observatory, and astronomical instruments belonging to the late Rev. Henry Cooper Key, M.A., F.R.A.S., and I erected the telescope and observatory at my vicarage, at Alnwick, Northumberland. The instrument itself is one of the very finest silver-on-glass reflectors in existence, the speculum being by the celebrated Mr. Calver, of Chelmsford, of 18½ in. aperture; and, as regards perfection of figure, I believe it cannot be excelled. As a specimen of the work it is capable of performing under the best conditions, I may say that last November I measured γ Andromedæ, the components of that exceedingly difficult double star being now separated by a vacancy of only 0.28" according to the Washington observers. The weather, however, for observational purposes during the last six months of 1880 was so bad here, that I determined to keep a record as far as possible of every night in the year 1881 as regards its fitness for astronomical work, and this record I now lay before your readers. I may promise that no fault can be found with the situation of the observatory. It is 250ft. above sea-level, four miles from the sea, there are no mountains or streams sufficiently near to affect the definition, no collieries or manufactories in the immediate neighbourhood; and, if the definition be bad no cause can be assigned for it but atmospheric disturbance. The following is the record for each month:—

JANUARY.—In this month there were eleven nights completely overcast, four partially overcast, and sixteen clear. I opened the observatory on five nights, on four of which the definition was very bad, and on one bad. On fifteen nights there was hard frost, accompanied by deep snow.

FEBRUARY.—The nights were—completely overcast, twenty-two; partially overcast, six. The definition was—on four very bad, on one bad, and on one fair.

MARCH.—Completely overcast, twenty-four; partially overcast, seven. The definition was, on one very bad, on one bad, and on three fair. On two nights hard frost prevented observations.

APRIL.—Completely overcast, twenty-five; partially overcast, three; clear, two. The definition was on two very bad, and on two nights wind, and on one snow, prevented observations.

MAY.—Completely overcast, ten; partially overcast, nine; clear, twelve. Definition on fifteen nights was very bad, on one bad, and on four fair. One of the partially clouded nights was too cloudy for observations.

JUNE.—Completely overcast, fourteen; partially overcast, two; clear, fourteen. Definition was on five very bad. I was away from home nine, and engaged on two nights.

JULY.—Completely overcast, twenty-six; partially overcast, one; clear, four. Definition was on one very bad, on three bad, and on one I was away from home.

AUGUST.—Completely overcast, twenty-five; partially overcast, three; clear, three. Definition was on one very bad; wind or cloud prevented observations on four nights, and on one I was away from home.

SEPTEMBER.—Completely overcast, twenty-five; partially overcast, four; clear, one. Definition was on four very bad, and on one of the partially-clouded nights there was too much cloud for observations.

OCTOBER.—Completely overcast, nineteen; partially overcast, six; clear, six. Definition was on four very bad; on one very fine, wind prevented observations on four nights, and on three I was away from home.

NOVEMBER.—Completely overcast, thirteen

partially overcast, five; clear, twelve. Definition was on seven very bad; on two, bad; on two, fair; and on one very fine. Wind prevented observations on five nights.

DECEMBER. — Completely overcast, fifteen; partially overcast, one; clear, fifteen. Definition was on six very bad, and on four, fair. Wind prevented observations on three nights; on two I was away from home, and on one engaged.

The summary for the year is as follows:—229 nights were completely overcast, 51 were partially so (but of these four were too cloudy for observations) and 85 were clear. Thus 132 nights ought to have been available for observations. Of these the definition on fifty-four was very bad, on nine bad, on fourteen fair, and on two very fine. Wind prevented observations on sixteen nights, frost and snow combined on fifteen; on two frost alone, and on one snow alone. On sixteen I was absent from home, and on three engaged. Total, 182.

I need hardly point out to your readers that the above record is a somewhat melancholy one for the astronomical observer. Ours is a cloudy sky; but, in addition to the great amount of cloud, the atmosphere here is almost perpetually in a state of violent disturbance, so that difficult and delicate telescopic work can very rarely indeed be attempted. Last year there were only two occasions on which I found the definition really fine, and on those it only continued so for a short while.

When the stars are visible they are, as a rule, when looked at through the telescope, seen to be flaring, flashing, fluttering, jumping, twirling, or waving—anything, in short, rather than remaining steady. This is clearly owing to atmospheric perturbation, because, on some very rare occasions, the images are still, and the definition is superb. I have not been in the habit of using a telescope for a sufficient length of time to say whether last year was an exceptionally bad one for the North of England; but, from what I have heard and read, as well as from a nine years' residence here, I am afraid it was not. Perhaps others of your readers can throw a little light on this point.

Jevon J. Muschamp Perry, M.A., F.R.A.S.
St. Paul's Vicarage, Alnwick,
January 4th.

PLINIUS, DAWES, AND THE RILLS IN THE NEIGHBOURHOOD.

[19681.]—THE accompanying drawing of this interesting portion of the Moon's surface was made on Jan. 25th, between 5h. and 6h. 30m. with a power of 350 on an 8 in. Calver reflector, the E. wall of Julius Caesar being on the terminator. Both Mädler and Neison speak of, and draw cen-

ing night its true nature was apparent. Among the other objects in the interior, I remarked two large mountains (1 and 2), a bright region reaching from the centre to the N. wall (3), two craterlets on the N.W. portion of the floor, and a range of low hills extending from the centre to the S. wall (4). At the foot of the glacis on the S.W. side are two very small craterlets, and a second pair on the S., near the border of a ridge which runs from Plinius towards the S. The smaller and less conspicuous ring-plain, Dawes, was about half full of shadow, a dark line like a rill, was seen reaching from near the centre to the S. wall, and a light marking from the centre to the E. wall. North of Dawes the short rills, 5 and 6, were well seen, both terminating on the E. at a ridge, and 5 (on which occurs a craterlet), abutting on the W. on a fine crater-row (7).

The rills δ , ϵ , and e , were remarkably distinct. The latter runs on the N. and not on the S. side of the Prom. Acherusia, as shown in Neison's map. It cuts through the great serpentine ridge of the M. Serenitatis near its S. termination.

Thomas Gwyn Elger.

Bedford, Jan. 28.

SELENOGRAPHICAL—PLINIUS.

[19682.]—WILL you kindly allow me a corner in your paper to call the attention of observers to the crater Plinius? Observing last night the numerous rills which cross in almost every direction the E. border of Mare Tranquillitatis, I cast my eye on the floor of Plinius, and saw at once, and to my surprise, two craters lying close together in a S.E. and N.W. direction, about the centre of the floor. They were very easy objects, and there was no doubt about them being craters. As I have never noticed them in any previous observations, and as I find no record of them so far as I can see, perhaps some correspondent will say if they have been observed already.

January 26.

E. Gaudibert.

DIFFERENTIAL GEARS.

[19683.]—MR. CHARLES F. STEEL (letter 19665, Jan. 27) states, "So long as x and y revolve at equal speed" (see diagram in Mr. Steel's letter) "7 and 5 will and must press equally on b and c ." Now it is evident that the pressures of the pinion upon the wheels x and y must be equal under all circumstances, friction being neglected. But as there is friction of the pinion upon its stud, and of the pinion teeth upon the teeth of the wheels x and y , one of these pressures may exceed the other by the amount of this friction, and this may be so, whether the velocities of rotation of x and y be

If the excess of resistance to y arises from the action of the steerer, this proposition still holds true. The pressure of the pinion upon y is equal to that upon x , plus the friction—and this is still true in the extreme case supposed by Mr. Steel, of the machine being made to describe a circle upon one wheel as centre; the pressure upon y is still there, though its effect is only to produce strains in the machine, and the force exerted upon the wheel x is only half that exerted upon the stud, less the friction.

Again, "a well-known correspondent has said that the wheel which meets with most resistance does least work." I cannot agree with Mr. Steel in admitting this, although from one point of view it may seem to be true. To explain: Suppose the machine, running in a straight line and with uniform speed, and refer still to Mr. Steel's diagram. In this case the driving force applied to the stud of the pinion must equal the sum of all the resistances. So long as this sum is equally divided between x and y there will be no tendency to rotate the pinion, but if an excess of resistance be thrown upon y , this tendency will be developed, and will, in the first instance, be opposed by the friction of the pinion. Should the excess of resistance not exceed this friction, there will be no strain on the steerer; and, so far, I think no one will deny that the most resisted wheel does most work. When, however, the excess of resistance exceeds the friction, the surplus is opposed by the steerer; and then we have y , the most resisted wheel, helped in its difficulties by x , while still the driving force exerted upon y exceeds that exerted upon x , by the amount of the friction which resists rotation of the pinion. I submit that most work is still done through or by y , though, at first sight, x may seem to be doing more, because it is helping y .

I hope Mr. Steel will pardon me for saying that I do not think his description of the action on a curve is quite correct. I would put it in this way, again referring to his diagram: Suppose the machine running straight and at uniform speed. The pressures or driving forces exerted upon x and y are equal (neglecting friction), and their sum balances the total resistances; the pressure or driving force of 5 upon c is equal to the resistance of c upon 6. Now suppose the steerer turned to the right, the resistance of c is increased, and there is a reduction of speed of the wheel y . At the same instant the resistance of b is diminished, and there is an increase of speed of the wheel x . When the machine has settled into a circular curve, and while it continues to run in it, at a uniform speed, we have again the driving forces balanced by the resistances, and a strain upon the steerer due to the tendency of the machine to run in a straight line. If we take the friction into account, we have the driving force exerted upon y exceeding that exerted upon x , by the amount of the friction, and the strain upon the steerer proportionately increased.

It is hardly necessary to state that, so long as speed is uniform, the driving force must be equal to the resistance; and to effect change of speed there must be excess either of driving force or of resistance.

Wm. Bindon Blood.

[19684.]—LEAVING out the scientific part of the question, Mr. Blood brings a very important point forward when he speaks of the friction of the gearing; for both "Sunlight" and "66-Inch" can but allow that all their objections are based on the fact that the gear acts sometimes when not wanted, or, in other words, it is too sensitive. Now my theory is that if it be fitted closely so as to give a sufficiency of stiffness it would only act when it is beneficial that it should, and so save the machine many nasty strains which no other double-driving gear in the market can do.

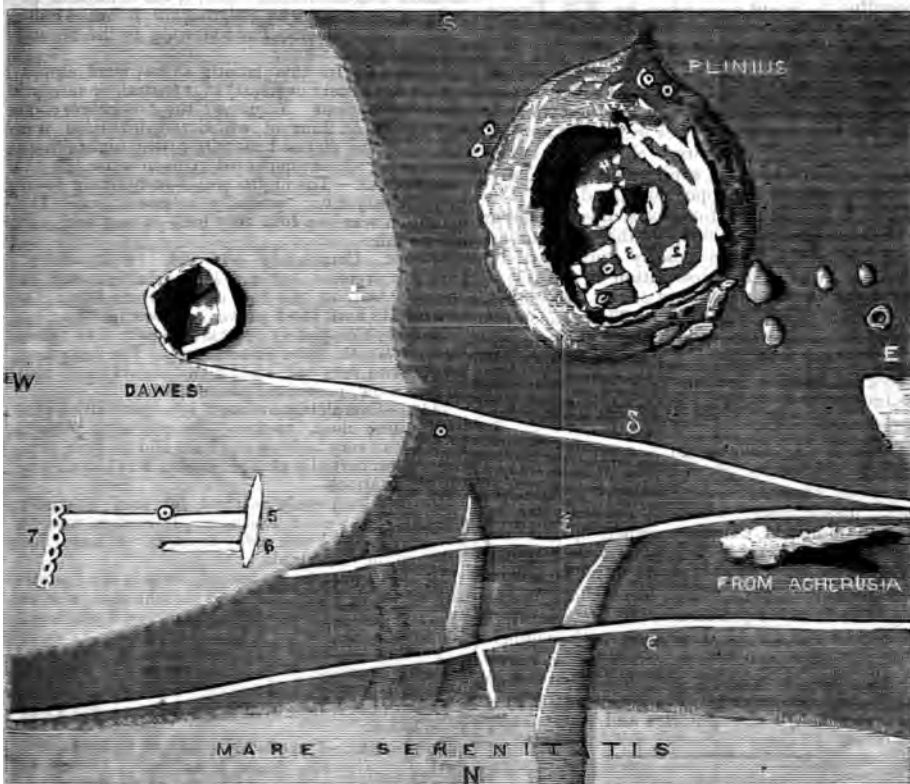
To take a case in point, which once came under my notice, and will serve to make my meaning clear. A portable engine was fitted with an extremely sensitive governor, connected direct with an automatic cut-off working on the back of the main slide-valve. Now this governor would keep the engine at its right number of revolutions per minute, only the rate constantly altered during that minute. Well, what was done? Why the governor was braked a little bit, and the engine ran exactly as desired. My deduction from this is, then, that differential gear should be always fitted with a certain degree of stiffness, and if the roads on which "66-Inch" has ridden contain so many "varying resistances," I should fit it with two or even three pinions, which I am positive would remove the only objection which can be raised against this the most mechanical of any double-driving arrangement as yet applied to the tricycle.

Thomas J. Scott.

Tinkleton, Dorset, January 23rd.

LEVER POWER APPLIED TO THE BICYCLE.

[19685.]—WILL you permit us to reply to the letter of "Clerical Bicyclist" under the above heading, which letter is full of misconceptions, as your better informed correspondents will have observed. Taking his remarks in their order:—



tral mountains on, the floor of Plinius, but the most westerly of the objects shown in this position in my sketch is evidently a large crater or crater-cone, with a very lofty E. wall, the shadow of which, on the evening of the 25th, resembled a second crater; but when examined on the follow-

equal or not. If y meets with greater resistance than x , this excess of pressure will be upon y . We have only to suppose friction indefinitely increased, and the proposition becomes obvious. We should then have the means even of surmounting the brick.

1. He asks, "Why is the bicycle still only a fair-weather machine?" It is not so, though of course the ease of propulsion must always be much greater on good road than on bad. "Clerical Bicyclist" himself says that he has ridden his "Facile" every day since last spring, and he has been exceptionally fortunate if he has had "fair weather" all that time. The writer, in common with many friends, has ridden his 40in. "Facile" several hundred miles during the winter months, and his "Odometer" shows 150 miles since the 1st January. It is too much to expect that muddy roads will ever be ridden easily: the thing is to improve the roads themselves, and in this direction a great deal may be done.

2. "Clerical Bicyclist" calls the "Facile" the "only lever-driven machine out." Every machine (bicycle) is driven by a lever, ergo, every bicycle is a "Facile." Argal: We are doing a gigantic business without knowing it!

3. "The wheel is too low. A higher one would admit of the use of a larger lever." The exact contrary is the fact. The smaller the wheel ridden the longer the stroke may be made. This is self-evident.

4. "The treadle—especially if curved up to the saddle—would increase the leverage." Of course, curving the treadle upwards would not add a particle to the leverage, and would make an ungainly machine. If greater power is needed, the treadle may be lengthened horizontally, or the crank may be lengthened, and the stroke increased from 10in., as at present, up to 12in., or even more. This we can easily manage for "Clerical Bicyclist" if he wishes it; but, of course, speed on good road would be proportionately reduced.

The inventor of the "Facile," Mr. John Beale, is the patentee also of many other most successful inventions, including Beale's gas-exhauster (which machine is probably known to many of your readers, and, simple as it now appears, is the result of much thought and experiment, every detail having been carefully considered). It is, therefore, rather extraordinary for a writer of (evidently) very limited mechanical knowledge, who rides the machine, and, apparently, considers it the best he knows, to pronounce that the inventors have "thrown away a valuable principle by a bad application of it." The testimony of a large and quickly-increasing number of riders seems to show that the principle is not altogether "thrown away," after all.

165, Fleet-street, E.C.

Ellis and Co.

TRICYCLES.

[19086.]—"FIFTY-EX INCH" (19644, p. 474) expresses surprise that the double-driving power of the balanced-gear machine is to a certain extent "altered and spoiled" by the varying state of the road. Herein lies his error. It is not "altered" or "spoiled" at all. Let us consider a case in point. Suppose 100lb. of power are given off at the pedal-axle: each wheel gets 50lb. of this. Suppose that the resistances are, say, 40lb. on one side and 30lb. on the other, is it not obvious that, in the absence of the controlling power of the steering-wheel, the side where there is only 30lb. of resistance must travel faster than the other where there is 40lb.? Of course it travels in a curve, and if the resistances continue uniformly constant, the curve will be a circle, as I have before stated.

If the resistance offered by the "brick" is assumed to be equal to both, it is clear that 50lb. of power applied to the wheel will not enable it to mount the brick. Does it, therefore, follow that no power is applied to the wheel at all? "50-Inch" maintains that this is the case, when he says that "the wheel opposed by the brick has no more power to mount it than the wheel of a Meteor, which is not driven, would have under the circumstances."

What actually happens is this. The steering-wheel must move laterally, or impart additional resistance to the free wheel; this enables the rider to increase the power applied to mount the brick from 50lb. to 60lb., and the obstacle is surmounted accordingly. Whereas the meteor-wheel is simply dragged over an obstacle by force applied on the other side.

With reference to the "immense strain" on the steering-wheel, I can only say that the seat of my machine is hung so far over the axle that my weight almost balances the weight on the steering-wheel, so that I can lift it from the ground with the least pull at the handles. In addition to this, I have hung loads from the back of the seat until I have had some little trouble to keep the wheel on the ground at all. So long, however, as it does touch the ground, I am at no loss for steering power. How, then, is the "immense strain" applied?

In conclusion, let me recommend "50-Inch" and Mr. Staproole Westropp to carefully study the letter (19615) of Mr. W. Bindon Blood, with all of which I entirely agree. If this fails to convince them, I fear that an entire volume would be written in vain.

No. 170.

LATHES AND LATHE-MAKING.

[19687.]—In reply to "Orderic Vital" (letter 19676), I have not the last volume by me; but I believe I sent a notice of lathe which was submitted to me for criticism, and of which I returned the drawings. I also think some discussion ensued, consequent upon my commendation of these front slide-rests. A firm at York did—and probably do still—make them, and there is one, I know, in use at the Britannia Co.'s shop at Colchester, of which I will get some details.

On page 7 of the Yorkshire firm's last catalogue, one of these lathes is illustrated, and with sufficient clearness to give a good idea of the whole arrangement. The lathe is a very neat one in other respects. I am not sure, however, that the horizontal part of the saddle is so kept back as to allow the poppet to slide past it, which is one advantage of the design sent to "E. M.," if I remember rightly. I think the drawings (working) of the other lathe referred to are in possession of Mr. W. J. Brown, of Halesworth, Suffolk; but I am not quite sure.

O. J. L.

[19688.]—REGARDING the Armstrong lathe, as "J. L." says—and I don't think anyone can give a safer opinion on the subject—I think the overdone combination-lathe a mistake. It will be very costly to make, and very troublesome to use; something always in the way, want moving, or fixing; the amount of gear-wheels about is something dreadful to a mechanic. It looks well in drawing and theory; but a practical mechanic knows the difficulty of making gear run well and quietly. Try to imagine the noise and vibration in some of the combinations. What would intricate and fine delicate patterns look like, after the motion of the cutters had been transmitted through some of the trains of wheels and shafts proposed.

I think the best combination is to fit up a good lathe with an iron or wood gantry, plated with iron, and planed true, with angle edges. Have the bed 6ft. long at least, and at the opposite end to fasthead fit up a small planer, and use the gantry top for the table of planer to work on; make use of the slide-rest for the slide and tool-box of planer; work planer-table with a toothed wheel and rack under said table, by means of a hand-wheel, in front of gantry bed; said hand-wheel to have levers, say, about 3ft. across. Such a planer would plane from 15in. to 18in. in length and 8in. or 10in. wide.

As for drilling holes, from 3in. or 4in. and upwards, bore them in the face-plate, or fix to the table of slide-rest; for smaller holes a small drilling apparatus can be made to fix with a single bolt in the middle of lathe-bed (or any part of it), and driven by gut band and small pulley from a crank-shaft, and when out of use might be removed and hung out of way in two minutes. Finally, I think it unwise to load a lathe or gantry with a quantity of appliances. I know as a mechanic, who has spent a great part of his life in the machine shop, as apprentice, foreman, and manager, that a workman cannot do good work with a litter about him. I return my hearty thanks to "J. L." for what he has taught me. Our kind friend, Mr. Evans, also, I hope, will kindly accept the same for his welcome contributions on ornamental turning and descriptions of tools and appliances; he will excuse me reminding him of his promise given a week or two ago to describe the spiral appliance of "G.C.C.," and I wish I could persuade him to give us a series of drawings of the cutters used in ornamental work. I have a difficulty in making these out; if he would give us an article on this department, numbering the cutters or naming them for reference, I am sure it would make his articles all that could be desired.

Liverpool.

E. P.

THE ARMSTRONG LATHE.

[19689.]—"J. L." does not answer my question. It is nothing to tell us "the lathe in question is far less suited for wood and ornamental turning than for metal." It seems to be "J. L.'s" desire to impress it on us that this lathe is designed as much for ornamental work as for metal. This I don't think treating it fairly. The parts or combinations which were illustrated were evidently intended for metal—e.g., shaper-drill or leading-screw, change-wheels, slide-rest, and back-gear,—these do not go to make up an ornamental lathe. Therefore it is only leading us away from the subject to talk of it, and it is only misleading to speak of these attachments being suitable for a 5in. Holtzapffel.

The only ornamental attachments that I can recollect on the moment are the fret-saw and the chucks worked from the leading-screw, and to these latter I confess I did not pay much attention, and if I had I should, without experience, express no positive opinion, it being a subject out of my line.

Of course no ordinary wood-turner would buy a back-gear screw-cutting lathe when he could get one to suit his purpose better for one-tenth the

price. If "J. L.'s" turning in wood and ivory is confined to pen-holders, draught- and chess-men, &c., then by all means have a light and lively driving-wheel; but if it goes on to tool-handles, and chair-, table-, and bed-legs, or things from 1in. to 2in. or 3in. diameter, I don't think he will disagree with me as to the ease obtained from having more than a light driver.

The last sentence of "J. L.'s" letter seems to concede what he denied in his first—that none of these combinations did their work efficiently. Now, he says, he has "no doubt they would one and all prove perfectly efficient." That the cost of the combination would be greater than the separate machines seems not likely; but the Britannia Company could soon tell us about that.

Now to "Orderic Vital's" letter, which, I am happy to say, is not all made up of objections. Are they so serious as he would lead us to think? First, that the speed will be too high unless the back-gear is used. I should say, for the shape, undoubtedly the back-gear must be used, and as the lathe must have back-gear headstock, may not as well be used for reducing the speed, as pinion on the driving-shaft? For I do not think the saving in reduced noise from gear would be much, or worth the trouble and complication in the gear on the slide-rest. As to the drill, the speed would not be too high without the back-gear, and it could be made high enough by the quick speeds on mandril and driver-wheel. I must be very stupid, but I cannot yet see how the fret-saw worked from the rocking-bar, as its chief motion seems to be in a horizontal direction, and only to a very slight degree indeed in the vertical. I should be much obliged if "O. V." could make it plainer to me. I have been asked to make up some articles for a bazaar, and my fret-saw machine, made from designs in "E. M." years ago, is not the best form, so I want to fit up a new one, and on the best plan I can discover. Perhaps someone could help. I hope "Sunlight" will soon be able to give us his promised letter on lathes.

Fredk. Carré.

SPIRAL APPARATUS.

[19690.]—As a very old subscriber to the "E. M." may I ask if it is the intention of Mr. Evans to continue his description of the spiral apparatus (partly described on pages 101 and 102, 7th Oct., 1891)?—feeling sure that there are very many subscribers like myself waiting patiently for the concluding papers on this very interesting subject, which has hitherto been but meagrely described in one or two works on lathe matters.

Mr. Evans remarks, "I intend, in the first place, to show the apparatus in its original form, and later on I will illustrate the various improvements I have added to it," and in course of his description says, "my principal object being to show the improvements in the arrangement I now make"; this information will be fully appreciated by, and very valuable to, those about to construct, and a guide to those purchasing the apparatus. And again he mentions that under certain conditions the transfer chuck must be used, and writes, "these will come anon," so that I cannot but think it was his intention to write another paper or two on the subject.

I would like to ask Mr. Evans if the drawings given on page 101 are to scale?—which numbers (wheels) are to be bored out to 14in. and what pitch wheels are generally used?

I believe Mr. Evans is always so willing to give help to all concerned in lathe work that I do not hesitate to bring this subject again to his mind, and apologise for the length of my letter.

Spiral.

ORNAMENTAL LATHE-THREADS.

[19691.]—I HAVE to thank Mr. Evans for so kindly offering to lend me tools for the screws about which I asked for explanations. But I am not making anything in pursuance of his interesting articles; and, if I were, I have the Holtzapffel screw-tools at hand. I am merely perusing Mr. Evans' articles from a scientific interest, and because I look upon amateur mechanics as one of the most healthful and instructive amusements in which a gentleman can indulge. My object is asking for these explanations was a wish to see Mr. Evans' articles made complete as papers to serve for the diffusion of knowledge; and now that he declines to answer my inquiries, I would frankly point out that, in papers which are professedly written to enable readers who have the time and skill to make these things for themselves to do so, the introduction of enigmas degrades his papers from a scientific level.

It is obvious that Sir Joseph Whitworth has not suffered in any way from publishing the details of his standard screw-threads, measuring machines, or gauges. Nor have Holtzapffel and Co. suffered in any way from publishing their classical and truly scientific volumes upon turning and mechanical manipulation. And I would submit to Mr. Evans that, even pecuniarily, and apart from questions of reputation as a scientific mechanician,

he is mistaken in making a mystery of the screw-threads or other data to which he refers in his published papers.

The microscope makers of the last generation each screwed his own microscope with a gauge of his own for the purpose of making a slave of every one who invested in his apparatus, and of necessitating their always coming back to him for repairs and additions. The result was, that microscopists found themselves encumbered and worried with a heap of adapters, which had to be obtained whenever they needed to apply some speciality of another maker to their original stand. The nuisance of this became so serious, that the Royal Microscopical Society took up the question, and fixed upon a suitable gauge, which was known as the "Society screw." This, to the great comfort of microscope users, and in no way to the detriment of microscope makers, has ever since been in vogue, and any objective can now be screwed on to any stand, while a microscope not having the universal screw is now unsaleable. The question is, why are ornamental lathe users to go on buying costly apparatus which necessitates their always going back to a particular maker for the most trifling repair, alteration, or addition, and simply because a mysterious "J screw" or "N screw" has been used in its construction? And Mr. Evans, when asked by me to state the advantages which these screws possess over our public standard screws, frankly says:—"There is no practical reason why a Whitworth thread should not be used, and one of the great features with regard to the latter is that you can get them any and everywhere." Now this is perfectly well-known to everyone who has studied the question; but it is a great thing to have the admission from Mr. Evans himself and the question which he will now be asked is, Why, then, victimise your clients by putting these mysterious screws into the apparatus which they unwittingly buy on your recommendation as a scientific mechanic? I now have in my own laboratory a slide-rest in which the head of one of these screws has come off, and, instead of being able to work into an iron-monger and for a few pence buy a Whitworth bolt, I must either have my slide-rest packed up and sent away in order that this trumpery little bolt may be replaced, or I must myself have forged and then screw up a steel bolt by one of the Holtzapffel tools. If for the latter job I have not time or not skill, the slide-rest runs the risk of injury in transit, my work is stopped for several days, and the cost is twice as many shillings as otherwise it would be pence. To an amateur in the country or in the Colonies the result is much more serious.

It is perfectly true that the Holtzapffel screw-tools can be purchased by anyone. But Holtzapffel's catalogue—which can be got by post for eight stamps and is a most useful little volume—thus describes (page 64, articles 2,011 and 2,012) the set of screw tools. "Twelve pairs for the deep threads, and twelve pairs for the shallow threads," i.e., 48 tools. Then in my laboratory I find a mahogany box of beautiful little taps, dies, &c.: (article 1817, p. 53), marked in sets "N," "P," "R," "T." These consist of a screw die-stock, two tap-wrenches, eight dies, twelve taps, and a gauge-plate with four screws, so as to size the bolts, and the screws—inside and out, when perfected; in all 29 pieces. Thus one has 77 surplus tools to buy, to store, to keep in order, and to make no mistake about when using, simply because ornamental-lathe makers have not yet adopted a standard aliquot thread. Of course one has to keep Whitworth tools also. As to the meaning of these mysterious denotements, "N," "P," "R," "T," some more experienced amateur will perhaps enlighten us, as Mr. Evans declines to do so, and there is no clue that I can find to them in Holtzapffel's volumes. Of course I can easily take wax or lead impressions of these taps, and measure out their details; but never yet having taken the trouble to do this, I have no means of knowing what they are, except that they are a beautiful little lot of tools, and that they work charmingly.

Turning to Holtzapffel's classical volumes, I find (Vol. II., pages 673-675), the following table of the 48 screw-tools referred to in his catalogue, and which, as it may not be accessible to all the readers of the *ENGLISH MECHANIC*, I reproduce, together with Holtzapffel's comments thereon in the year 1846:—

"Approximate values of I.I. Holtzapffel's original screw threads:—No. 1, 6.55 threads in one inch; 2, 8.25; 3, 9.45; 4, 13.09; 5, 16.5; 6, 19.89; 7, 22.12; 8, 25.71; 9, 28.88; 10, 30.10; 11, 33.83; 12, 55.11. The angle of the deep threads is about 50° of the shallow 60°."

"This irregularity of pitch would not have occurred had the screw-lathe, with its change wheels, been then in use; but such was not the case. . . . Since the period at which H. and Co. made their screw lathe they have employed the aliquot threads for all screws above half an inch; indeed, most of these have also been cut in the screw-lathe. To have introduced the same method in the small binding screws which are not made in the screw

lathe, but with the die-stocks and chasing tools, would have doubled the number of their working screw tackle and the attendant apparatus; with the risk of confusion from the increased number, but without commensurable advantage as regards the purposes to which they are applied. . . .

It must, however, be freely admitted that advantage would ultimately accrue from making *all new screws of aliquot measures*; and which, by gradually superseding the old irregular threads, would tend eventually, although slowly, to introduce a more defined and systematic arrangement in screw tackle, and also improve their general character."

At page 1,017, Vol. II., after giving a series of tables of all sorts of gauges for wire, sheet metal, &c. Holtzapffel goes on to remark:—

"From the perusal of the foregoing particulars of numerous gauges employed in different branches of mechanical art, it will have been seen that little analogy on the one hand, but great confusion on the other, exist in such of the gauges as have been referred to; and the author will now briefly state the remedy he would suggest to obviate the difficulty in the most simple and inexpensive manner."

"The remedy proposed to remove the arbitrary incongruous system of gauges now used is simply to employ the decimal divisions of the inch, and those under their true appellations."

The gentleman who now, with such distinction, represents the Holtzapffel firm, has recently brought out the fourth volume of the series of which his father produced the first three, and that volume has already reached a second edition. This volume fully maintains the scientific and literary reputation earned by the first three. But many readers were disappointed at seeing in it no further scientific development of the screw-thread question, and I confess to having been one of such readers. The only reference which I have noticed in the fourth volume (page 163) reads as follows:—

"A wheel of 53 teeth has been introduced into the table [of change-wheels], in order to enable the apparatus to cut a thread of the same pitch as the screws of the mandrils of Holtzapffel and Co.'s 5.11 centre lathes; the approximate value of which is stated on page 673, Vol. II., as 9.45 to the inch. The table shows that 53 on the mandril and 50 on the screw [guide-screw ten turns to the inch] give a pitch of 9.433 (9.434) to the inch, as the result of the combination, which, although not theoretically correct, is a sufficient approximation for most purposes."

This passage from Holtzapffel's new volume is curious and interesting. In it a gentleman, one of our most eminent mechanicians, gifted also with admirable literary abilities, exhibits himself as incapable of perceiving that the thread on the nozzle of a Holtzapffel lathe might be made an aliquot part of the inch—say nine or ten threads to the inch—as easily as an incommensurable number, such as 9.45! As an unintentional specimen of "how not to do it," this burdening each of his clients with a useless extra brass change-wheel of fifty-three teeth, instead of simply carrying out that recommendation which his father so ably advocated, and screwing all new lathe-nozzles to an aliquot part of an inch, is very funny.

The fact, however, is clear, and it ought to be embalmed in the pages of the *ENGLISH MECHANIC*, for Macaulay's New Zealander to cite as an example of the "goings on" which impeded scientific progress in the days of Queen Victoria, and of the docility of the people who then bought ornamental lathes.

In Vol. IV., at page 108, a footnote will be found which explains an anomaly that puzzles most users of the Holtzapffel traversing or screw mandril. It reads thus:—

"The screw-guides ordinarily made for H. and Co.'s screw mandril lathes, are numbered 1 to 6: their threads correspond, in like order, to those numbered 3, 4, 5, 6, 8, 10, of the table, page 673, Vol. II.: these are generally found to suffice; but the number may be extended if required."

This is really a delicious dispensation. By means of it an amateur desiring to use the guide numbered 1, has to use with it the screw-tools numbered 3; with guide numbered 2, the screw-tools numbered 4; with guide numbered 3, the screw-tools numbered 5; with guide numbered 4, the screw-tools numbered 6; with guide numbered 5, the screw-tools numbered 8; with guide numbered 6, the screw-tools numbered 10! If the amateur is not up to this little conundrum, he necessarily spoils his work when he proceeds to screw it, as his work is running at one pitch and his screw-tool is cutting another. As to the relation which Holtzapffel's alphabet screw-tools bear to the mandril-guides, or to the numbered screw-tools, I find no clue anywhere in the four volumes. 1. Do they belong to another series of screws altogether? 2. Are the numbered screw-tools the same as some of the alphabet screw-tools, and only varied in their denotation for the purpose of exercising amateurs in the solution of conundrums? 3. If the answer to query 2 be yes, which is which?

These considerations will not affect gentlemen

who value a lathe for its shininess, or who limit themselves to the ivory pagoda business. But to the intelligent amateur—who not only has feeling for a finely-shaped vase or an eccentric column, but who may desire to make a piece of philosophical apparatus comprising wheel-work and regulating-screws—the first thing wanted is to know the number of threads per inch which he can cut with the beautiful Holtzapffel screw-tools which have been sent to him. Taking down Vol. II. of Holtzapffel's work, he finds himself confronted with the table which I have cited, and which seems to have been planned to prove that the ornamental lathe is incommensurable with the doctrine of ratio and the four rules of arithmetic. Now that we have an Amateur Mechanical Society, this question will no doubt be taken up, and, in a few years, lathe-apparatus encumbered with screw-threads which are only a barbarous survival of rule-of-thumb-mechanics, will be as unsaleable as the old microscope apparatus already is. That our ornamental lathe-makers should carefully keep on hand the whole multitude of their obsolete screw-tools is only due to those clients who have invested in the present apparatus; but that they should continue to inflict upon a new generation of unwitting clients these incommensurable and mysterious screw-threads is a proceeding greatly to be deprecated, and one which, if persisted in, will assuredly turn awry the present currents of business.

As to what cross section the screw-thread should have, and how the cross section should be varied for various purposes—these are questions of infinitely less importance than that which I now raise—i.e., the question whether the pitch of our ornamental lathe-thread shall be commensurable or incommensurable with our English inch? I venture to submit that in future no pitch other than an aliquot part of the inch should be used unless where necessary for the utilisation of existing apparatus.

The great practical importance of this question is my apology for the length of this letter.

James Edmunds, M.D.

Grafton-st., Bond-st.

THE DANGERS OF OXYGEN MAKING.

[1892.]—I AM glad this discussion has brought out something worth reading, and I do hope the lesson will not be forgotten by amateur lanternists. A. W. Sward seems to have thought that I condemned his method. In this he is mistaken. I did not for one moment wish anyone to believe that his test-tube method was not correct; but what I did say I repeat, it "is not satisfactory." If every one who uses a lantern, or makes oxygen, was a chemist, then I should give them a chemical test; but I know too many of the readers of the "E.M." who are not chemists at all, and would be alarmed by the bubbling of the gas in the test-tube, and the least bit of crackling in the tube would make them discard the sample of manganese. Seeing is believing, so the old people say, and when flame can be seen on a shovel it is at once satisfactory and complete. "F. I. C." only suggests a ladle, which is not far off a shovel, but very few people possess ladles, except perhaps soup-ladles, and I fancy the use of the latter would bring on an explosion of another kind. The simpler method is always the better. I have in my laboratory a number of test-tubes; so have many others, but not one out of 50 oxygen makers have a test-tube, while everybody possesses a shovel. "F. I. C." has jumped to a conclusion without giving the matter sufficient thought. I did not say that I had had the explosion, but that I had had samples of manganese. The manganese, from which I had the samples sent to me produced the explosions. I should have been sorry to have been anywhere near the retort when it burst, but I happened to be in the town in which the first explosion occurred; it was at the residence of a Colonel, and he had every precaution for safety. He had a safety-cork in the top of a conical retort, had indiarubber tube some 10ft. long, and he had built into the recess the huge iron perforated castings I spoke of. I drove to the house, and certainly I never saw a much greater wreck; the casting had been blown 15ft. away, and removed several bricks in the opposite wall by the force of its impact. The ceiling gave way, and several of the joists supporting the room above were moved considerably, and had to be supported. Three of the plate-glass windows in the room above were smashed. This was something like what the Americans would call a jolly big explosion, and, even if not terrific, it certainly terrified everybody in the place, and, as "F. I. C." says, "terror means exceeding great fear"; therefore, exceeding great fear must mean terrific. Q. E. D.

I may say that, for over twenty years, we have received manganese from one manufacturer, and we have never once had a bad lot, and, using some four or five cwt. a year, one would think by this that it did not need a test; nor does it, but I do personally test every barrel that is opened, and then I am sure as to its quality. I shall always test it; I would not trust to anybody's word as to

manganese. Trust yourself; don't deceive yourself, and all will go smooth. Not long ago I heard of a queer case.

There were two casks in a cellar one filled with manganese, the other with lampblack, the chemist's assistant had partly filled a paper-bag with the manganese when he was called to the bottom of the steps, and ladle in hand he went back to the wrong barrel and filled up the bag. Fortunately, the mistake was found out in time; otherwise the results would have been disastrous. Everyone who makes gas has his own little dodges or peculiarities. Some like making it on a fire. I do not recommend the fire; better make it over a good gas-stove with a hood to nearly cover the bottom part of the retort, allowing room for the heat to come round the retort. This will give plenty of heat and will allow the operator to make the gas quickly or slowly as he may wish. For purifier, always use a glass bottle, and it is much better to use two bottles, one with water in nearest to the retort, the other empty nearest to bag. Through the glass can be seen the least change in the rapidity of the evolution of the gas. I would not recommend the use of a mercury bottle for making oxygen; the bottles are so thick that they take a long time to heat and then become so hot that very often the upper part becomes choked and if they burst they explode more like a shell than anything else. I have heard of several explosions, dangerous ones, with these mercury bottles. W. J. Lancaster.

EXTENSION TO TRIPOD-LEG OF TELESCOPE.

[18693.]—I ENCLOSE a sketch of an attachment or extension to tripod-leg of telescope, which I

and hard wood—and two bolts, A and B; or, rather, the bolt A and steel pin B. The eye is wedge-shaped to and from the claw-foot; the foot is turned to fit a metal ferrule somewhat smaller than the foot of the main leg. The end at A is $\frac{1}{16}$ in. thick and $1\frac{1}{2}$ in. wide, owing much to the weight of the instrument. I have a $\frac{1}{4}$ in. refractor. The bolt A is an ordinary bolt, driven into a hole in the main eye, tight, to prevent its turning while tightening or loosening the thumb-nut A; the steel pin is $\frac{5}{16}$ in. in diameter, driven into the main-leg tight, to prevent its loosening; it projects $\frac{1}{16}$ in. as shown in Figs. 3 and 4; by loosening the thumb-nut A, the extension-leg will drop off of the steel pin B, as seen in Fig. 3, which will permit of its being reversed, as seen in Fig. 4; by tightening the thumb-nut, the eye is held in its place and out of the way, as it folds up inside the main-leg. With this device, I can raise or lower my tripod in a minute, and at the same time avoid loosening the extension or extra leg; the bolt A should be long enough to avoid taking the thumb-nut off. Figs. 4 and 5 show the eye-face and side view, and also bend the claw-feet to prevent slipping, which I find improves it much, especially when the tripod is well spread out. I simply give the above believing it to be useful to many, especially those who exhibit in the street.

D. C. Meeker.

32, Lorimer-street, Denver, Colorado, U.S.A.

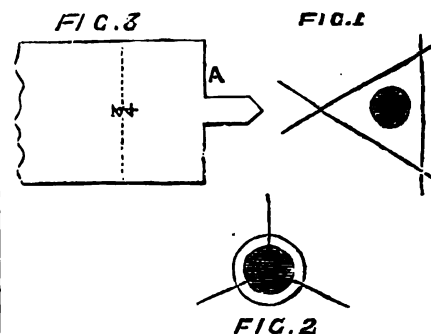
SPOT AND PINHOLE—MODE OF ADJUSTMENT.

[18694.]—THE thanks of your readers are due to Mr. Skelton for his letters on this subject; and as I have adopted his plan, I shall be glad to bear my

places three other spots on his mirror, but they are unnecessary, nothing can be more perfect than the above.

The adjustment of the flat is made by Mr. Skelton's two pinholes, one at each end of the eyetube. The first, or outer one, is the usual adjustment-piece, or eyepiece with the lenses removed. The inner pinhole, after one or two partial failures, I perfected as follows:—

I took a rod of brass $\frac{1}{16}$ in. diameter (Fig. 3 full size), and put it into the chuck of a lathe, and turned down the small pin, δ , perfectly true $\frac{1}{16}$ in. in thickness, and the face, a , quite square. I then turned out a brass disc $5\text{--}32$ in. thickness, and rather larger than the size of the tube, and drilling a hole in the centre, exactly fitted it on the pin (δ). The disc was then slightly soldered to the



face (a), and then turned down to fit the tube, leaving a very slight flange on the outside to prevent its going into the tube, and to make it quite square, taking care that the flange was $\frac{1}{16}$ less diameter than the exterior of the tube, that it might not be pulled out when in the telescope. The disc was now truly centred, and it was only to melt the solder and it was ready for the tube.

I have found it best to adjust the mirror, as named above, without the inner pinhole, as can be seen better.

When this is done, bring the flat, in the usual way, concentric with the mirror, and make the eyetube as correct as this method will admit of, by trying it at different focuses, till it is concentric all. Then "refine" the adjustment, as Mr. Skelton so well calls it, by introducing the inner pinhole, when the appearance, when perfect, will be as Fig. 2, the shadow being seen in the centre of the pinhole with the spot in its centre, and a concentric ring of light all round. If it is not at first, make it so with the flat motions, and the test of the perfection of the eyetube will be, that it remains so at all focuses, and also when the tube is rotated.

All this may seem a good deal of trouble; but it must always be remembered that, no matter how perfect the mirror is, it will not do its best unless the adjustment is absolutely perfect, which only the last "refinement" can accomplish, so that it is worth it over and over again.

The satisfaction also of knowing that, on all occasions, you can see all that the night will allow, with splendid definition on good nights, and the light "well-gathered in" on all, must be experienced in order to be fully appreciated.

Fordingbridge.

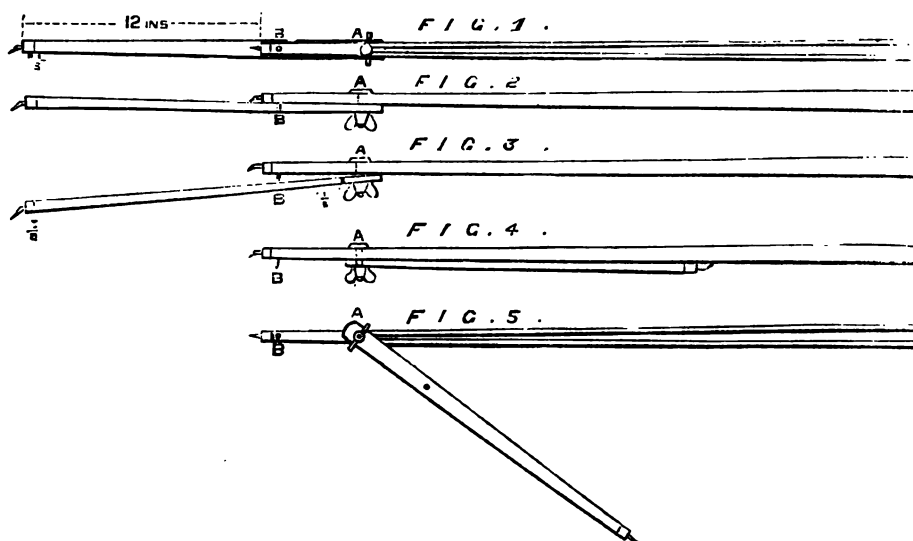
T. Westlake.

CHEAP MICROSCOPES.

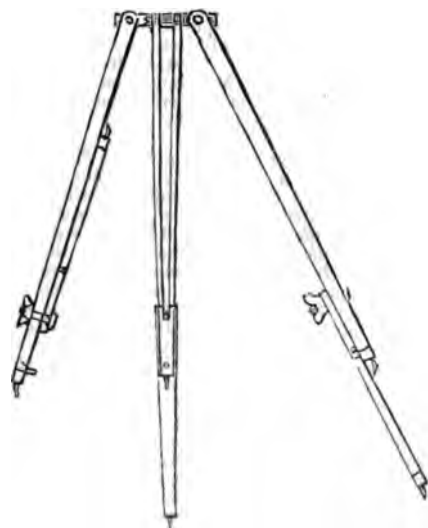
[18695.]—C. WELBORN, 18659, will find that an "equally effective instrument" cannot be produced at half the present prices, since it is not the cost of material, but skilled workmanship and time, that constitute the main part of the cost. The actual value of material is not more than five shillings in many microscopes, so that to substitute iron for brass could not make much difference. A perfectly efficient stand for ordinary purposes can be bought for a couple of pounds; beyond that, everything depends on the array of lenses and apparatus, and the best of these are costly; but very good ones can be got at a reasonable price.

To those who read the following letter, I say, Do not buy combinations of lenses—that is $\frac{1}{2}$ in., $\frac{1}{4}$ in., and $\frac{1}{8}$ in. combined, if you can possibly do otherwise. No microscope so fitted gives satisfaction for any period. A decent $\frac{1}{2}$ in. will show more than such a built-up $\frac{1}{2}$ in. The letter of "J. F." is sound sense on the matter. Nearly every maker, as well as his Birmingham friend, supplies a very decent instrument for the price he names, but the lenses have nearly always to be superseded by better ones. I should suggest purchasing a stand only, and then trying a decent $\frac{1}{2}$ in., say, Gundlach's, which is as good as any, and low in price; and afterwards he can get a good $\frac{1}{2}$ in. for 30s., and have a satisfactory instrument.

H. Holmes.



designed and have in use. The necessity of elevating the instrument at times, and lowering it at others, is obvious, no doubt, to all who read your



paper. Therefore, it will only be necessary to explain its construction, which consists of an extra piece of wood—which should be good straight grain

testimony to its extraordinary accuracy. I have worked on somewhat different lines to the same result, and my experience may perhaps be interesting to amateur observers.

It will be evident that, where the accuracy is so great, the appliances must be equally so, or they will be a source of error in themselves. This, however, I have found easy by adopting the following methods:—

To find the exact centre of the mirror, divide the circumference of the cell of the mirror into three equal parts, taking care that the mirror is quite central in its cell. If it is not, allowance must be made for this.

From these three points as centres, describe a small spherical triangle near the centre of the mirror, marking it with the compasses very slightly, just so as to show in the light, the sides of the triangle to be each 1-16 in. beyond the spot to be formed. The radius in my case was $6\frac{7}{16}$ in. Then either remove the silver by Mr. Skelton's plan, which I have done, or gum a circular piece of blackened paper of the size required—say, $3\frac{1}{16}$ in.—exactly in the centre of the triangle (see Fig. 1) which is full size.

When adjusting the mirror in the usual way, this spot must be brought by the adjusting screws into the centre of the reflection of the flat (or shadow), and this can be done with astonishing accuracy and with the greatest ease. The shadow is so small, that it can be exactly estimated as being in the centre, and the slightest motion of the screws is observable. The three watch-springs also, which hold the flat in the centre of the tube, may be made themselves an additional test of accuracy; the three, being produced, will exactly meet in the centre of the spot. (See Fig. 2.)

Mr. Skelton, in his last letter (18611, p. 448),

[19696].—IN reply to letter 19661, I may say that I used a microscope of the kind described, but without condenser, for about three years, and found it extremely useful. It has a sliding adjustment to the body, and fine adjustment to stage, and is provided with a lin. objective of very fair quality; the body has the standard screw-thread, and with the addition of a $\frac{1}{2}$ in., I was able to mount a good many successful slides of selected diatoms; in fact, for mounting purposes generally, it is more convenient than a very large one, as the stage is so near the table that no rest is required for the hand when manipulating an object thereon. It is sold for £1 11s. 6d. If Mr. Cooper cares for further particulars, he can have them on advertising his address. E. C. A.

THE RIGHTS OF INVENTORS.

[19697].—I AM very glad indeed to have the advantage of "Sigma's" antagonism. But does he not state the position wrongly? If it is to the "advantage of the community to encourage everyone to bring forth his ideas," then it is to their advantage, and there are no two ways about it. To admit the advantage, however, and then follow it up by that which restrains and discourages, is simply to play fast and loose. Before the admitted advantage of encouragement, all inventors are equal. As of right, then, they may claim that their equality as inventors should be upheld, and that fowl should not be made of one and flesh of another by a money dividing-line. Now what exaggeration of claim is there in this? And if this right can only be maintained by making the grant of patents free, is the community to stultify itself rather than make it free? When application is made for a patent, "Advantage to the Community," looking to the substance, inquires only—Is an invention here?—as to inventor, Don't know him. Expense in obtaining protection, on the contrary, rejects the substance that the community does want, unless it can also get shadow that the community does not want. Thus expense runs counter to advantage to the community. The view "Sigma" advances that "patents prevent some one else from using their substance," I by no means accept; but the discussion of this, as of some other points in his letter, is outside what I now have to confine myself to. So allowing that a "moderate check" is requisite, I merely say that this must not go back on the road that the community, in deciding to protect invention, has elected to follow, but must be a genuine weeding, conducted on the "survival of the fittest" principle; the determining question to be, What is the applicant's invention?—not, Has he got any money?—the latter mode of selection being blunderheaded and mischievous.

I have said that the grant of patents should be free. I do not, however, mean by that, there must be no money payment on a patent at any time during its existence, but only that, at any rate, up to the grant of the patent there should be none. If the community decide there shall be money payment, the method of this should accord with their own resolution that invention is to be encouraged, that's all; and not be framed from a "how not to do it" point of view. My own opinion is, that if the duration of a patent is fixed at a term of years, there should be no money payment. An inventor pays for his patent in "particularly describing and ascertaining the nature" of his invention; in other words, by the equality of knowledge he confers on the community. If, with fixed term of duration, the community will have fees in addition to description; or, if no period of duration is fixed, then, in either case, payment should take the form of an "annual growing tax;" not, however, exactly such as "Sigma" describes, a blind levy without foundation principle, but a percentage on income actually derived from the patent.

Aliquando.

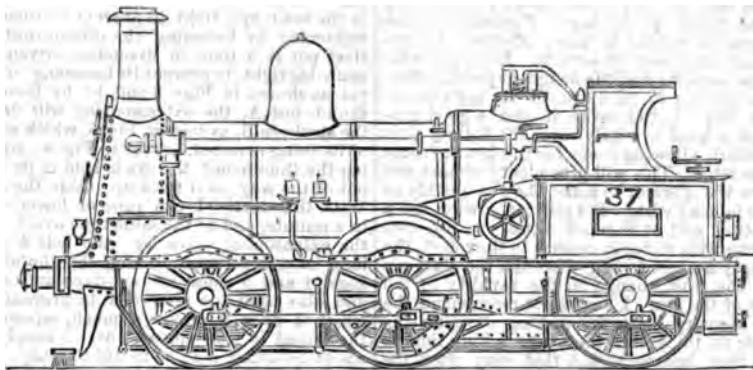
L. & S.W.R. GOODS ENGINES.

[19698].—A WEEK or two since I noticed a letter asking particulars of goods engines; I therefore send a few particulars of the L. & S.W.R. engines.

The engine of which I send sketch was designed by Mr. Beattie, and built by Beyer Peacock and Co., in 1878. The wheels are 5ft. in diameter, the cylinders 17 by 22, the wheel-base is 14ft. 6in., the load on each axle is (I believe) 15 tons. These engines are fitted with Beattie's patent apparatus, by which the steam, instead of blowing through the safety-valves into the air, can be turned into the tender-tank, thus heating the water before it enters the boiler. These engines run the "Tavy" and other goods trains; there are 36 engines of this class, 24 of which are fitted with the brake on the engine; the numbers that came in 1878 are—151, 152, 160, 162, 229, 230, 368, 369, 370, 371, 372, 373.

There is another class of goods-engines having the same dimensions as the 371 class, only the axle-boxes are outside, the engine having double frames and differently shaped cab; there are 12 of this class: the numbers are from 273—278 and 285—290.

Another class of engine, like the above, except in the dome, which is over the firebox, and valve on boiler, with open weather-board, is represented by the "Anglia," "Colossus," &c.; there are 12 of this class. Both the latter class have over-hung springs, and no brake on engine.



There are three engines, Nos. 291, 292, and 293, having valve-chests on top of the cylinders; they were built at Nine Elms. The dimensions are—wheels 5ft., cyl. 17in. by 22in.; the bearings are inside.

The most numerous class of goods-engines is represented by Baby (No. 108), Stonehenge (16), and over thirty others: the bearings are inside, the drivers 5ft., cylinders 17in. by 22in. These engines have no brake, except on the tender-wheels.

The "Elephant" (51) is a representative of the most ancient 6-coupled engines on the road; she has outside bearings, cylinders are (I think) 16in. by 22in., the wheels are 5ft. Many of this class are "scrapped."

I am sorry I have no further details and weights of the engines I have noticed, nor particulars of the new 6-coupled engines just put on the road by Mr. Adams, built by Neilson and Co., Glasgow. Perhaps some correspondent can give them. I am sure they would be interesting to many others besides Clyde.

SCREW-PROPELLERS.

[19699].—It does not matter what the subject may be; once ventilate it in the columns of the "E.M." and some one of your numerous readers and contributors is sure to pick it up, and have something to say on it. Some six or seven weeks back, I read in the columns of the "E.M." a notice on the experiments of a Mr. Root in America on the position of the axis of the screw-propeller, in which it appeared that when the axis was at an angle with the keel of the vessel, the results were better than when it was parallel with it. Such being the case, the old cry arose up, "Who would have thought it?" But somehow, sooner or later, someone does think of it, and as a result, something beneficial comes from the thought. When I read the article in question, my memory went back to the days of youth when I had "to scull the captain ashore" in the jolly-boat, and well do I recollect the difference in speed between the sculling with the oar as nearly horizontal as could be and when I stood on the aftermost thwart of the boat, and sculled with the oar at a large angle with the line of keel, and bore downwards so as to depress the stern of the boat—using, in fact, the oar as a compound lever: the water over the blade of the oar forming the fulcrum, the rullock-hole in the stern of the boat the point of pressure, and the sculler working the oar and pressing down the power. A skilful sculler can get a good speed if he keeps his hand well up. Any one who has been in the Eastern seas becalmed, may have often seen a Chinese junk with her large oar over the quarter, and four hands sculling and getting one-and-a-half to two knots an hour out of a heavy junk carrying 200 or 300 tons. Again, the way the Chinese handle their sampans in the rivers is something wonderful. The Chinaman does not rest his oar in a hollow in the top of his sternboard, but works it on a pin, with a small hollow in the underside of the oar.

Consequently, it is only by the pressure of the loom of the oar downwards on the pin that it is kept in place. Whether a motion is realisable like that of the oar of the sculler, which is an imitation of the fishes' tail, for large sea-going steamers, is a question of doubt and, probably, the only approach to it has been realised in Mr. Root's experiment of placing the axle of the screw at an angle with the line of the keel; but I firmly believe that some such motion might be made available as an auxiliary in cases of calms. It often happens that twenty or thirty miles change of position would take a ship out of a belt of calms into a trade or monsoon wind. The idea is not a new one. A friend of

mine, who was my superior officer in a merchant-man trading to the East half a century ago, tried his hand with an auxiliary, not in the shape of a screw, but of paddles on each quarter, not revolving, but in imitation of the savage "paddling his own canoe." He had a small steam-boat running

between Blackwall-pier and Greenwich, which was christened "Daddy Long Legs." His purse was not strong enough to go on very long. That was in 1843.

I suggested the sculling motion, but his money loss and expenditure sickened him of any further experiments. I believe that the notion may be worked out and utilised in inland navigation, especially in canals, where paddles, either breast or stern, or even the screw, are objectionable, on account of the wash on the banks. Were I a score years younger I should go in and try. There are plenty of your contributors who, if not thorough salts, have had a considerable lick of the tar-brush, combined with mechanical proclivities, who will see the value of the motion of the scull, and may probably elaborate a motion worked by steam, similar to that of men. Your contributor, "Sunlight," who seems to be able to tackle most things, may possibly take up the idea.

Rhoda Bux.

PURE ZINC-DYNAMO-MACHINES.

[19700].—WITH reference to the question raised about pure zinc being obtained by electrolysis, in letter 19523, "Sigma" does not say what the cathode should consist of. My experience is that zinc is always alloyed with hydrogen, which must be melted in a crucible, in order to drive it off, and this is the great difficulty I find, as a crucible containing lime, iron, or silica, will not do, as zinc, when melted, takes up a small amount of these elements. I have not cared about making the experiment in a platinum crucible. As to the extract which "C. F. M." kindly gives, in letter 19578, it will be as well to make allowances, seeing which side the water it comes from, and also the class of journal in which the statement is made. If pure zinc has or can be made in such large quantities, it would surely have found its way into the English market, where such a product would be a boon, not only to the chemist, but to all engaged in the making of batteries, etc.

In regard to dynamo-machines, I wish to point out that if, in describing a machine, people would be more particular, they would save a deal of trouble. This I mean kindly, and trust that those gentlemen who have favoured us with a part of required information, will not be debarred from continuing the same. First, as to the Siemens machine, described by Mr. Hanson on page 310, he says that the length of wire on armature is about 1,200ft. of 14 or 15 B.W.G., the R. of which is about 4ohm.

Now, according to table given in "Sigma's" book, that length of wire—say, 14 B.W.G.—would have a R. of 1.7 ohm. No length of wire is mentioned for field-magnets, but merely the statement that it is wrapped with 8 or 9 B.W.G. wire, R. of which is equal to R. of armature. If this is so, about 4,000ft. would be required for R. to be 1.7 ohm. Supposing Mr. H. be correct in the R. of $\frac{1}{2}$ ohm. for the 1,200ft. of 14 B.W.G., he would require about 1,100ft. of 9 B.W.G. to make R. equal to R. of armature, and as 1,100ft. of 9 B.W.G. double cotton-covered would weigh about 84lb., which, at 1s. 9d. per lb., would cost £7 7s., and, if as I calculate the length to be 4,000ft., would cost £29 8s., which, in addition to the 1,200ft. of 14 B.W.G. double cotton-covered for armature, will weigh about 361lb., which, at 1s. 10d. per lb., would cost £3 6s. Therefore, I make out the cost of wire to be £22 1s. different in the two cases, and all on that simple-looking statement of R. given by Mr. Hanson. Had Mr. H. stated the actual length of wire on F. M.'s, it would have been far better. The prices and weights (approximate) of covered-cotton wire are from the quotations given

me by one of the largest manufacturers of insulated wire. In a paper given by Dr. Siemens, and published in this journal, it stated the R. of F. M.'s should be ten times the R. of armature, and I cannot but think that if such be the case, Messrs. Siemens must construct their dynamos more on these proportions.

Now, as to "Anglo-Dane," who certainly has given us most willingly his experience and results; but, unfortunately, I cannot make out the length and sizes of the wire on his machine. I have followed up the correspondence between "Anglo-Dane" and Mr. Kennedy, and have noted carefully the letter where "Anglo-Dane" asks about the construction of dynamos, also the letter where he asks Mr. Kennedy's aid, he having constructed one which, unfortunately, would not work. How he succeeded in getting it to work he does not say, except that he did not follow Mr. Kennedy's advice, but worked it out on the original lines—see page 510, present vol., and on page 355, states that it will deposit 2.5 lb. of copper per square foot in 24 hours; but as to sizes and lengths, also weights of wire, we are in the dark. I should like "Anglo-Dane" to answer me these few questions: 1st, Theoretically, what weight of copper should the dynamo deposit per hour? 2nd, The lengths, weights, sizes, and cost of wires, and method of winding and joining up for R's? 3rd, The theoretical, and also practical power for driving? 4th, The theoretical and actual electromotive force, also speed at which armature runs? 5th, The total weight of machine? In fact, I should like to know how the machine compares with the law laid down by Mr. Kennedy, as to the R. of F. M.'s being five times R. of armature.

The letter sent by "R. P.," page 426, has misled me, as it appears to have done "Earnest Enquirer." In giving the data, &c., of wires, I quite thought that it was for a machine that would give a light of 3,000 candles. Perhaps "R. P." would kindly say what light it would give in candles? On page 474 "R. P.," speaking of the R. of armature, says, "but as it is divided into two parts in the armature, its actual R. is only 1 of the whole, or say, 1 ohm." I do not understand how it is only a 1—why not 2? "R. P." gives the R. of an arc lamp as 10 ohm, but in a book just published it gives one lamp when burning the R. from 1 to 1.4 ohm, two lamps in series R. from 4 to 5 ohm, three lamps in series R. from 8 to 10 ohm. Which is correct? It appears to me that the only way to tackle the difficulty is, first, to know the R. of lamp and conductors; secondly, to know the current required to give a certain light measured in candles, and then build a machine that will give the required current, in constructing which the cost of wire should be considered with the least amount of power required for driving.

Perhaps some readers will come forward and give us some data as regards what I have just stated as being required, and perhaps "Anglo-Dane," Mr. Hanson, and "R. P." will give us data about building machine for same. As to what "Sigma" says about here and there being found a reader who would build a machine successfully, I am inclined to think there are a good many who could, if they might have explained to them in a simple manner what is required in the way of data, &c., to work upon.

It, perhaps, can be found by looking up some half-dozen journals or so for the last two years; but it means a great deal of trouble, and as so many readers of the "E. M." as there are, who show they have a thorough knowledge of electricity, surely they will come forward with the required information. As I look back the last three or four years "E. M.'s" I see how well the subjects of telephones, microphones, and gas-engines, &c., have been gone into; and with dynamos, I quite thought that we had a permanent friend in Mr. Kennedy, but who, I am sorry to say, has not given us any of his knowledge for some time. Hoping that by this, "Sigma" will have recovered his health, and that he may aid us with his information, I must bring this letter to a close, trusting that the replies will take up a good space in the "E. M." Questor.

To Bleach Guttapercha.—Dissolve the guttapercha in twenty times its weight of boiling benzole, add to the solution plaster of very good quality, and agitate the mixture from time to time. By reposing for two days the plaster is deposited, and carries down with it all the impurities of the guttapercha insoluble in benzole. The clear liquid decanted is introduced by small portions at a time into twice its volume of alcohol of 90 per cent., agitating continually. During this operation the guttapercha is precipitated in the state of a pasty mass, perfectly white. The desiccation of the guttapercha thus purified requires several weeks' exposure to the air, but may be accelerated by trituration in a mortar, which liberates moisture which it tends to retain.

REPLIES TO QUERIES.

* * * In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[43383]—**G. W. R. Engines (U. Q.)**—"Emperor" is of "Great Britain" class:—Cylinders, 18in. by 24in.; driving-wheels (single) 8ft.; heating surface, 1,952 sq. ft. No. 2001 was formerly a double-bogie tank-engine, belonging to B. and E. R., with 9ft. drivers. She is now a G. W. tender-engine, with leading bogie only: cylinders, 17in. by 24in.; drivers, 8ft.; heating surface, about 1,700 sq. ft.—C. R. M.

[43701]—**G. E. R. Engines**—Unless the numbers have been altered lately, 280, 291, and 305 must be Mr. Sinclair's 7ft. singles, with 10in. by 24in. cylinders. No. 242 used to be one of Gooch's 5ft. 6in. coupled:—Cylinders, 15in. by 24in.; built by Sharp, Stewart, and Co., Manchester, and known as "Butterfly" class. No. 116 used to be one of Sharp's passenger engines: cylinders, 15in. by 20in.; single drivers, 5ft. 6in.—C. R. M.

[44083 and 44505]—**G. W. R. Engines.**—Dimensions of G. W. R. engines, No. 1000 class (narrow gauge), have been several times given (see indices, back vols.). I sent sketch two years ago. Cylinders are 18in. by 24in.; driving-wheels (single), 7ft.; heating-surface, 1,278 sq. ft.; weight, loaded, 32½ tons.—C. R. M.

[44511]—**L. O. & D. R. Engines.**—No. 23 has cylinders 16in. by 24in.; coupled-wheels, 6ft. 6in.—C. R. M.

[44505]—**G. W. R. Engines.**—In reference to the remarks of "Castles" (p. 70), whom I have to thank for several interesting illustrations of Caledonian engines, I may state that, in accordance with my promise, I forwarded tracings of the 7ft. singles, G. W. R. and S. E. R., more than two years ago. Unfortunately, however, they were of rather large size (being taken from the official drawings), and, owing to that drawback, I suppose, did not appear. I had no drawings available at the time for reducing the drawings, and they are no longer accessible to me.—C. R. M.

[44632]—**Old G. W. R. Engines.**—"Ixion," cylinders 15in. by 18in., driving-wheels 7ft. (single); "Courier," cylinders 18in. by 24in., driving-wheels (single) 8ft. This latter engine belongs to the "Great Britain" and "Lord of the Isles" class, and is still running. I have no particulars as to other engines mentioned.—C. R. M.

[45071]—**East Anglian Passenger Engines.**—In letter 16731 (Vol. XXX., p. 435) I gave a tracing and some few particulars (which I now supplement) of the engines asked about by "East Anglia." They were 10 in number (Nos. 103 to 117 of the old Eastern Counties engines), and were built by Messrs. Sharp and Co., Manchester. Cylinders, 15in. by 20in.; driving-wheels, 5ft. 6in.; leading and trailing-wheels, 3ft. 6in.; inside cylinders and double frames; 117 tubes (1½in.); heating-surface—tubes, 6,000 sq. ft.; firebox, 57 sq. ft.—total, 748 sq. ft.; weight, 20 tons. Nos. 250 to 270 of the E. C. R., Nos. 1 to 50 of N. E. R., Nos. 1, 10, 30, 70, and 80 classes on the L. B. and S. C. R., 19, 50 and other classes on S. E. R., and many on L. and N. W. R., Midland, Great Southern and Western of Ireland, and other lines, were of same pattern. They were general favourites, and did excellent work.—C. R. M., New Zealand.

[45246]—**"Antares" Limelight Jet.**—I am sorry to have overlooked this till I saw it in the "Unanswered" column. The jet "Antares" sent me to try with the gas-regulators was a very ordinary "mixed" pattern, not at all one of the best. A safety-jet cannot be altered to the mixed form without more trouble or cost than it is worth; and if "Novice" gets a good light with what he has, and his oxygen-bag will last the time he wants, he had better let well alone. We may have better jets before next winter. I am certain the blow-throughs can be vastly improved in light; and as to mixed jets, there is not one that pleases me to be had at any reasonable price.—L. W.

[45261]—**Charcoal Blacking (U. Q.)**—In making charcoal the billets are formed into a conical pile, which, being covered with earth or clay, is suffered to burn with a limited access of atmospheric air, by which its complete combustion, or reduction to ashes, is prevented. Another and a more perfect mode is that of submitting wood to a red heat in a kind of distillatory apparatus, consisting of cast-iron cylinders, from which issue one or more tubes for the escape of gaseous matters and vapours. A third method consists in exposing it to the action of highly-heated steam. The quantity of charcoal obtained from wood decreases in proportion as the temperature increases. At 482° (Fahr.), the average product of charcoal is 50 per cent.; at 572°, 33 per cent.; at 752°, about

20 per cent.; and at the temperature of fusing platinum, about 15 per cent. It also varies with the duration of carbonisation, and is greater when the process is slowly carried on. During carbonisation the normal carbon of the wood is divided into two parts, one of which remains in the charcoal and the other escapes with the volatile products. This division varies with the temperature: thus, at 482° the carbon remaining in the charcoal is double that which escapes; between 572° and 662° the two portions are equal, and at a higher temperature the quantity that escapes is double that remains. The charcoal retains a quantity of carbon proportionate to the temperature of carbonisation; at 482° it includes 65 per cent. of carbon, at 572° 73 per cent., at 752° 80 per cent., and at a higher temperature 90 per cent.; but at no temperature is the product carbon in a state of purity, as, however the charcoal may be prepared, it always contains gaseous matter, varying with the temperature of its preparation; when made at 182° it amounts to half the weight of the charcoal, at 572° to one-third, at 662° to one-fourth, at 752° to one-twentieth, and at the highest temperature to about one-hundredth. When wood is carbonised in perfectly-closed vessels, the resulting charcoal retains nearly the whole amount of carbon; when thus charred at between 300° and 660° the percentage of carbon is about 80, which is thrice that contained in charcoal prepared in the usual way. The position of the pieces of wood in the cylinders—namely, whether central or external, in reference to their contents, affects its quality. The following table shows the produce of charcoal from 1,000 parts of several varieties of dense and light woods, after exposure to a very high temperature out of contact of air:—

Ebony	305	Birch	202
Botany Bay-wood	281	Fir	181
Brazil-wood	260	Lignum-vitæ	175
Eveas-wood	225	Oak	174
King-wood	220	Mahogany	167
Tulip-wood	208	Beech	150
Satin-wood	207		

The stick of charcoal, when broken, should be equally black throughout. Sugar, and certain other substances which neither contain nitrogen nor leave any residue after combustion, when intensely heated in closed vessels, yield a pure charcoal.—F. BAKER COOKE.

[45308]—**Fusel-Oil (U. Q.)**—No method has I think, yet been devised for the estimation of fusel-oil present in small quantities in spirits. Its detection even is difficult. Among the methods recommended are the following:—1. Rub some of the suspected spirit between the hands, and after permitting the ethylic alcohol to evaporate, which it will do more readily than the amyllic alcohol, &c., forming the fusel-oil, endeavour to detect the presence of the oil by its odour. 2. Allow the spirit to stand over porous chloride of calcium for some hours and examine as to odour. This method is more delicate than No. 1. 3. To 150 parts of spirit add 1 part of potash dissolved in least possible quantity of water, well shake, slowly evaporate to 15 parts, mix with 15 parts of dilute sulphuric acid, allow to stand in a closely-stoppered bottle, apply nose.—ALFRED W. SOWARD.

[45305]—**Fusel-Oil (U. Q.)**—The best mode of detecting the presence of fusel-oil in spirit is to allow the spirit to evaporate slowly, as by rubbing it on the hand, or rising a glass out with it and leaving it to stand till the odour of the ethylic alcohol is no longer perceptible; the smell of the fusel-oil, being no longer disguised by the alcohol, becomes apparent. Diluting the alcohol with warm-water likewise brings out the smell of the fusel-oil. The complete removal of fusel-oil from spirit is a matter of considerable difficulty, and is seldom attained on the large scale. Simple distillation will not effect the object, although the boiling points of ethylic and amyllic alcohols differ from one another very considerably; common alcohol boiling at 79° C., and amyllic alcohol at 132°. The method most generally adopted consists in absorbing the fusel-oil by wood-charcoal. To give the charcoal its full absorbing power it must be recently ignited and left to cool in well-closed vessels; it is then reduced to coarse powder in rotating barrels containing a few iron balls. To effect the defuselation with the smallest possible quantity of charcoal, the spirit may be made to trickle through a number of casks filled with the charcoal, and placed one above the other. According to Luedersdorff, 2 quarts (or 2.25 litres) of spirit of 80 per cent. Trebles, require for defuselation the following quantities of different kinds of charcoal:—

	Potash-spirit.	Corn-spirit.
Lime-charcoal	1½oz.	2½oz.
Fir	1½oz.	2½oz.
Birch	2½oz.	3½oz.
Willow	3½oz.	5oz.
Oak	4½oz.	8oz.
Bone-black	10oz.	14oz.

These numbers, must, however, be understood

as merely approximate expressions of the relative defuselising power of the several kinds of charcoal, inasmuch as the detection of small quantities of fusel-oil in spirit is very difficult. In practice, the treatment of spirit with charcoal is seldom adopted, since a large quantity of spirit remains in the charcoal, and a considerable portion of it is lost by volatilisation during the transference of the saturated charcoal to the still; moreover, this operation takes a great deal of time. For this reason it is more usual to add the charcoal to the spirit in the rectifying apparatus—which, however, is a bad method, and never yields spirit free from fusel-oil, at least in the first portion of the distillate; a better method is to pass the vapour of the spirit through an apparatus filled with charcoal, before it is condensed. A method very generally practised is the addition of solution of chloride of lime, before rectification, to the spirit previously defuselised with charcoal (1lb. of saturated solution of chloride of lime to 150 litres of spirit). One-third of this quantity of chloride of lime, is, however, sufficient, if, after it has been mixed with the spirit, an equivalent quantity of chloride of zinc be added, hypochlorite of zinc being then formed, which is easily decomposed. Milk has long been used as a defuselising agent, its action being probably due to the fat which it contains. "Breton" states that olive-oil, shaken up with spirit containing fusel-oil, takes up the whole of that impurity, and when the whole is left at rest, settles down and may be separated by filtration. For operating on a large scale, he recommends that the spirit be filtered through a layer of pulverised pumice-stone, slightly drenched with the oil. As soon as the oil in the pumice becomes saturated with fusel-oil, the filtration is interrupted, and steam at the pressure of two or three atmospheres is passed through the pumice; the fusel-oil then volatilises, and the oiled pumice may be again used for defuselising.—F. BARKER COOKE.

[45338].—Preservative for Iron Ships.—If Mr. Clifford will send me his address, I will give him the composition of an anti-fouling preparation for iron ships' bottoms, on which it is impossible for either animal or vegetable life to exist. The same composition will serve as an anti-corrosive also, and no previous or extra painting is required.—C. M. FIELSTICKER, 5, Sydney-terrace, Kilburn, N.W.

[45458].—Pumps.—I did not recommend you to give the valves less lift. In fact, I think your valves are small enough to begin with. In my opinion, the area of the valves ought to be, as near as possible, the same area as the ram. A 30in. ram has an area of 706.86 square inches, and the size given of the valves (two 15in. by 8in.) only gives an area of 210 square inches. I think you would find, on applying the indicator to the pump, that the diagram which it made would, most probably, slant more or less to the left, instead of being a rectangle, which it ought to be. This would show that the pump-barrel is not filled at each stroke, and the ram in descending would cause the knock to be heard and felt. If air were leaking into the pump, say through one of the suction-pipe joints, you would hear and feel the same knock or bump, but the indicator diagram would have the top pressure-line serrated or wavy. If I could only see the pumps, I could very likely point out the cause of the noise in a few minutes. Shall be pleased to give any further information.—LABOR OMNIA VINCIT.

[45444].—Tait's Thermic Ventilator.—If "Bronchitic" will look again carefully at the sketch, he will find that the fresh air passes up a tube in the centre of the large tube; there is a cap on the top of large tube, with a hole in the centre, allowing the smaller tube to pass through and project about an inch. The discharge pipe is fitted to the large tube, and carries off all products of combustion. The elbow should be packed with wire.—AN OLD SUBSCRIBER.

[45548].—Drilling Apparatus.—I beg to thank "T. P." for noticing my query. I find I am quite correct, but perhaps I should have stated that it was under the head of "Index Plates for Gear-Cutting," which commences on p. 487, but the illustration in question is on p. 488. What I wish is some means of feeding the drill for about 2in., while the pulley on drill-spindle remains in the same plane as the driver.—THE MECHANICAL MASON.

[45552].—Tait's Thermic Ventilator (U. Q.).—I cannot speak from experience of this ventilator, but I can assure "Constant Reader in Italy" that two Bunsen burners do very appreciably warm a small room. I have such a one (contents about 1,000 cubic feet) which is occasionally pressed into service for experimental work. I scarcely ever have a fire there, but, about an hour before using it, light a couple of Bunsens, or, more usually, a single Bunsen and an ordinary gas-jet (Bray's, burning 5ft. per hour). At the expiration of the time mentioned the room is, even in cold weather, quite warm and comfortable.—ALFRED W. SOWARD.

[45552].—Tait's Thermic Ventilator.—To "CONSTANT READER IN ITALY."—My bedroom is about 18ft. by 10ft. by 10ft., and is a very cold room, having three walls exposed to cold winds from N. and E. I cannot say what temperature a Bunsen burner would maintain in such a room, having only tested a petroleum lamp, gas not being near my house. The lamp I use is the ordinary table-lamp with two 1in. wicks with a iron chimney 10in. long. This keeps the temperature in my room 12° to 14° higher than outside (4ft. from ground), and although we have had pretty well of fog this month, the room has been perfectly free from it. I have slept in this room ten years, and during the winter have had a fire at night and frequently all day, but have never felt the room so agreeably warm as it has been last winter and this, with the petroleum lamp and thermic ventilator. I think the comfort consists in warm-air entering the room instead of cold, as when the ordinary fire is used.—AN OLD SUBSCRIBER.

[45570].—Slide-Bars Cutting of Loco.—This query must be answered by another. Do slide-bars cut more when the engine runs tender first? If "C. O." knows of a case, there is some not altogether good work about.—NUN. DON.

[45571].—Inclined Firebox of Loco.—Impossible to say without knowing the engine. Perhaps the firebox is extra long, and the idea is that the fuel shall shake down gradually to the front end. What is the amount of inclination?—NUN. DON.

[45595].—Quantity of Water Flowing in a River at a Given Time.—"Aquarius" will find a number of formulae in Molesworth's pocket-book; but it is obvious that the calculation of the quantity of water flowing through a channel is not easily made, and that the result, without several elaborate experiments, could be only approximately correct. The formulae are so "formidable" that I hesitate to quote them, and I must confess I have no time to work out an example. If "Aquarius" will refer to Molesworth, he will get at least an idea; and then if he consults "Neville's Hydraulic Tables, Coefficients, and Formulae for Finding the Discharge of Water in Orifices, Notches, Weirs, Pipes, and Rivers," he will no doubt be able to calculate approximately the water power of any river or tidal basin.—NUN. DON.

[45597].—Porcelain.—Pipe-makers' clay, china clay, or some potter's clay, to be obtained from the potteries, would suit this querist.—T. P.

[45599].—Wood Screw-Making.—If you mean bench screws, they are made with a die fitted with cutters; tap and die, in fact, the same as screws of iron.—S. R.

[45614].—Industrial Insurance Policies.—This query could surely be answered by the secretary or solicitors of the society in question. As a rule, persons who insure in these societies can nominate anyone to receive the money.—E. G. M.

[45654].—Owen's Acme Incubator.—Your best plan would be to purchase one of Christy's Hydro Incubators, cheap form, price £3 10s., or, if money is no object, you can get one similar to the gold medal one for £4 10s., packing 7s. 6d. I presume you will have to pay carriage out. On no account use oil, as lamp flame tends to vitiate and dry the air, and an absolute necessity for successful incubation is to obtain a supply of pure air, especially after the tenth day. These incubators are heated by boiling water, in the following manner. A 90-egg machine will take the first time about 15 gallons of boiling water, heating-point 212°, and the effect of such a quantity will be a much higher temperature in the egg-drawer than is required, but which will rapidly fall as the sides and top of the incubator absorb the heat. After 12 hours, draw off the whole of the water. Notice this, as if you do not empty the machine the consequence will be that it will require a larger supply the second time than if it had been properly started. After the second filling it will, at the expiration of 4 or 5 hours, register in the egg-drawer heat from 120° to 130°. When this heat is attained the machine may be said to have been properly started; as soon as it falls to 108° or 106°, put the eggs in the drawer and draw off 2 or 3 gallons of water, and replace by adding about 2½ gallons of boiling water registering 212°. You cannot exactly fix the quantity required, but you must keep the heat in drawer 100° to 104°; the temperature and conditions of atmosphere in the room, both house, cellar used, and the circumstances of summer and winter cause variations. I will see that you are communicated with by letter giving you full information, as I am short of time just now.—YANKEE.

[45663].—Music.—I understand that "J. M. B." wishes to be able to reproduce a musical idea, without relying upon his being able to play it "mechanically"—i.e., remembering, as it were, the movement of the hands: for playing a piece "mechanically" from memory is a very different thing to playing it with an intelligent understanding of the composition. To be able to reproduce a

familiar hymn-tune without the music, at the same time playing the proper harmonies, is, unless you have a special gift for it, an exceedingly difficult thing to do. For instance, you know, say, the "tune," which is, of course, the treble part; to this, then, you have simultaneously to conceive the bass with the intermediate harmonies. Memory, of course, cannot be dispensed with, and if you carefully play the tune from the music, reading the names of the chords as you go on, and endeavouring to trace their relationship, you will, with the aid of memory, gain experience in the right direction. Practice—so essential in every study—will enable you to do this more easily. But I am but half-satisfied with these suggestions. It seems to me that an intuitive grasp of the idea is necessary for acquiring any great proficiency in this branch of the art. I know several people who can, without any premeditation, extemporise with the greatest ease on any melody that attracts their attention, and yet be totally ignorant of the grammar of the art. Others I have known, who had the faculty of writing and comprehending a score without the aid of the pianoforte, have been as helpless as a child in the matter of extemporise playing. Perhaps "J. M. B." belongs more to the latter. "Bannister" will perhaps indirectly help him to obtain his wish, and if his study of theory has not been too superficial, he will be able to write on paper the melody of a hymn-tune he knows, afterwards harmonising it according to strict rules. I should advise "J. M. B." to try this as soon as he is able.—G. L. PEARCE.

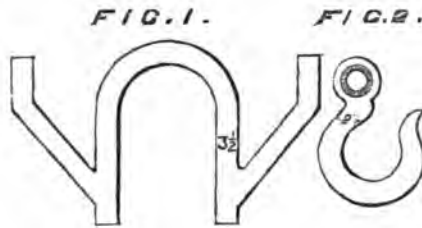
[45671].—Wood-Turning.—Thanks to "Wood-Turner" for his reply. Would he still further oblige me by making rough sketch of spoke-shave?—J. H. COYLE.

[45677].—How to Dress Rabbit Skins.—I am not a practical furrier or currier; but if "Niobe" will follow my instructions, she will have rabbits, or other skins as soft and white as a kid glove. Take the skin as soon as it is off the rabbit, cut it open down to the tail, and down each leg, which makes it larger; peel off all the inside skin, which is easily done when it is fresh, lay it on a board perfectly level, pulling it a little longways, from the head to the tail, no nailing or stretching; now get a 1lb. alum, handful of salt, pint of water, put it in a stone jar, and boil it on the hob; when all melted and hot, but not boiling, take a stick and a piece of flannel, dip in the liquid, and well saturate the skin all over the flesh side; take particular care not to wet the fur. Then turn the edges up all round, and pour some of the liquid in the middle; see that it is perfectly level on the board, so that it does not run away. Let it remain thus for three or four days. Now comes the part that has generally failed with most people. Take the skin and hang it upon a nail, or fence, or anywhere to drain, and watch it narrowly, so as to get it just dry enough, but not too dry to pull out soft; try a corner, and if dry enough, pull it crossways, and you will see it come like white kid; experience only will make you perfect; you must then well pull, beat, bang it against a wall, and rub it as much as you can to soften it; then pumice-stone the flesh side, and well brush the fur side with a clothes brush; if properly done, it will be as soft and clean as any ladies' sealskin. If "Niobe" wants any further information, and will publish her address, I shall be pleased to tell her all I know. I have four large rugs I have made, that now ornament—SWEEDLETTIE COTTAGE.

[45690].—Model Loco. Boiler.—Length of barrel, 10ft. 6in.; diam. inside, 4ft. 1½in.; thickness of plates, 7-16in. Tubes—Length, 10ft. 11½in.; diam. outside, 1½in.; distance of centres, 2½in. vertical, 2in. horizontal. No. of tubes, 250; area, 1,278.5 sq. ft. Outside firebox—Length outside, 6ft. 4in.; breadth, 4ft.; depth below boiler, 3ft. 3½in.; thickness of plates, ½in., 2 stays. Inside firebox—copper. Length outside, 5ft. 9½in.; breadth outside, 3ft. 6½in.; top of box to grate, 5ft. 9½in.; bottom of box to top of grate, 3in.; thickness of tube plate, ½in. top, ¾in. bottom. No. of stays, 104. No. of firebars, 44, ¾in. apart; area of fire-grate, 17 sq. ft. Smoke-box (circular)—Length outside, 2ft. 7½in.; breadth outside, 5ft.; depth below boiler, 4½in. Chimney (taper)—Diam. 1ft. 4in. to 1ft. 6in.; height from top of rail, 12ft. 10½in.; height of blast-pipe, 3ft. Cylinders, 18in. by 24in.; distance of centres, 2ft. 6½in.; distance below boiler, 1ft. 4in.; centre of cylinder to centre of valve-spindle, 1ft. 0½in.; diam. of piston-rod, 3in.; depth of piston, 4in. Ports—Length of steam, 1½in.; length of exhaust, 3½in. Slides—Travel, 4½in.; lead, fore-gear, 7-32in.; back-gear, 9-32in.; steam overlap, 1½in. Eccentrics—Throw, 3-1-16in.; diam., 1ft. 2½in.; breadth, 3½in. Motion bars—Length inside, 3ft. 8½in.; breadth, 5in.; distance apart, 10in. Driving-wheels—Diam., 7ft., 24 spokes; distance of wheels apart, 4ft. 5½in.; cone of wheel, 1 in 15. Leading and trailing-wheels—Diam., 4ft.; 12 spokes; distance apart, 4ft. 5½in. Centre of leading-wheel to centre of driving-wheel, 3ft. 6in. Centre of trailing-

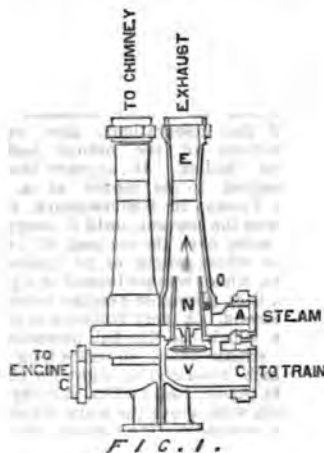
ing-wheel to centre of trailing-wheel, 9ft. 0in. Frames—extreme length, 25ft.; extreme breadth, 6ft. 9in.—METEOR.

[45700.]—Tools for Bending Iron.—I have sent you a rough sketch of the irons I want to bend. Fig. 1 is an axle-guard, and I want to

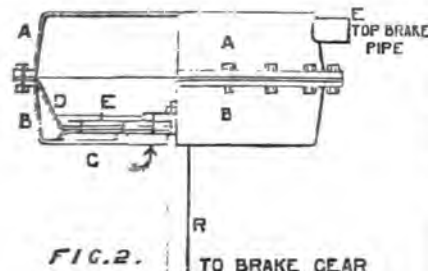


turn it with the wings shut on. The iron is 3½in. by 3½in. Fig. 2 is a coupling-hook for a locomotive made of 2in. round.—W. J. W.

[45711.]—Continuous Brakes.—I am unable to give a description of the Hardy Vacuum brake, as in use on L.Y.R., not having any acquaintance with that railway; but perhaps the following description of the standard form of the brake will answer. Fig. 1 represents the ejector. Steam is



admitted at A and finds its way into the steam chamber B, in which is fixed a conical nozzle N, which, when the check-valve V is lifted, is in communication with the passage C to train-pipes. The steam in B rushes upwards through the narrow annular orifice O with great force, and a powerful suction is set up by which the air is drawn from the train-pipes past the valve V. The object of V is to prevent the destruction of the vacuum after steam is cut off. As will be seen, the ejector is double, one being for the engine and tender, the other for the train, communication existing between steam-chambers only. Under each carriage is fixed a Hardy cylinder (Fig. 2), communicating



with the brake-pipe. It consists of two cast-iron shells, A and B, between which is bolted a leather diaphragm D, which is in turn bolted between two iron plates F and G, carrying the rod R which is attached to brake-gear. When the ejector is started a vacuum is created in the pipes, and therefore in the upper portion of the brake cylinders: the pressure of the atmosphere on lower side of diaphragm forces it up, carrying with it the rod R, by which action a strain is put upon the gear and the brakes applied. The brakes are released by destroying the vacuum, a valve being placed on the engine for that purpose. The ejector used on the S.E.R. is similar to Fig. 1, but that on the G.N.R. is single and of different form, but the

principle is the same. The vacuum for the Clayton Brake on the Midland Railway is created by a single large ejector, very much similar to Fig. 1. The reason why the G.W.R. and M.R. engines are fitted with steam-brakes is that, owing to the pressure being low, the cylinders would have to be very large, in consequence of the great weight of an engine and tender, and would take up too much space. "Brake-block" will find a description of the brake on L. and S.W.R. (350 class) bogie engines in Vol. XXVII., p. 124; of Webb's Hydraulic Brake (L. and N.W.R.), Vol. XXXI., p. 94; and of the Midland Steam Brake, Vol. XXXIII., 2nd No.—CENTAUR.

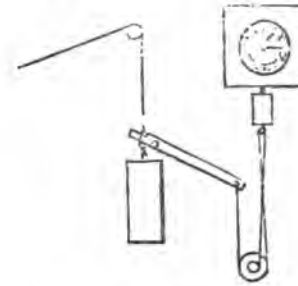
[45713.]—Trigonometry.—Sundry simple methods of solving the question of steam than by the rule he stated in "Ours" of January 6th (if they will answer his purpose) will be seen in the following:—Thus, supposing the engine direct-acting, steam admitted to the in or crank-shaft end of cylinder from top valve on its descending stroke, the radius of engine-crank 24in., radius of valve-motion, 10in.; lap of steam-valve, 5in.; and lead, ¼in.; 10in. less (5 + ¼) giving 4½in. for the distance the valve is from the bottom of its stroke when the piston starts from one end of its stroke; also 10 - 5, giving 5in. for the distance the valve has returned from the bottom of its stroke when the steam is just shut off from the cylinder, then:—1. Geometrically.—By scale drawing from centre O two circles, the largest A B C D E with 24in. engine-crank radius, and smallest F G H I with 10in. radius of valve-stroke; by setting off H K = 4½in. from H, and H L = 5in. lap; drawing the lines K G, L I at right angles to A C until each touches the circumference of circle F C H I; next continuing the line O G to B and O I to D; finally drawing from point D the line D M N at right angles to B O F, then B O C represents the angle of engine-crank's motion from its dead centre at B to when the steam valve gets to the bottom of its stroke; C O D represents the angle of engine-crank's motion from when the valve is at the bottom of its stroke to when it has ascended 5in. from the bottom, and the steam is just shut off; B O D is the angle of engine-crank motion from when the piston is at one end of its stroke to when steam just shut off; line B O E shows the direction of piston's motion relatively with H O F of valves; and finally B M E represent what the piston has moved and has to move of its stroke when the steam is just shut off from cylinder. 2nd. Trigonometrically.—H K = 4½in., representing the versed sine of angle G O H, H L = 5in., the versed sine of angle H O I, and O G or O I the radius 10in. of valve's stroke; inasmuch as the radius 10 to versed sines 4.75 and 5in. is same proportion as radius 1 to versed sines .475, .5, and mathematical tables are made of natural sines for radius 1; then, on referring to authentic mathematical tables, as the versed sine .475 is very nearly that of angle 58° 20', and .5 is exactly that of 60°; 58° 20' plus 60° gives 118° 20' for the angle of motion which the centre of engine crank-pin describes in moving the piston from one end of its stroke to where it is when the steam is just shut off from cylinder. 118° 20' less 90° gives 28° 20' for the angle R O D, whose sine R D is .4746, supposing the radius O B, or the sine P R = 1. The sum of sine 1 + .4746 = 1.4746, gives the distance B M; and, finally, as the radius of engine-crank is 24in., then 1.4746 × 24 gives 35.39in. for the distance the piston has moved from beginning its stroke to when the steam is just shut off; or, 48 less 35.39 = 12.61in. from the end of stroke. 3rd. By the method given in Mr. Michael Reynolds's work on "Stationary Engine Driving."—The length of engine stroke divided by the square of valve's stroke (all dimensions in inches), the quotient multiplied by the square of twice the lap plus lead will give the distance of piston from the end of its stroke when steam shut off; or, 48 ÷ 20² × 10.25² = 12.6 inches. And lastly, but most simply, by triple radius slide-rule, merely, by setting 20 on line D opp. 48 on slide C

opposite 10.25 on D is 12.6 on C for the inches the piston is from finishing its stroke as before.—BUTTERSHAW, January 14th.

[45725.]—L.C. and D.R. Tank-Engines.—In my reply to the above, p. 501, read, "while the modern Ramsbottom safety-valve has replaced the older valve," &c., not "other."—G. L. P.

[45738.]—Thermometer.—Reading over Mr. W. J. Lancaster's reply, he asks the question, "Whoever heard of boxwood thermometers used for boiling purposes?" I myself have used a boxwood thermometer over 25 years for boiling-purposes. I loaned one recently, and it was returned broken, and if Mr. Lancaster would like to see it as a curiosity, I will forward it to him, and he will see in how simple a manner a boxwood thermometer can be used for boiling purposes—at least for the special purpose it was required for. The scale, of course, was graduated higher than the boiling point.—JOS. RAWLINSON.

[45722.]—Alarm.—The most effectual awakener, as I have proved by experience, is to use a weight sufficiently heavy to pull off the bed-clothes. The weight is hung on the notch of a lever about a foot long, and pivoted near the



notch end, and the long end is held down by a string which passes round a pulley, and is fastened to the weight of the alarm, and is kept tight when the alarm-weight is drawn up. When the alarm-weight runs down the long end of the lever flies up, the weight slips off the notch, and off go the bed-clothes. The sensation the first time is very curious, and it had such an effect on me that it never caught me napping a second time. I always awoke just before the alarm went off.—R. S. H., Alderbury Vicarage.

[45742.]—Hydraulic Organ-Blower.—By the sketch you send the facts are just as I expected. When the wind-chest is full the water is not entirely cut off, and hence, the water passing through the reduced aperture would cause the hissing noise. Remedy: rearrange matters so that when the wind-chest is nearly full, the water is cut off entirely, and this is best done by a projection of the wind-chest striking an equilibrium-valve, and so closing the water supply; or supposing that the throttle-valve (which might be a piston one) was connected to a bell-crank lever, and through the horizontal arm of this passes a rod with adjustable stops on it. To the short arm of the bell-crank you would connect the tappet rod worked by the wind-chest, and to the long arm of it the equilibrium valve. This might be further improved by the addition of a lever and link with a weight arranged that as soon as the bell-crank by means of the tappets moved the throttle-valve either one way or the other for part of its travel, the weight by moving either way would complete the travel, and fully shut off or on the water. This would stop all hissing noise, whilst air-vessels on the supply-pipe (and the exhaust if needed) would take away all thump.—SUNLIGHT.

[45747.]—Platinum Amalgam.—I am sorry I have not made the query on page 457 as clear as it might have been. In Gordon's "Electricity and Magnetism," and in other books, contact-breakers are described, in which contact is made and broken by a platinum wire dipping into platinum amalgam, covered with alcohol. Mercury amalgam does not answer well, as it breaks up into little globules. I wish to know how this amalgam is made, as it is not mentioned in such books on chemistry as I have.—ETRA.

[45747.]—Platinum Amalgam.—I do not know the regulation method of making this; but I know that thick sheet platinum left in contact with mercury for some months dissolves in it. Probably spongy platinum would dissolve in a short time. It is all very well for Mr. Lancaster to say. Use nothing but pure platinum—I wish we could. I am not often foiled at any mechanical work, and do not like to give in; but, notwithstanding kindly help given in these columns, and unsparing use of the metal, I cannot get more than about a 2in. spark with a platinum break, while mercury easily gives 6in. with the same battery power.—BROWN, Belfast.

[45753.]—Taking out Piston.—If you only want to clean the piston, you can do it without taking it out of the cylinder. With the box-wrench (supplied to fit the screws in piston) take all the screws out; then, if eye-bolts are also supplied, screw them into the holes tapped for them into the cover of piston, and draw it out of cylinder; the rings can then be easily drawn out. Carefully clean all the parts removed, and be particular that no grit or hard grease is left on. Then, after oiling the rings with a non-gumming oil (mineral is best if you have any at hand), put the clip-band on the ring and tighten it so that the ring will just enter the cylinder, gradually tapping the ring forward to its place with a clean piece of wood. Time and patience, and you will make a job of it. If you do not understand sufficiently, write again, and I shall be pleased to help you.—LABOR, OXON VINCI.

[45761.]—Medical Coil.—To Mr. I. Lancaster.—I am obliged for your reply, but I want to know

connect up the battery-wires and the terminals for the handles? I have made several coils, but in this kind I cannot see how to fix connections, as the wire is really all in one when wound, and I have only two ends. Aply will be appreciated. I am looking for your papers on coils and experiments, as I read a few weeks back.—INQUIRER.

71.]—**Air-Pump.**—You can buy the bucket-ready made, either in iron, steel, or brass. The bucket is brass, have either iron or steel if iron, brass rings. But the best kind of it is made like a steam-engine piston, and is tight very much longer than the one you use. It is more expensive in first cost, but is by far in the end. This kind of bucket is well known as the metallic air-pump bucket. OR OMNIA VINCIT.

71.]—**Air-Pump.**—You cannot do better than three new steel rings; but see they are made to the correct curve, or they will not round. If I wanted such I should send to a firm who make a speciality of such. Small rings should make a first-class job. The vacuum may be the result of other defects, than wholly due to the piston of the air.—SUNLIGHT.

72.]—**G. E. R. Engine.**—No. 251 is sold at Stratford. The principal dimensions and particulars are—Cylinders (outside), 24 in.; driving-wheel, 7 ft. 6 in. diameter; and trailing ditto are 4 ft. diameter, centres of 7 ft. The steam-chests are on the top of the cylinders, and are fitted with round slide-valves, motion being communicated to these valves by two rocking-shafts, carried in brackets, are fixed to the frame. They have, also, slide-bars and a door in the "cab" so that driver and fireman can pass round the engine at the risk of being knocked off while climbing the outside of cab. There are ten of these, 245 to 251, all fitted with the Westinghouse-brake. It may be interesting to "H. W." to know that ten more of this class are being built by Messrs. Pease and Co., Leeds, three of which have been sold at Stratford. They are numbered 600 to 602 and are also fitted with the Westinghouse.—F. B.

73.]—**Wind-Power.**—The best thing I have seen for pumping in a small way is an engine some time since. It had eight sails, four at the end of a horizontal shaft, with eccentric and wheel in one casting; no gearing or cranks; it is direct to a force-pump below. It was simple and cheap. Could get more particulars if wanted.—T. N. C.

94.]—**Bunsen Photometer.**—This instrument consists essentially of a piece of white paper with a grease-spot in the centre. When the sides of the paper are illuminated by light of equal intensity, the grease-spot becomes invisible. To compare the intensity of any two lights, it is only necessary to bring the prepared paper into such a position between them as to render the spot invisible, and then to measure the relative distances of the two lights from the paper. Bearing in mind the well-known law that the intensity of the light falling on a given surface is inversely as the square of its distance from the source of light, the relative intensities of the lights is readily calculated. In practice, the prepared paper is mounted in a suitable frame, on a scale extended between the two lights compared, the whole apparatus being enclosed in a dark room or closet.—ANALYST.

95.]—**Burnishing Scabbard.**—Tack firmly an ordinary wood-polishing wheel or disc—a wire scratch-card; allow it to revolve on a smooth hard stone, or dead hard piece of wood, rub down any sharp points or edges that are on the ends of the wires, not pressing hard to depress them, and it is ready for use. Next, what "J. M. A." requires is to put a high polish that is seen on a scabbard when which many mistake for burnishing. In my opinion, burnishing leaves a scratched and streaky surface on the surface; so my advice is, Don't burnish, but use flour emery mixed into a paste with water, not oil, upon a naked buff wheel, then use our emery, after which use crocus with a stiff revolving brush. For all ordinary purposes the flour emery and water rubbed up and with a leather, and no grease except elbow, ought to suffice; after it is polished oil as you like.—ARMOURER.

103.]—**Boiling Linseed.**—Put a perforated tin in the bottom of your boiler, pass steam through, which will keep the linseed agitated, and boil it without burning.—OILMAN.

104.]—**Water-Gas for Illumination.**—The process of manufacturing water-gas is very simple. Steam is passed over red-hot coke in a retort, which decomposes the steam; the hydrogen, produced, is then passed through a second retort, in which it is being distilled from coal; the mixed gas is then purified and collected in a holder in

the usual way. The water-gas process has been tried and abandoned in several places, owing to the great difficulty of producing it regularly of equal illuminating quality. Sometimes it would be of high illuminating quality, at other times very low, and the wear and tear of the plant was very great. The cheapest and best method of making pure illuminating gas is first to extract the oil and tar from hydrocarbonaceous substances such as coal, peat, wood, bones, &c., and then convert the oil and tar into gas. Works upon the above principle for producing 20,000 ft. per day of 20-candle gas will cost £1,000, and be capable of making gas at the rate of 9d. per 1,000 ft.—H. B.

[45805.]—**Cal. and G. and S. W. Engines.**—I am sorry I cannot give "R. N. H." the required information regarding the G. and S. W. R. engines, nor do I remember dates of 271 to 280 class. Are not Nos. 268 to 270 (omitting Nos. 218, 219 and 220) of same class?—CARSTAIRS.

[45807.]—**Gas-Engine.**—The piston area and stroke are based on the theory of pressure set up by the makers. But in several instances not the least doubt exists that the dimensions are mere guess. In designing a gas-engine, certain data should be laid down at starting, and on these the size of piston and stroke would depend. As yet, the practical designing of gas-engine proportions is decidedly in its infancy, so that no known rules are rigidly followed. But in all cases the dimensions are in excess of those used for steam. But then there is another factor which is, on what system the engine is to be constructed? The simplest is the non-compression form. But the area of piston is then considerable. Recent improvements I have made in my own engines, strongly induce me to alter my views on some points. Before, therefore, advising the querist as to size of cylinder, it would be needful to learn the class of engine he has in mind. But, at the same time, let me in all fairness tell him that if he has not had previous experience, he is risking a great deal. A gas-engine is one of the most difficult motors possible to design and get to work I have ever met with. One reason is, that there are no data to guide one; and hence, we have to find out the points from actual experiment. By the time this is done, an engine would cost a person about two or three times the first cost to buy. And even then, it would be a great chance whether or not some patent would not be infringed, which would land the designer in a costly lawsuit. At the present time, I am positively of opinion that a new form cannot be designed without infringement—not on general details, but on one particular alone, where the Messrs. Crossley have so closed all means of attaining a required result by patent that I do not think it is now possible to avoid treading on dangerous ground. Anything I could do to help the querist, without encroaching on my own or other persons' rights, I would do with pleasure, as I have so thoroughly perfected my own motor that I have neither need nor wish to go any further. What that has cost me, however, I will not discourage the querist by even hinting at.—SUNLIGHT.

[45808.]—**Erasing Letters from Leather Bag.**—If the letters are simply painted on, they may be removed by very gentle and careful scraping with a blunt knife; but, if they are sunk, they have most likely been burnt in. In this case it is almost impossible to remove them so as to make a good job; the only way is to have a brass plate riveted over them—that is, if you want other initials on the bag.—H.

[45811.]—**Comets.**—The only possible proof that can be given of any hypothesis with regard to the nature of a comet is its accounting for the phenomena in a simple manner without the introduction of extraordinary combinations and forces. That bodies of such small mass as the comets should remain as incandescent gases for ages probably is a difficult, if not impossible, conception in itself, and then there is the discontinuity between the constitution of the comet and its meteoric train. These difficulties, besides, are gratuitously inflicted if the phenomena can be explained by supposing the comet a rather dense mass of meteors. If any correspondent is aware of any spectroscopic experiments that have been made with aerolites, I should like to hear of them. The theory of the tail may perhaps be considered as distinct from that of the nucleus and head. I am afraid that Mr. Lancaster has misunderstood my meaning as to the tail. According to the meteoric theory of tail, there would be no actual "swinging round at perihelion." The tail would be simply the train of meteors. It is this supposed swinging round which has given rise to the repulsion hypothesis—by some said to be due to solar heat, by others to electricity, by others the cause of the repulsion is left undetermined. If the sun can exercise at such distances, such unparalleled repulsive selective actions upon gases solely, we might expect to see some traces of its action at the Earth's surface, which is not the case. It is mainly a question of geometry. In many cases, whether the tail be in

the produced radius vector or in the orbit, the projection in the heavens would be nearly in the same direction; but this would not be the case always. Where this difference exists there would be a sort of experimentum crucis. If the Earth were stationary, then supposing the tail to be the meteor train in the orbit, the projection of this train would coincide with the immediate past or future path of the comet in the heavens. But as the Earth moves there will be an angle between the two projections, which is a question of geometry. I may here observe that I disagree with the statement in the "Warner Prize Essay on Comets," that the straightest tail could be produced by a force of repulsion only twelve times that of gravity.—W. C. E.

[45811.]—**Comets.**—The descent of a meteorite is a comparatively rare, and, at all times, very noteworthy phenomenon: yet everyone is familiar with what are called "shooting stars," while occasionally the somewhat more imposing phenomena, which are known as fire-balls, are witnessed. We have the best reason for knowing that what we call shooting stars are really small objects which dash into our atmosphere from external regions. Thus meteorites and shooting stars are the evidences which we possess of the existence of comparatively minute bodies in space, which are external to the earth and to our atmosphere. Although the descent of a meteor is rare, large collections of these objects are to be seen in the British Museum and almost every other museum in Europe and America, and they can be easily bought from dealers in geological specimens. Mention is made of a meteorite which passed within twenty-five miles of our planet, and was estimated to weigh 600,000 tons, and to move with a velocity of twenty miles per second. The very remarkable fire-ball which was seen on November 6, 1869, from different parts of England, and the very accurate information which has been obtained by a comparison of the observations, give us very satisfactory notions of the nature and motions of these bodies. It appears that this meteor commenced to be visible at a point 90 miles above Frome, in Somersetshire, that it then moved across the heavens, until it disappeared at a point 27 miles over the sea near St. Ives, in Cornwall. The whole length of its course was about 170 miles, which was performed in a period of five seconds, thus giving an average velocity of 34 miles per second. A very remarkable part of the appearance which the fire-ball presented was the persistent streak about 50 miles long and 4 miles wide which remained in sight for fully 50 minutes.—(Brit. Assoc. Rep.) The velocity of 34 miles per second, with which the body, whatever it may have been, entered our atmosphere, altogether transcends the velocities with which we are accustomed to deal on the surface of the earth. It is more than a hundred times as great as the swiftest shot that was ever fired from a cannon. Now supposing these masses to be a thousand times greater than we have ever found them, they would still look like the minutest particles of dust, when seen at the millions of miles at which we view them when seen as the so-called tail of a comet; but we are not justified in assuming any larger than we have found. Think for a moment of their utter insignificance when compared with the mighty volumes of the stars; then, if you know anything of the laws of optics, if you know the principle of the zoetrope or wheel of life, it is manifest that opaque bodies, separated from each by what appears to us—small intervals, and moving at an enormous velocity, would not obliterate the light of a star. I have seen Arcturus through the tail of the comet of 1858.—F. I. C.

[45813.]—**Liability for Damages.**—No doubt Mr. Wetherfield may be correct in his answer; but I should have valued it far more had he referred to some book or cases for it. I cannot find that which he gives as law mentioned in any book I have, nor do any of my legal friends endorse his views; no doubt it is from my and their ignorance, and I should be indeed agreeably surprised if Mr. Wetherfield could remove the same. What he states may be law in the City of London County Court; but I doubt if it would be held so anywhere else, and perhaps "Sigismund" may not reside within the City. I would strongly advise "Sigismund" to consult his own solicitor before paying damages, and I think he will be advised that every man is bound to take reasonable care of his own property before he can make another liable in damages for its destruction, and that the onus of proving negligence on the part of "Sigismund" for his chimneys and tiles, or rather his roof's tiles, leaving their proper places, would be upon the owner of so frail and unprotected a structure as a glass roof, and not that "Sigismund" must prove that his tiles were safely and securely fastened.—JOHN ALEX. OLLARD, Solicitor, 136, Fenchurch-street.

[45815.]—**Legal.**—To MR. FRED. WETHERFIELD.—With reference to my query, I beg to say that the facts of the case are these, viz.: That the railway runs through the field which I hold, that

there is a bridge constructed over railway, and a passage in my field leading to the bridge from a road, both as accommodation to persons who hold lands beyond the bridge. Now the only matter I want to get solved is, viz., who are the real owners of this passage? As I intimated to you before that I have been paying rent to the landlord for many years for this passage, I am anxious to get a decision.—LUMEN.

[45817].—Telephone.—You can remedy the humming sound by giving the carbon pieces less free motion inside the microphone. You can, I have no doubt, open the microphone, and you will find some form of carbon contacts. These, in your microphone, are evidently too loose, and will require a little tightening. Perhaps there is a regulating-screw that you have not yet used.—W. J. LANCASTER.

[45818].—Dredging.—Wherever there is a current of water, dredging can be done most effectively and cheaply by forcing a jet of water down a pipe, hanging, for instance, over the side of a ship, to near the bottom to be dredged; this main pipe having a horizontal pipe attached to it, from which the water issues, and of, say, a dozen nozzles, striking the mud with great force, and which is then carried out to sea by the current. The ship or tug is to change its position constantly. Send your address for further particulars.—ORIMAN.

[45822].—Lead Castings.—"Ladle" should face his mould with new sand, about lin. thick, and ram it hard, and vent it well. Do not hit your pattern when you are ramming it up, for that may cause it to crack. Your vents should be kept 3in. away from the face of your mould. The face of the mould should be rubbed with a piece of hard wood, planed smooth for the purpose; then work your trowel on the edge when slicking the mould. If you keep your trowel too flat it causes a hard skin, which scales off when casting. You will find that it is the coal-dust that burns and spoils the work. I should melt the metal after casting iron, or in the ladle after it has been used for iron. I have done this myself. I should not melt it hotter than a dull red heat.—HUNTINGDON.

[45824].—Loans.—"C. W." will find in most manuals of Algebra chapters on "Compound Interest" and "Annuities," which explain the forms and processes employed in calculations of the kind he alludes to. Tables are also published, and in very general use, for facilitating the calculations in question. His query is one of "Annuities," the loan in the case proposed being the present value of it, in point of fact, the sum paid down for an annuity to be continued for so many years as the repayment of the loan is to be spread over. In the case in point, the present value of the annuity (i.e., the loan), the rate of interest, and the number of years are given, and the question for solution is, What is the amount of the annuity required to repay the loan in the given number of years? The form for this is

$$P = \frac{R \times (1 - (1 + R)^{-N})}{R}$$

Where P = the annuity, " R " = the present value (or loan) N = the amount of £1 for 1 year at the given rate of interest, n = the number of years. Taking, for illustration, the question, "How to repay a loan of £100 in 10 years by equal yearly instalments, reckoning interest at 5 per cent.," and applying the above form; then

$$P = \frac{100 \times (1 - (1 + .05)^{-10})}{.05}$$

$$= \frac{100 \times (1 - .681315)}{.05} = \frac{100 \times .318685}{.05} = 637.37$$

$$= 637.37 \text{ nearly,}$$

$$= \text{the yearly payment required.}$$

The same result may be obtained more readily by the help of a table, showing the "present value of an annuity of £1." A table of this kind gives, on inspection, at once, for the present value of an annuity of £1 for 10 years at 5 per cent., and, dividing £100 by this number, then $\frac{100}{1.57771} = 63.435$, as above; $= 637.35$, = the annuity or which, under the like conditions of time and rate of interest, £1 is the present value. "C. W." may prove the above result as follows, and derive, perhaps, from the operation a clearer perception of the nature of the proposition under consideration, as well as of the meaning of the terms employed:—Calculating, first, the amount of £100 at compound interest of 5 per cent. for ten years, and, next, the amount of an annuity of £100, forborne for ten years, with compound interest at 5 per cent. on the several instalments as they accrue, the result in either case should be the same, viz., £162.55. In the case of instalments being made payable half-yearly or quarterly, instead of yearly, it is usual in practice to make the calculation as above, and divide the yearly instalment (or annuity) by 2 or 4, as the case may require. This would give a slight, but practically inconsiderable, advantage to the recipient of the annuity. But if scientific accuracy is aimed at, the period allowed for repayment should be divided into a greater

number of shorter terms, with rate of interest in proportion for the shorter term. Thus, for quarterly payments, the question above would stand: How to repay a loan of £100 by 40 quarterly instalments, reckoning interest at 1½ per cent. per quarterly term.—E. C. CALDWELL.

[45825].—Bichromate Batteries.—The bichromate cell will run down in half an hour, if joined up and left; but if used occasionally it will last a long time—several hours. The difficulty in using a bichromate is the polarisation of the surfaces of the plates. I have just devised a new arrangement, by which the plates are kept in motion, and the resulting action is much more continuous than with the ordinary cell. I will send particulars when I have finished my experiments.—W. J. LANCASTER.

[45827].—Marking-Ink.—Bond's marking-ink is made from a private formula. I have no doubt it is a nitrate of silver ink, and think I can give Mr. F. Barker Cooke a formula almost, if not the same, if he will advertise his address.—J. KENDALL.

[45829].—Portable Engine.—This is a common job with old engines. Screw nuts off, or break bolts at smoke-box end, weld on new ends, screw them up to take up slack; will be much better than rods right through. If you want to put boy in boiler to clean out, you can move them out of the way, as they are now.—T. N. C.

[45829].—Portable Engine.—I should strongly advise "Traction" to leave his angle-irons and boiler-stays alone. I had the same fault in a portable engine a year or two ago; the stays were so slack that they would rattle when the engine was moved on the road. Well, I tightened them just a little by the nuts at the smoke-box end. Result: One broken stay after a day or two's work, and the other leaking at the nuts constantly. So I altered them as near as I could guess it to "as you were."—THOMAS J. SCOTT.

[45832].—Enlarged Toenail, or Ingrowing Toenail.—Poultice parts till clean, then rub a stick of caustic or nitrate of silver on parts which you want to get quit of, every day for a few weeks; this will gradually do its work, and produce a healthy condition. Protect the toe with cotton wool until it is well. Painting strong carbolic acid on parts every day, for 7 to 10 days, will also remove superfluous flesh, &c. Neither method is painful.—SURGEON.

[45835].—Soda-Ash.—I presume "Micro" wishes to estimate the total alkali present in the ash. If so, let him dissolve 10 grams of the sample in water, filter if necessary, and dilute to half a litre. Transfer 50cc. of the solution (equivalent to 1 gram of the soda-ash) to a beaker, add 25cc. of normal sulphuric acid solution, boil for a few minutes to expel the carbon dioxide, add a little litmus solution, and then normal caustic soda solution from a graduated burette until the blue colour of the litmus is restored. Note how many cubic centimetres of the soda solution are required for this purpose, and deduct the number from 25. The difference is the quantity of acid solution that was required to neutralise the alkali present in the sample; multiply this by .053, and you obtain the weight of total alkali (calculated as sodic carbonate) contained in 1 gram of the sample. If it is required to estimate the amount of caustic soda in the sample, take another 50cc. of the original solution, add barium chloride as long as it causes a precipitate, filter, and determine the amount of free alkali in the filtrate by titration with normal sulphuric acid solution, multiplying the number of cubic centimetres used by .049, to give the amount of caustic soda in 1 gram of the sample. I have given full instructions for preparing the normal acid and alkaline solutions in No. 873 of this present volume.—ANALYST.

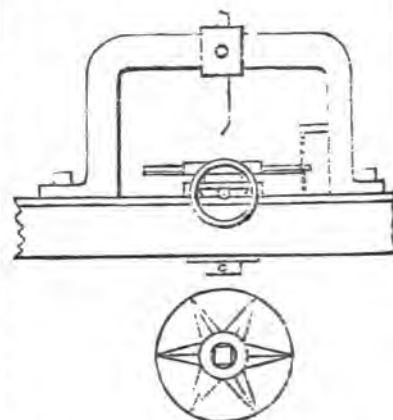
[45835].—Soda-Ash.—Weigh out 10 grams of the powdered sample into a weighed platinum crucible, and heat gently for half an hour over the lamp; place the crucible in the desiccator, and weigh when cold. The loss of weight gives the water. Transfer the weighed salt to a beaker, wash out the crucible, and dissolve the salt in a small quantity of water, filter (if necessary) into a half-litre flask; wash the filter thoroughly; dilute to containing mark, and shake. Take out 50cc. of the solution, equivalent to 1 gram of soda-ash; pour the liquid into a flask, and add 25cc. of standard sulphuric acid. Boil the solution until the carbonic acid is expelled. Add a measure of litmus solution, and standard soda-solution from a burette, drop by drop, until blue colour of litmus is restored. Example: 1.025 grams soda-ash were heated, dissolved in water, the clear solution made up to 50cc., 50cc. equivalent to 1.025 grams soda-ash were transferred to a flask, 25cc. standard sulphuric acid (i.e., = .915 gram SO_3H , $\text{N} = 20$) were added; the liquid was boiled, mixed with a measure of litmus solution, and standard soda solution, drop by drop, until the blue colour was restored. 10cc. soda solution = 5.0cc. standard sulphuric acid. 5.0cc. of the alkaline liquid were

needed. $10:9.2 :: 9.8:9.0$. $25-9.0 = 16$ cc. of standard acid have been used to decompose 1.0025gram soda-ash. But 1cc. of acid contains 0.049 x 1.0204gram of sulphuric acid; this corresponds to 0.053 x 1.0204 of sodium carbonate. The amount of sodium carbonate in the 1.025gram of original soda-ash is, therefore, $.53 \times 1.025 \times 16.0 = 0.865$ gram, or in 100 parts 100:100 :: 0.865 : 86.3 per cent.—F. L. C.

[45848].—Coating Metal with Glass.—This can be done by making a glass from 10 parts of carbonate of potash, 15 of quartz (or sand free from iron and alumina), and one part of charcoal, fused together, dissolved in four or five parts of water, evaporating nearly to dryness, and then spread on the warm metal; it is not attacked by the air, but, of course, soluble in water.—KENDALL.

[45841].—To Mr. W. J. Lancaster.—(1) You can have a 3in. tube which will weigh only 5lb., or you can have one up to 4 or 5lb.; it depends entirely on the gauge. (2) The tube for 3in. will weigh about one-eighth more, or 2½lb.; the ordinary thickness tube would weigh as much as 3½lb. as possible. (3) A good 3in. refractor is much better than a 4in. refractor in every way. You can keep a refractor much better than a reflector, and a refractor once in adjustment is always so; whereas a great many things will turn a reflector out of adjustment.—W. J. LANCASTER.

[45845].—Metal Planing and Shaping.—It is rather inconvenient to make a lathe answer the purposes of a planing machine, but have sent you a rough sketch of what I have found very useful



in light work; get a strong casting to hold the tool, and clamp it down to your lathe-bed; lift clear the top of the slide-rest about 1in. or 2in. take the tool-box out of the slide-rest, then tap four ½ holes, and tap them, so as to hold the tool down you wish to plane. If you get a piece of sheet-iron, 1 thick, cut a star and fix it in the place of one of the handles; it will then hold itself one way (see sketch), so that it will keep the cut equal; in place of the other handle, get a small hand-wheel by which you will work the tool easier; when you want to set the tool deep, tap gently with hammer.—ECCLES.

[45850].—House Well.—Why not raise the top, say, 6ft., and put a drain from the front to the yard? When the water reached the drain, it would run away. The top of the well might be covered in; but if the water does not rise to the level of the well, why not simply cover it over and have done with it?—TREACE.

[45850].—House Well.—I had just set another well; only in my case there was a pump. I had the pump taken up, a drain laid as far as possible to run the water off, and then the well was filled with broken bricks, gravel, and sand. This was a perfect cure, and I was better than the dodges and recommendations of a lot of friends. You can try the effect of digging with bricks and gravel, sand as well; the water will find its way out, and, with a little care, you will get rid of the nuisance.—W. J. LANCASTER.

[45852].—Varnish for Loco.—Give your loco two coats of underating body-varnish, rub down between each coat, then finish with a coat of the best wearing body-varnish.—J. BARNES.

[45853].—M. R. Engines.—The M. R. bogie express engines. Nos. 1312-1314, 1315, 1316, 1317, 1318, 1319, 1320, 1321, 1322, 1323, 1324, 1325, 1326, 1327, 1328, 1329, 1330, 1331, 1332, 1333, 1334, 1335, 1336, 1337, 1338, 1339, 1340, 1341, 1342, 1343, 1344, 1345, 1346, 1347, 1348, 1349, 1350, 1351, 1352, 1353, 1354, 1355, 1356, 1357, 1358, 1359, 1360, 1361, 1362, 1363, 1364, 1365, 1366, 1367, 1368, 1369, 1370, 1371, 1372, 1373, 1374, 1375, 1376, 1377, 1378, 1379, 1380, 1381, 1382, 1383, 1384, 1385, 1386, 1387, 1388, 1389, 1390, 1391, 1392, 1393, 1394, 1395, 1396, 1397, 1398, 1399, 1400, 1401, 1402, 1403, 1404, 1405, 1406, 1407, 1408, 1409, 1410, 1411, 1412, 1413, 1414, 1415, 1416, 1417, 1418, 1419, 1420, 1421, 1422, 1423, 1424, 1425, 1426, 1427, 1428, 1429, 1430, 1431, 1432, 1433, 1434, 1435, 1436, 1437, 1438, 1439, 1440, 1441, 1442, 1443, 1444, 1445, 1446, 1447, 1448, 1449, 1450, 1451, 1452, 1453, 1454, 1455, 1456, 1457, 1458, 1459, 1460, 1461, 1462, 1463, 1464, 1465, 1466, 1467, 1468, 1469, 1470, 1471, 1472, 1473, 1474, 1475, 1476, 1477, 1478, 1479, 1480, 1481, 1482, 1483, 1484, 1485, 1486, 1487, 1488, 1489, 1490, 1491, 1492, 1493, 1494, 1495, 1496, 1497, 1498, 1499, 1500, 1501, 1502, 1503, 1504, 1505, 1506, 1507, 1508, 1509, 1510, 1511, 1512, 1513, 1514, 1515, 1516, 1517, 1518, 1519, 1520, 1521, 1522, 1523, 1524, 1525, 1526, 1527, 1528, 1529, 1530, 1531, 1532, 1533, 1534, 1535, 1536, 1537, 1538, 1539, 1540, 1541, 1542, 1543, 1544, 1545, 1546, 1547, 1548, 1549, 1550, 1551, 1552, 1553, 1554, 1555, 1556, 1557, 1558, 1559, 1560, 1561, 1562, 1563, 1564, 1565, 1566, 1567, 1568, 1569, 1570, 1571, 1572, 1573, 1574, 1575, 1576, 1577, 1578, 1579, 1580, 1581, 1582, 1583, 1584, 1585, 1586, 1587, 1588, 1589, 1590, 1591, 1592, 1593, 1594, 1595, 1596, 1597, 1598, 1599, 1600, 1601, 1602, 1603, 1604, 1605, 1606, 1607, 1608, 1609, 1610, 1611, 1612, 1613, 1614, 1615, 1616, 1617, 1618, 1619, 1620, 1621, 1622, 1623, 1624, 1625, 1626, 1627, 1628, 1629, 1630, 1631, 1632, 1633, 1634, 1635, 1636, 1637, 1638, 1639, 1640, 1641, 1642, 1643, 1644, 1645, 1646, 1647, 1648, 1649, 1650, 1651, 1652, 1653, 1654, 1655, 1656, 1657, 1658, 1659, 1660, 1661, 1662, 1663, 1664, 1665, 1666, 1667, 1668, 1669, 1670, 1671, 1672, 1673, 1674, 1675, 1676, 1677, 1678, 1679, 1680, 1681, 1682, 1683, 1684, 1685, 1686, 1687, 1688, 1689, 1690, 1691, 1692, 1693, 1694, 1695, 1696, 1697, 1698, 1699, 1700, 1701, 1702, 1703, 1704, 1705, 1706, 1707, 1708, 1709, 1710, 1711, 1712, 1713, 1714, 1715, 1716, 1717, 1718, 1719, 1720, 1721, 1722, 1723, 1724, 1725, 1726, 1727, 1728, 1729, 1730, 1731, 1732, 1733, 1734, 1735, 1736, 1737, 1738, 1739, 1740, 1741, 1742, 1743, 1744, 1745, 1746, 1747, 1748, 1749, 1750, 1751, 1752, 1753, 1754, 1755, 1756, 1757, 1758, 1759, 1760, 1761, 1762, 1763, 1764, 1765, 1766, 1767, 1768, 1769, 1770, 1771, 1772, 1773, 1774, 1775, 1776, 1777, 1778, 1779, 1780, 1781, 1782, 1783, 1784, 1785, 1786, 1787, 1788, 1789, 1790, 1791, 1792, 1793, 1794, 1795, 1796, 1797, 1798, 1799, 1800, 1801, 1802, 1803, 1804, 1805, 1806, 1807, 1808, 1809, 1810, 1811, 1812, 1813, 1814, 1815, 1816, 1817, 1818, 1819, 1820, 1821, 1822, 1823, 1824, 1825, 1826, 1827, 1828, 1829, 1830, 1831, 1832, 1833, 1834, 1835, 1836, 1837, 1838, 1839, 1840, 1841, 1842, 1843, 1844, 1845, 1846, 1847, 1848, 1849, 1850, 1851, 1852, 1853, 1854, 1855, 1856, 1857, 1858, 1859, 1860, 1861, 1862, 1863, 1864, 1865, 1866, 1867, 1868, 1869, 1870, 1871, 1872, 1873, 1874, 1875, 1876, 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, 1908, 1909, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000.

traffic between Leeds, Leicester, and London, but have been superseded by the 1,400 classes with a pair of single-leading wheels. A few may yet be running between Leicester and London. Some were fitted with the Westinghouse brake, others were fitted with Smith's vacuum; but Mr. Stretton informed us that the Sanders and Clayton brake had been substituted.—METEOR.

[45854.]—To "Sunlight."—In answer to "Sunlight," we can keep steam up at 30lb., but the engines won't keep speed. What we want to know is, will a boiler at 60lb. do as much work as the two 30's. They used to run at 50lb. two years ago; but the inspector pulled them down to 45lb. We have not had all the weight on till now, and we want some more on. The safety-valve is 2½ in. diam. and as you say that 5lb. is not much, will you please state how to weight it to 45lb. in plain figures? I understand decimals a little.—SAFEY.

[45855.]—Measuring Globes.—By slide rule: Set the diameter on C to 1:382 on D. Then above the diameter on D find the cube contents on C. The accuracy of result depends, of course, on the extent to which the graduations of the rule are carried.—TREADLE.

[45857.]—Chemical Formula.—The correct formula is Fe_2Cl_6 . It is prepared by dissolving iron wire in hydrochloric acid, forming ferrous chloride $\text{Fe} + 4\text{HCl} = 2\text{FeCl}_2 + 2\text{H}_2$. The solution thus obtained is heated with a little more hydrochloric acid, and a little nitric acid, until the iron is changed to the ferric state, $6\text{FeCl}_2 + 6\text{HCl} + 2\text{NHCl} = 3\text{Fe}_2\text{Cl}_6 + 2\text{NCl} + 4\text{H}_2\text{Cl}$. With regard to works on "quantitative analysis," there are so many devoted to special subjects, such as organic manures, phosphates, brewing, &c., that it is almost impossible to recommend any author unless the particular subject is stated.—J. KENDALL.

[45857.]—Formula of Ferric Chloride.—To "F. I. C."—In his answer at p. 505 to the query upon this subject, "Dabbler" says that " FeCl_3 " is undoubtedly the correct formula for the perchloride of iron, as has been shown by experiments upon the vapour density of this substance. Without qualification such an answer is misleading—viewed in the light of modern knowledge, it is wrong. If the law of Avogadro be true (that is, that equal volumes of all gases under like conditions as to temperature and pressure, contain equal numbers of molecules), and if the molecule of hydrogen consist of two atoms—and there seems no reason to doubt either statement—then, taking the atomic weights of iron and chlorine respectively as 56 and 35.5, or thereabouts, the formula of ferric chloride, as shown by the careful vapour density experiments of Deville and Troost, is Fe_2Cl_6 .—ALFRED W. SOWARD, Jan. 29th.

[45857.]—Chemical Formula.—The formula believed to best express the constitution of ferric chloride, and that generally used is Fe_2Cl_6 . The best works on quantitative analysis are: On mineral analysis, "Fresenius's Quantitative Analysis;" but for a beginner without the guidance of a teacher, "Thorpe's Quantitative Analysis," published by Longmans—a much smaller book—is much better, as being simpler and readily followed. On "Volumetric Analysis" alone, "Sutton's," published by Churchill, is the standard work. If agricultural analysis is wanted, "Church's Laboratory Guide" (Van Voorst) is most excellent: the first part is taken up with simple tests and qualitative analysis, whilst the second half treats of the quantitative analysis of manures, soils, feeding-stuffs, &c. On the analysis of foods—tea, coffee, milk, beer, wine, &c., and the detection of poisons, J. Winter Blyth's "Practical Chemistry" is very good. A. H. Allen is publishing a work on "Organic Analysis," the first volume only of which is out. These are all thoroughly reliable, but the last two presuppose some previous knowledge of analytical manipulation. On water, butter, &c., there are several special books.—A. DUNCAN.

[45859.]—Butter-Making.—This phenomenon is not altogether an unusual one, especially at this time of year; and various are the opinions concerning it, and if the true scientific reason has been discovered, I have never heard of it. Poverty of the cream I have heard assigned, and sometimes with reason. I should change the diet of the cows a little, as this seldom occurs, except when they are milked too continuously and almost close to their calving time.—T. J. SCOTT.

[45862.]—Lens.—Such a lens could be utilised for a telescope of short focus, or even for photography; but the length of focus and the fact that in all probability the correction for the actinic ray, as well as the visual, has not been made, would render it by no means so useful for photo. purposes as for the construction of a telescope. You would also require to get the necessary lens for the eyepiece. These are small ones of plano-convex form. The best formulae for constructing the Huyghenian eyepiece have been repeatedly given in this journal both by Mr. Lancaster, myself, and others. The

cost of the lens to make an eyepiece would be but very trifling.—SUNLIGHT.

[45862.]—Lens.—You can use your lens for a lot of purposes; for instance, you can easily make a camera-obscura with it. Get a piece of looking-glass, 7 in. by 4 in., mounted so as to swing over the flat surface of the lens, then make a conical box with a base 20 in. square, and tapering up to, say, 4 in. or 4½ in. square at the top; into this fit the lens in a sliding tin or wooden mount, so that you can focus easily. You cannot do much good with it for a telescope, except by using a diaphragm to reduce the aperture of lens down to 2 in., then it will work fairly well. You can have lenses to make it into a telescope for three or four shillings, but I should recommend you to exchange the lens you now have for a telescope-lens of equivalent value; then you would have a much more successful telescope.—W. J. LANCASTER.

[45866.]—The Spectroscope and Meteorology.—The spectroscope has done more harm to the legitimate study of meteorology than anything else. You should get a copy of the address given by Mr. Symons at the Meteorological Society on the 18th, a brief extract of which is in the last issue of "ours." Read it carefully, make up your mind which branch to take up, and do it with a will. A pocket spectroscope is of no value in meteorology, and at present the more expensive instruments have been but sorry helpers to the science of meteorology.—W. J. LANCASTER.

[45866.]—The Spectroscope and Meteorology.—One use of the spectroscopes in meteorology which has lately, it is asserted, been discovered, is in the observation of the "rain-band." For further information let Mr. Tipping read a pamphlet on the subject by Mr. Raou Capron.—YENTUP.

[45867.]—Throttle Valve Model Loco.—I must say that, not having constructed a model of the above class, I cannot give any information; but I am sure "Sunlight" will give the required details.—METEOR.

[45868.]—Bending Model Boiler Plates.—Cut out two discs of wrought-iron plate for the two flanged plates, and let them be from ½ in. to ¾ in. larger all round than the sizes of the firebox crown and boiler-crown. Then get a round stake such as timmer use, and when the edges of the plates are red-hot, you can easily flange them down. If you have not got a stake, you may with care turn the flange down by heating and working with a ball-pated hammer on the anvil face. There is no difficulty in doing the job if you are handy with tools. When the outside flanges are turned to fit, punch out the centre hole for the fire tube. A good smith should be able to flange down both plates in an hour or two.—SUNLIGHT.

[45870.]—Waterwheel.—You have omitted to say the width of the river you have available. Also can you draw back the water so as to enable the tail water to flow away without partly drowning the wheel. If you can contract the course of the stream to say 12 ft. or 14 ft., and then by drawing back the water raise the fall so that the 14 in. would be the clear fall, I should then advise a form of Poncelet's wheel for efficiency and the common undershot wheel for cheapness. The local circumstances of the case would also greatly influence a decision on the question. An engineer, on seeing the place where the wheel was proposed to be erected, could tell better how the best result could be obtained by a few minutes' inspection, than by any quantity of description. You may, however, fairly assume the facts would be as I state above. Perhaps a form of low breast-wheel might be used to save first cost, but the Poncelet or bucket-wheel would yield by far the best result as far as power goes. Send me the width of stream, depth from the bottom of tailrace to the water level of the top water, and I will give you a further opinion on the subject.—SUNLIGHT.

[45871.]—L. and N. W. R.—Albion, April, '72; General, Sept., '73; Ida, March, '58; Duke, Nov., '52; The Duke of Edinburgh, June, '66; Penguin, Nov., '53; Nightingale, June, '55; Mazepa, Nov., '61; Princess Alice, Jan., '63; Outram, Feb., '63; The Queen, April, '72; Prince Alfred, Jan., '63; John o'Groat, Oct., '74; Shakespeare, Oct., '66; Byron, Nov., '66. As to the number of Yakob Khan, I have never seen it; but it has been repeatedly given in these pages as 859, and comes in the middle of a "batch" of the same sort of engines, numbered from 857 to 872 respectively, and bearing the date of 1877.—DIOXED.

[45872.]—Larch-leaves.—There is nothing poisonous in the leaves themselves, though, of course, they will soon decay in the water, and so make it unhealthy.—F. BARKER COOKE.

[45873.]—Removing Burnt Clay from Castings.—You must make your moulds soft. Use common firebrick or good red brick, ground to powder, to mix with the clay. Rotten-stone and plaster of Paris mixed will stand a good heat, and is easy to get off the castings; but for steel it

would, perhaps, not answer. It, however, gives a very sharp impression. Smoke your moulds.—J. SUTCLIFFE.

[45875.]—Bleaching Hair.—I tried bleaching hair by peroxide of hydrogen some years ago, but met with no success. I, however, found that a hot dilute solution of nitric acid was most effectual. Brown hair, when carefully treated, is turned the most brilliant golden, more resembling golden-spun glass than anything I can think of. The method I employed was to put the hair in a porcelain dish with dilute NO_3H (I think about 1 part strong acid to 10 parts of water), then gradually heat, and as soon as the required shade is obtained take out and wash. If the acid is too strong, or the heat too great, the fibre of the hair is spoiled. Dark-brown hair acquires generally a reddish colour, and I believe black hair would turn nearly white, but I did not try the latter. I do not know if the method is known to wig-makers; I have certainly never seen it in print.—DABBLER.

[45878.]—Coating Metal with Glass.—Melt together 130 parts flint-glass, 20 carbonate of soda, and 12 boracic acid. Pulverise after cooling; mix with silicate of soda of 50° Beaumé, coat the metal with it, and heat in muffle till fused. It adheres very firmly to steel or iron.—OILMAN.

[45879.]—Engine Query.—If the engine has double-acting cylinders of the size quoted, I should use a flywheel 6 in. diameter, and to weigh about 1½ lb. If single-acting, it should be the same size, but not to be heavier than about 12 to 14 oz. The size of boiler would depend on the question whether the cylinders are double or single-acting. Let me hear as to that point, and if you want a vertical or horizontal boiler, and I will, with pleasure, tell you size and other particulars. Is the engine a vertical or horizontal?—SUNLIGHT.

[45880.]—Gravity Escapement Clock.—"Gimel" should ascertain whether the fly of his clock is properly fixed to its arbor; because if it is not the clock is sure to trip. Or perhaps the fly is too small, and the defect he complains of may be remedied by lengthening it a little, if there is room in the clock to admit of this being done. It appears, from what "Gimel" says, that the maintaining springs of the clock are too strong, and thus too much power is applied to the train during the time of winding; he might, therefore, try winding without the preliminary turn back. It seems to be almost impossible now to get a really good clock-train, and for an indifferent train with a gravity escapement a heavy weight is inevitable. Currents of air bring dust, and cause rapid changes of temperature, and for both these reasons are bad for clocks.—REGINALD BUSHELL.

[45880.]—Gravity Escapement Clock.—1, "Gimel" will not find his clock at all affected by being near street-door. 2, A 36 lb. driving-weight hung by three cords is not by any means excessive, or even large, for a gravity clock. 3, The escapement probably "trips" while winding, because the maintaining power which is then in action is stronger than the power of the weight; but this should not cause clock to trip, if the stops on pallets are properly placed. I have a gravity escapement clock, and I find it impossible to make it trip whatever additional weight is applied. 4, The lagging of the seconds-hand is obviously caused by its being fitted too loose on its spindle. If "Gimel" will communicate his address to me, I would with pleasure look at his clock. I have given much attention to the subject, and made three gravity clocks for my own pleasure.—H. TILLY, Woodside, near Croydon.

[45880.]—Gravity Escapement Clock.—There can be no doubt that the maintaining power work is defective. The very fact of the maker advising you to give a slight pressure the wrong way shows he was aware it could not be trusted. It may be that the maintaining-spring is too strong, consequently the weight does not wind it up so as to act when weight is taken off, or the detent may not hold the teeth, either from turning the point off or from not falling freely into them. Try the following experiment:—Wind slightly, so as to take power of weight completely off, hold up detent out of teeth, then let detent fall; now let the power of weight on again, and see if detent clicks over three or four teeth. Then take power of weight off again, and see if detent remains its place. By observing these instructions defect will be detected. The weight is not excessive if it is multiplied three times by pulleys. Position clock is placed in is no consequence, so long as it is firmly fixed, has good oil which does not freeze, is not damp so as to cause rust. Should I not be plain enough in my remarks, I will answer any questions on results of above experiments.—FRANZEDSTUFF.

[45881.]—Hard Skin on Castings.—A plan that is frequently put forward is to place the castings for twenty-four hours in a mixture of nitric acid one part, water four parts. I cannot say if this is true or not, that it will soften the metal, or rather, the skin, as I have never tried it; but, in fairness, I may add that it has been so stated.

mechanical works of known reliability. But, if you ask me as to any plan I have personally tried, I should advise you to use a drip of petroleum on the point of the tool. In some cases the addition of one part turpentine to two parts of petroleum does well; but the petroleum I have repeatedly used with success. Small or thin castings are frequently chilled from several causes, and hence, are so hard that nothing hardly can be done with them. If you use petroleum, and a slow speed, I think your difficulty should vanish. From what you say, I fancy you drive the work too fast also.—SUNLIGHT.

[45882].—Automatic Arrangement.—Why don't you have a revolving drum with a slit over the top, through which the checks are dropped? The drum can be connected with a clock, and the dimensions may be one to pass every five minutes if you like, or any longer period you desire. The drum could rotate once every three hours, or quicker; then you can obtain the exact time a man reaches the works. This is far simpler than any electric arrangement. I worked out some time ago an electrical timekeeper, but it was not so effective as the clockwork-drum. I shall be very pleased to give any further information if it will be of service to you.—W. J. LANCASTER.

[45884].—Compressing Gas.—Compressed gas is practicable for magic-lantern purposes, but quite impracticable for your purpose. Why don't you get a lot of the inhabitants to strike? Get some paraffin lamps and dispense with the gas company for a time; they will speedily lower the price then, or get the town to buy up the gasworks. There are a lot of machines sold for making gas, but you would find it a troublesome and expensive way of getting out of your present difficulty.—W. J. LANCASTER.

[45884].—Compressing Gas, &c.—The question is, whether it would not be far cheaper to supply the needful apparatus, either on hire or otherwise, to consumers, so that they could make their own gas rather than attempt to compress gas at a distance and convey it to where wanted. The compression of gas would mean costly steam-machinery, to compress the gas into iron cylinders. On this point we have experience with compressed oxygen and hydrogen gas in iron bottles, as used for the lime-light. This plan would need a thoroughly good reducing valve, so as to deliver the gas at the pressure suitable for use in the usual fittings. And, therefore, looking at the question broadly, I do not think it would answer. Next, the plan you mention as to benzoline lamps. The production of gas by blowing air through a vessel containing a porous material saturated with gasoline or some other spirit hydrocarbon has long been in use; as see the Alpha gas-apparatus of Mr. Müller, of Birmingham; the "Sun" gas-light machine, and others. What you could easily do would be to fit a fan, or some plan to supply the air under pressure, and which could be driven by a weight. This air being passed through gasoline, would produce a gas of good quality. In proof of this, see Mr. Fletcher's generator for his injector furnaces: several schemes propounded in this journal, and also the plan I perfected for enriching gas to use in the lantern, with the special burner I designed for that purpose, and also the gas-generator I use on my patent gas-engines. All these work on the same lines, and if it would be of any help to you, if you ask any questions you may wish, I will give the required information. With gasoline you would not need hot water to warm the generator. I may add that a gentleman of my acquaintance has just started a very fine set of apparatus to light his house and stables with gasoline gas, the air being supplied by bellows worked by a turbine placed on a spring near the house. The pressure of air is so little that very small power is needed.—SUNLIGHT.

[45884].—Gas from Mineral Oil.—"Country Johnny" will find the following plan answer the purpose of supplying a house with good illuminating-gas at a cheap rate. Get a gasometer, and fill it with air, and force the air through a refrigerator surrounded with ice and salt, to condense the water-vapour suspended in the air. From the refrigerator the air must be made to pass through a vessel containing three or four sieves covered with unslaked lime broken into small pieces; the air in passing through the lime gets thoroughly dried, and is then in a fit condition to pass through the benzoline saturator, and from thence to the burners; but he must be careful not to place a burner too near the benzoline vessel, for the mixture of dry air and benzoline-vapour is highly explosive. Many plans have been tried for saturating air with hydrocarbon-vapours, but they have all failed to give satisfaction, for the simple reason that the air was saturated with vapour of water, and therefore could not take up a sufficient quantity of hydrocarbon-vapour at the ordinary temperature of the air to produce a good light. Many years ago, when experimenting with coal-gas, I used to dry the gas as above, and then saturate it with the vapour of turpentine, and got a most brilliant light, equal to 60 candles. N.B.—The re-

frigerator should be made of lead or glass, and the bottom covered with strong sulphuric acid, to absorb the condensed vapour. I have been advised several times to take out a patent for the above plan, but I doubt if it could ever realise the cost of an English patent, therefore I give it, "free, graciously, for nothing."—WM. BURNS.

[45886].—Ice.—If "J. W. H." only requires a small supply of ice occasionally, I should recommend him the ether process; but if a lot is required, the compressed-air process is the best and cheapest.—J. KENDALL.

[45886].—Ice.—You will find the ether-process much the better of the two. Dr. Ure gives in his dictionary the following patented process, which is intended for hot countries only, where ice becomes actually one of the necessities of life. In a reservoir, or boiler, was placed a quantity of sulphuric ether. This reservoir was placed in a long vessel of saline water; this fluid, by the arrangement, being made to flow from one end of the trough to the other—that is, to and from the reservoir. In this water was placed a number of vessels, the depth and breadth of the trough, but of only 2 in. in width, and these were filled with the water to be frozen. A steam-engine was employed to pump the air from the reservoir; this being done, of course the ether boiled, and the vapour of the ether was removed by the engine as fast as it was formed. The heat required to vaporise the ether was derived from the saline water in the trough, and this again took the heat from the water in the cells; thus eventually every cell of water was converted into ice. The ether was, after it had passed through the engine, condensed by a refrigerator of the ordinary kind.—F. BARKER COOKE.

[45888].—To "Sunlight."—I should consider that an engine with 1 in., or at the outside 1 in., cylinder, and a stroke of 2 in., would be the outside size I could advise you the boiler could manage. With a pump feeding cold water, an engine 1 in. by 2 in. would be quite as much as the boiler could keep steam for. If you made a feed-water to work with the exhaust, it would be a great help; or you might try a plan of heat round the root of the funnel. But I prefer the former plan. With a coal-fire you could no doubt manage a 1 in. cylinder engine; but with spirit it would hardly do the work with ease. If the pump ram was 1 in. diam., it would be ample, and a by-pass on the pump-valves would enable you to keep it always running and feeding in just the volume of water needed. Have you thrown the exhaust-steam into the chimney, and if so, how do you find it act on the fire?—SUNLIGHT.

[45890].—Induction Coil.—Not the slightest objection. You can bring the wires to terminals on an ebonite plate above coil, and either use each section alone, or use the whole connected up in a similar manner to a series of battery-cells.—W. J. LANCASTER.

[45890].—Induction Coil.—"H. A." should make his coil on the Fergusson plan, that is, in two parts with a large central disc between them. Coils made on this plan do not require so much insulation between the primary and secondary coils, and give a much denser spark than those wound in any other way.—H. B. T. S.

[45890].—Induction Coil.—It is difficult to see how all the ends of the discs could be joined outside the coil without bringing the inner and outer ends of each disc in close proximity to each other, necessitating additional precautions to insulate them. The beauty of the disc method is that no two parts of the wire between which there is much tension (i.e., at very different potentials), are close to each other. If the discs be first joined in pairs, there is no difficulty in joining the ends inside.—J. BROWN, Belfast.

[45891].—Photography.—Developing solution must be used once only on each plate, then thrown away. Toning and fixing solutions will do over and over again, until they become too weak to do the work they ought to do. Don't attempt to take ordinary positives on dry plates. You can take any number of lantern transparencies on dry plates, but not ordinary positives.—W. J. LANCASTER.

[45893].—Object-Glasses (Dialytes).—It is the position of the concave in the cone of rays rather than the focal length, that should be first studied, as a short focus lens placed near the Huyghenian eyepiece partially corrects the chromatic aberrations in much the same manner as a concave of longer focus lens does when placed further down the cone of rays—that is, nearer the object-glass. My trials, so far, confirm our valued correspondent, "Orderic Vital's" conclusion, that the nearer this is done to the o.g. the better; and I use the longest focus I could obtain—namely, 100 in., i.e., about 8 ft., and longer would, mathematically, be more suitable. No. 2 query.—Was in "E. M." about 15 months ago. No. 3 query.—It lengthens the telescope. No. 4 query.—It very considerably increases the magnifying power (in a Barlow-lens sort of

fashion), possibly too much with 118 power on your telescope. Finally, I will add, it diminishes the field and improves the definition. And it ought theoretically to make it darker, but it doesn't always do so, to any great extent.—ALFRED HINDE.

[45894].—Acne.—"Inquirer" can be cured of this troublesome disease by following a strict vegetarian diet combined with perfect cleanliness of person. I myself suffered terribly from this disease some years ago; but am now perfectly cured by adopting the above system, which I have followed ever since. I believe medicine to be of no use in this disease. I shall be most happy to give further information if required.—A VEGETARIAN FOR SIX YEARS.

[45895].—Wrought-Iron Pulleys.—"G. J. C." does not say what sizes of pulleys he requires; but I would recommend him to use the patent wrought-iron "Disc" pulleys. If "G. J. C." will address his address, I will write to him upon the subject.—J. B. F.

[45897].—Artificial Indigo.—One method of synthesis is as follows:—Cinnamic acid $C_6H_5CH=CHCO_2H$, treated with nitric acid, yields ortho and para-nitrocinnamic acids, and the former variety combines with bromine to form the dibromide of the acid, which probably has the formula $C_6H_4(NO_2)(CHBr)_2CO_2H$. This acid acted upon by caustic soda, loses two molecules of hydrobromic acid, and leaves a substance having the formula $C_6H_4(NO_2)C_2CO_2H$, which is reduced by nascent hydrogen thus— $C_6H_4(NO_2)C_2CO_2H + H_2 = C_6H_4(NO_2)CH=CH_2 + CO_2 + H_2O$. Cis-Indigo

Indigo acid itself may be produced artificially by acting on benzylene dichloride with sodium acetate. There was an article in *Nature* on the subject some months ago giving details.—WM. JOHN GREY, Elswick Science School, Newcastle-upon-Tyne.

[45897].—Artificial Indigo.—The substance referred to by "Dabbler" is probably ortho-nitro-dibrom-hydro-cinnamic acid $[C_6H_4(Br)_2(NO_2)]$; but the action of potash upon this produces Indigo, but ortho-nitro-phenyl-propionic acid $[C_6H_4(NO_2)O_2]$. On reduction of this latter compound by grape-sugar, in an alkaline solution, Indigo $[C_{16}H_{10}N_2O_2]$ is formed.—ALFRED W. SOWARD.

[45898].—Vacuum Tubes and Coil.—There is no remedy for that of which "W. R. C." complains. It is the nature of vacuum tubes to behave so. If he will turn his tubes the other way round he will find that the light and dark ends will remain in the same positions relatively to his coil. Does our Editor want a few articles on "What to do with a Coil"?—ALFRED W. SOWARD.

[45898].—Vacuum Tubes and Coil.—The difference in the two ends of the tube is because one is negative and the other positive. A coil which would send equal quantities of electricity alternately in opposite directions, would give a similar appearance at each end, provided the alternations were sufficiently rapid.—J. BROWN, Belfast.

[45898].—Vacuum Tubes and Coil.—"W. R. C." will find that if he changes the direction of the current from his coil, the more brightly illuminated end of his vacuum-tube will change places also. This takes place in all tubes, though the extent of it varies. The "Voss" electrical machine illuminates tubes beautifully; and if the terminals of the tubes are connected with the outer coatings of the two small Leyden jars, the discharge is continuous as long as the machine is in motion; and it is extremely brilliant when the spark passes between the terminal knobs of the machine.—H. B. T. S.

[45898].—Vacuum Tubes and Coil.—Reverse the vacuum-tube, and you will find the bright end will be reversed also. The so-called negative and positive ends of the tube are always different, and you can reverse the current if your coil has a commutator, and show the reversion of the luminous envelope. There has been a lot written as to the use of coils. Perhaps you are a new reader; if so, let me know whether you wish to use your coil for pleasure only, or to gain some knowledge of the hidden mysteries of electricity, and I will tell you how to set to work.—W. J. LANCASTER.

[45899].—Valve-pressure.—As the diam. of the valve is given with such exactness, would it not be better for you to say the weight of the valve itself? It is, then, a matter of calculation to find the requisite remaining weight needed to hold the valve to blow off at 120 lb.—SUNLIGHT.

[45900].—Lime-light.—I see you have just the same idea that I had some years ago. I tried artificial lime cylinders, made as follows: I took 4 parts by weight of precipitated chalk, and 1 part of carbonate of magnesia. (The mag. pons. is the right kind). See that both materials are quite dry at starting. Now well mix when in powder, and

into a stiff paste with strong gum-water. I tried these, but found them very friable. I then tried two other plans. One was to compress the paste as above into pieces of tin tube. Tin will do if the joint is folded. The neatest was short pieces or sections of brass tube, cut to the length of a lime pipe. Then compress into it the paste mass, force a hole for the lime pillar. Next, well an oven, and see that the heat is kept up the cylinder is dry throughout. Now examine, and placing the joint on the tube at the side to the jet, expose it to the hydrogen first and get warm. On turning on the gas the heat quickly fuses through the shell, and impinging on to the mass behind light results. Without the metal case the brass are apt to wear away by the expansion, and off corners and the outside parts. Slaked lime is no good, as the lime once absorbed water you can do nothing with it. So let me know how you succeed. It is as good as a proper lime cylinder, but found a fair substitute.—SUNLIGHT.

15.]—Tests for Air and Water.—The tests occurring in air and water are usually in such minute quantities as to require of the most delicate and refined methods of analysis to detect and estimate them. A description of these processes would occupy more space than is usually devoted to replies. I must, therefore, refer the querist to works as Fresenius' "Quantitative Analysis," or "Gasometry," and Wanklyn and Chapman's "Water Analysis" for information. If, however, "H. S." simply requires a few qualitative tests, I will do my best to help him. The accurate method for determining the hygrometric condition of air, is to aspirate a known volume (10 litres) through a weighed U-tube containing pumice saturated with strong sulphuric acid. The tube being weighed after the experiment will show by its increase in weight the weight of aqueous vapour in the 10 litres of air.—F.R.T.

105.]—Tests for Air and Water.—Most of impurities in air are from organic matters in state of putrefaction, and can be generally removed by the nose. Of other impurities the carbonic acid gas, of which there ought to be more than .04 per cent. To see if this case, you only need a 10oz. bottle with glass stopper, and some lime-water. Having filled the bottle (by moving it about) in the air, you then add a tablespoonful of lime-water, and then the stopper in and shake it; if it does not become cloudy, the amount of carbonic acid gas is less than .04 per cent., and, therefore, not poisonous. Tests for impurities in water: The common and dangerous impurities are from iron matter and lead. First, then, to test for iron matter, add some dilute oil of vitriol to the water, and then some Condry's disinfecting fluid (permanganate), which is diluted with water to one. If much has to be added, it shows that the water has some organic matter in it, and is, therefore, unfit for drinking. Lead impurity (lead) can be tested for by adding hydrosulphuric acid to the water, and, if it becomes coloured, it shows that there may be some lead. I have not time to mention other impurities and tests, but these are the chief. To determine the hygrometric state of air, you must have a table of the tensions of aqueous vapour.—

106.]—Tests for Air and Water.—"S." will do well to get Church's "Plain Treatise on Water" (Chapman and Hall). It costs a few pence, and contains a lot of useful information. I am afraid that there are no ready means of ascertaining the impurities in samples of water, so as to obtain comparative results. Such results can only be obtained by analysis, the methods for conducting which are found in the textbooks. If required, I will explain them; but this seems hardly the place for anything so comprehensive.—ALFRED W. D.

109.]—Oxygen and Hydrogen.—Oxygen gas, from chloride of lime would certainly be a better way for limelight purposes as that prepared by ordinary way, for oxygen is oxygen, from any source it is obtained. I should not, however, advise H. Richards to attempt to prepare it at source, as nothing would be gained, either in the way of convenience or safety. The use of the wash bottle is to arrest particles of the materials that may be carried mechanically from the retort; it is also useful in the rapidity with which the gas is being evolved. Ordinary commercial sulphuric acid, when decomposed by zinc, more than as much hydrogen as an equal weight of special hydrochloric acid, and as these acids are sold at about the same price per pound, the acid evidently has the advantage in point of economy.—ANALYST.

[45909.]—Oxygen and Hydrogen.—Oxygen gas, whether it is obtained from the red oxide of mercury, from chlorate of potash and manganese, and any other bodies, is one and the same gas, and is, therefore, just as well suited for lime-light purposes. In all cases it is best to pass the oxygen through a wash-bottle, and if the water is saturated with caustic soda, so much the better, as the chlorine gas evolved is thereby absorbed. By this the light is increased, as the chlorine, which would otherwise have been carried over with the oxygen considerably reduces the light; therefore the abstraction of it is a decided gain. Add to this that chlorine gas is most destructive to the gas-bags and we have another reason for wishing to eliminate it. We might dry the oxygen by passing it through a drying tube, but that would be needless for general purposes. It would be considerably cheaper to use sulphuric than hydrochloric acid for the production of hydrogen, as you would soon find out if you tried it in practice.—SUNLIGHT.

[45909.]—Oxygen and Hydrogen.—The source of the oxygen used for lime-light purposes is of no consequence, provided the gas be pure. It is merely a matter of convenience and expense. If H. Richards desires to try the chloride of lime method, he should make a thick paste of bleaching-powder, add a little solution of cobalt chloride, and, to prevent frothing, a small quantity of paraffin oil. This mixture he should heat to between 70° and 80° C. The gas, before being collected, may be passed through a wash-bottle containing water. The object of a "wash-bottle" is to remove any traces of soluble gas, and to retain any solid matter mechanically carried over. Thus, in the preparation of oxygen by the usual method (by heating oxide of manganese and chlorate of potash), small quantities of chlorine and of carbonic acid gases are evolved. These are stopped by the wash-bottle, especially if the liquid contained therein be rendered slightly alkaline. In the preparation of hydrogen it is more economical to use sulphuric than hydrochloric acid. For although 3lb. of the latter will go as far as 4lb. of the former, still as, roughly speaking, commercial muriatic acid contains but one-third its weight of pure acid (the residue being water in which the gas is dissolved), whilst oil of vitriol is practically without water; it is evident that about 9lb. of hydrochloric acid, as met with in the market, are equivalent to the 4lb. of sulphuric acid. If these figures are multiplied by the respective prices of the two acids, it is seen that the first-named is about five times as expensive as the second.—ALFRED W. SOWARD.

[45910.]—Ink for Sketching on Terra-Cotta.—Try Brunswick or Japan black. Thin with a little turpentine if necessary.—J. KENDALL.

[45912.]—Mathematical.—If a vulgar fraction has a finite square root, the numerator and denominator of the fraction will be exact squares, when the fraction is reduced to its lowest terms. In the examples given in this query, $343/1183$ has a finite square root, as when reduced to its lowest terms it becomes $49/169$, the square root of which is $7/13$; the next two examples have no finite square root, but the fourth has a finite square root, $3/11$. The algebraic expression given in the query may be put in the form $17x(x-y)(x-y)^2$; the last factor is a cube, and in order to make the whole expression a perfect cube we must multiply the remaining factors by their squares, therefore the required multiplier is $289x^2(x-y)^4$.—M.I.C.E.

[45915.]—Nitrates.—The process given for the estimation of nitric acid in commercial nitrate of soda will only answer for nitrates of the alkali metals. For other nitrates, I prefer the following: Weigh out 0.5 gram. of the sample into a tubulated retort, add about 100cc. of strong soda-lye (free from nitrates), and connect the retort with a bulb-tube containing 10cc. of normal acid solution. Drop into the retort, through the tubulure, a few strips of thin sheet aluminium, immediately replace the stopper, and allow the whole to stand for a few hours. The aluminium will gradually dissolve, with the evolution of hydrogen, which will completely reduce the nitric acid present to ammonia. The contents of the retort are now heated to boiling for about an hour, so as to distil the whole of the ammonia into the standard acid. It now only remains to titrate the contents of the bulb-tube with normal soda solution, so as to ascertain how many cubic centimetres of the standard acid have been neutralised by ammonia, and to multiply this number by .063, which will give the weight (in grams) of nitric acid in 0.5 gram. of the sample. The above process is applicable to all nitrates, even when present in minute quantities, such as occur in samples of well-water, the ammonia in this case being estimated by means of Nessler's reagent. Nitrates may also be reduced to ammonia by the copper-zinc couple; but I have not found it give such good results as the above method.—ANALYST.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last C. R. M. has replied to 43383; F. Barker Cooke, 45363, 45306; A. W. Boward, 45308, 45552; An Old Subscriber, 45552.

45349. Specific Heat, p. 290.
45358. Sulphate of Strontium, 290.
45361. Centring Waggon Wheel Axles, 290.
45384. Friendly Societies Valuation, 290.
45392. Manufacture of Soluble Cocoa, 290.
45405. Slate Cutting, 290.

45563. Velocity of Water in Sewers, p. 387.
45573. Fan. To "Lockstitch," 387.
45579. Metallurgical, 387.
45581. To "L. W." and "W. L.," 387.
45591. Deafness, 387.
45606. Jacquard Loom, 387.
45617. Chatterton's Compound, 387.
45618. Lodgers and Landlords, 387.
45620. Quantity of Coal Carbonised Annually, 387.

QUERIES.

[45916.]—Launch.—Many thanks to "Sunlight" for his kind offer. In the "Address Column" last week will be found my address. I am sorry he does not consider my engine quite large enough, for I cannot now change it. In reply to query 44607, he said a 4in. by 4in. cylinder should drive a boat up to 25ft. at fair speed; and it was on this authority that I started the engine. I should be obliged for any suggestions from "Sunlight" in addition to the plan (which he has kindly promised), sufficient for a novice to get the right lines. Also, the address of a reliable maker where I can get a horizontal boiler. I need hardly add that I shall feel under a great obligation to "Sunlight" for offering to communicate with me through the "Address Column"—CANADIAN SUBSCRIBER.

[45917.]—Launch.—I hope this will be seen by "Sunlight" before he has replied to mine of last week. Since writing before, I have about decided to make my launch 23 or 25ft. long, towing 20ft. will not be very satisfactory. To my present 4 by 5 cylinder I could add another of same size, or I could get up new castings, as, so far, I have nothing but the castings. Would two cylinders 4 by 5 be too much power? or, if you advise another set of single-cylinder castings, please give dimensions; I prefer horizontal boiler. Please give me measurements of size! How do steel boilers compare with copper for safety and weight? Which would weigh the most (strength being the same), a wooden or iron launch? and how much lighter would one of steel be than iron?—CANADIAN SUBSCRIBER.

[45918.]—Grafting Fruit-Trees.—As the season advances, doubtless many readers will try their hands at the above operation. Knowing how often failure occurs, I hope some of "our" practical gardeners will tell us the proper time and the proper way to set about the matter. I have sometimes succeeded with apple—but very seldom with plum-trees.—O. V.

[45919.]—Filtering Feed-water for Boilers.—Can any of your readers give me any information on the above subject? I have two 40-horse boilers fed from a river, the water of which is at times very thick and muddy with silt or "warp," as it is called. I had thought of putting down a long tank divided into compartments, arranged as a labyrinth for the feed-water to pass through, and so allow it to settle before pumping into boilers. I require about 600 gallons of water per hour. Can any of your correspondents suggest any filtering medium, or any better arrangement than the above?—FILTER.

[45920.]—Audiophone.—Can any reader give me any information concerning an instrument called an audiophone, for the assistance of hearing? I am told they are constructed of vulcanised indiarubber, made into the form of a ladies' fan, with silk cords running round the edge for the purpose of drawing it into a more or less concave form; and for the purpose of hearing is held between or against the teeth. I am given to understand that they are to be procured from a firm in Scotland, but the price is two guineas. Now as I do not know whether it would be of any practical use to me as an assistance to hearing public speakers (really, the only thing for which I should require it—being partially deaf), I do not feel myself justified in laying out so much without first putting it to the test. If any reader who has seen or used one could give me any further hints as to the construction I have no doubt I could make one sufficiently well to test their efficiency before buying a more perfectly-made instrument. I may mention that it cost the possessor of one 30s. to have one of the ribs repaired, without which it was perfectly useless. Any information will greatly oblige—C. H. A. B.

[45921.]—Drilling Earthenware.—Will any correspondent kindly describe the sort of drill-stocks and bits to be used for drilling earthenware and china?—CHINA.

[45922.]—Chrysolite.—There is an article of the above name made into harness furniture, buckles, &c. Will any reader kindly tell me what are the metals entering into its composition? and when used for the above purpose, what character has it obtained as to its wear, strength, ease to polish, and liability to tarnish, and is it well adapted to form harness furniture?—ESQUIMAUX.

[45923.]—Brazing Bicycle Forks in.—Will any of your numerous correspondents inform me of the best method of brazing bicycle forks in?—ROBERT WRIGHT.

[45924].—**Lathe Chuck.**—Will "Sunlight," or some reader of the "E. M.," explain how to make an iron self-centring chuck for 6in. centre lathe? The jaws will not be required to move all at once. I require four jaws; can make it myself, as I am a—CARRIAGE SMITH.

[45925].—**Model Multitubular Boiler.**—Will "Sunlight," or some other gentleman, tell me how to make a model multitubular boiler, 12in. long, and 4in. diameter; how to create a draught, as it is to be stationary; and if soft solder will do for joints?—C. H. PHILLIPS.

[45926].—**Bookedge Gilding.**—When I have used the prepared glair, and laid on the gold leaf, I allow them to dry for a few hours. Then when I try to burnish them, I find the gold leaf come off. I previously scrape the edges, and the stone of the burnisher is agate, so that these are not the causes of my failure. I should be obliged if any of your readers could tell me the cause, and so help me out of my difficulty.—R. NODD.

[45927].—**Belgian Tank Engines.**—I am anxious to obtain particulars of the ten-wheel coupled tank engines used on the Belgian State railways, with a drawing if possible. Being of such an uncommon type, this would no doubt interest many other readers. Perhaps the "Flying Dutchman" can give one from the collection he mentioned in a former number.—GROSVENOR.

[45928].—**Spherical Rest.**—I have access to a spherical rest of foreign make, the worn-wheel of which feeds the tool up to its cut. Answers admirably for making brilliant balls, but it is useless for ornamental turning or drilling, as the number of teeth in it are not susceptible of division. It has 39 teeth, and is advanced one tooth at a time by a complete revolution of its tangent screw, which, therefore, drives it forward 1/39th part of the circle, or 0.010256. Will anyone say how I am to fit change-wheels to the tangent screw, so that one complete turn of the driving-wheel will drive the tangent screw so much short of a complete revolution that it will move the worn-wheel exactly 1/16th of the circle.—GERARD ADRI.

[45929].—**Magneto-Electric Machine.**—May I be allowed to inquire through your paper whether any of your readers have made a magneto-electric machine according to the description given by Mr. Cuttiss, Vol. XXX, pp. 142, 188, 316, and if so, how it works? Or would Mr. Lancaster give an opinion on the same? If any report and opinion has been already published since Vol. XXX., I should be quite satisfied with a reference to it.—R. J. JONES.

[45930].—**Cupola Work.**—Will any of your readers kindly suggest the best possible means of preventing sparks flying from a cupola? I have two cupolas working alternately every week (about five feet apart) under a very strong pressure of blast, and, unfortunately, a timber-yard is about 40 yards distance from them; and in the summer time there is great danger of a stray spark doing serious mischief.—J. L.

[45931].—**Oboe.**—To "VULCANITE."—I was much interested in your remarks in "OURS" of 20th ult., and should be very glad if some information could be given as to the method of making an oboe. Also the kind of tools used, and the correct shape of the bore; and especially the mode of tuning the instrument, that being the most difficult and critical part of the whole business. It would also be a great advantage if the best mode could be ascertained of correcting the intonation and tone of defective notes in an old oboe. Also, whether any method is known of restoring the bore when it has become worn out of shape, by lining with wood or otherwise? Is vulcanite a good material for oboes? If answers in characters very well, I believe.—W. S. B.

[45932].—**Exhausting Large Cylinder.**—I want to exhaust a large cylinder, and I wish to appeal to some of your readers as regards the construction of an air-pump. I may say that I have got a special pump (Cameron's patent), if, by a little alteration, this would suit the purpose.—J. W.

[45933].—**Legal.**—To Mr. WETHERFIELD. A and B. entered into partnership last August, entering upon premises to carry on business. They each paid in an equal sum of money, and each to receive half of all profits. There are no articles of partnership, nor any writing whatsoever. They have a lease predicated from May next for 4 years, and each are parties to it jointly and severally. A. has proposed a dissolution, offering B. the alternative of paying A. out, or A. will pay B. out. B. can't raise the capital, and refuses a discount on the ground that as he is a party to the lease, it is sufficient evidence for him the co-partnership was intended for that period. The landlord is willing to take either as tenant. The case is in Scotland. Does this come under the case of a "Partnership at Will"? Can A. force a dissolution? Is B.'s position that he takes legal?—ONE IN A FIX.

[45934].—**Flute Making.**—To "VULCANITE."—Could you oblige by giving instructions in your paper how to make and tune a flute or piccolo? Many of our readers would, I am sure, be pleased to make an instrument which can be almost entirely finished in the lathe.—F. I. D.

[45935].—**Clarinet Tuning.**—I should be much obliged if Mr. Fryer would give a little more detailed description of the instrument he recommends for clarinet tuning on page 481, and say if he thinks it would be sufficiently accurate for laying the bearings of an organ.—ANONYMOUS.

[45936].—**Electro-Motor.**—I have a machine of my own invention and make, which works at present by two levers, and I should like to work it by electricity—if possible. The object in this machine is to revolve a shaft with a number of brass wheels. I wish to set this shaft in motion and let it stop where it likes, and when stopped to be held in position by ratchet-wheel and pawl. This I have on now, worked by lever No. 1. This lever at extreme end works about 1 1/2 in., and is released mentally. No. 2 lever works about 4 in., and pulls at about 14lb.—G. CARSON.

[45937].—**Engine-Tubes.**—I cannot keep the tubes of a nearly new portable engine which I have tight for long together, although a sister engine from the same shop, which has done a deal more work, gives no trouble. I have been forced to expand them twice in about 18

months. The engine has a bad firebox, the iron being much laminated;—has this anything to do with it, or is the fault to be traced to the staying?—THOMAS J. SCUTT.

[45938].—**Soldering.**—Will some reader kindly explain how lead is fused together without soldering, as in Butler's C-trap?—N. W. E.

[45939].—**Electro-plating.**—Will Mr. Lancaster, or some other correspondent, kindly give me particulars of materials required for tinning articles with a battery?—N. W. E.

[45940].—**Beam Engines.**—Will any fellow-reader kindly inform me how to get the proper proportions for the length of beam and height of beam to different-sized cylinders in plain figures, and oblige.—X. X. X.

[45941].—**Extracting Silver from Lead Ore.**—Will any of our subscribers kindly tell me know of a cheap process of pulverising and extracting silver from lead ore? The matrix is a hard blue limestone, and the chief expense is in crushing that up time. The ore is tolerably rich in silver. Also, the best and cheapest crushing machinery for the purpose? What is Molloy and Warren's process for treating poor argentiferous and auriferous ores?—H. H.

[45942].—**Compressing Gas.**—A friend of mine has had a pump made for compressing gas for a certain purpose; it is wanted to be compressed to about 100th part of its normal capacity. The pump he has got made is a three-chambered one, a 4in. and a 2 1/2 in. chamber, and last a 1 in. jam, forcing the gas into a chamber for after-use. He finds a great difficulty in getting the pressure up, although the gear of the pump by multiplying cog-wheel gives nine to one, with a heavy 4ft. fly-wheel, but driven by hand. Can any reader let me know where the fault lies?—JAS. GALE.

[45943].—**Pressure of Water.**—What will the pressure be in inches on a water-main 100ft. fall from the reservoir? and, also, what is the best gauge to prove it by? Any information will oblige.—WATER-MOTOR.

[45944].—**Central-Driven Tricycle.**—Would Wm. Bindon Blood kindly send sketch of his tricycle (central driver), on which he has "travelled many thousand miles over all sorts of roads"? and greatly oblige—G. D.

[45945].—**Expansion Link.**—Would "Sunlight," or any other reader kindly inform me whether there is any rule for finding the length of an expansion link? I am speaking of the ordinary curved open link, which fits into the top eccentric rod-pin. Also, how much does the eccentric rod in valve more than the valve when in full gear? and how much does the valve move when out of gear? Could I get a book on valves and link-motion? By replying, you would greatly oblige.—A TWO YEARS' READER.

[45946].—**Pumping Gas.**—Would any of our readers help me out of the following difficulty?—Being in a small way of aerated-water making, I am sadly hampered with the supply of gas to the pump that fills the bottles. I have two bottling machines, but I can only use one at a time, which is very awkward owing to pressure not being sufficient. The gasometer is about 12 yards from pump. A friend of mine says, by bringing the gasometer nearer the pump I shall get as much gas as to be able to work both machines at once. If it is so please show the reason why. I might say the supply-pipe is 3/4 in. diameter. I would like some practical information on the subject.—H. H.

[45947].—**Condenser.**—To "SUNLIGHT," or OTHERS.—Will you kindly assist me in the following?—My condensing engine for the last fortnight has heated the water in the lodge, reaching as high as 128°. We have examined the condensing part, and found the air-pump run came out of the cylinder of the air-pump. We have had this made all right, and a new indicator put on the foot-valve, and all the valve-gears scraped and cleaned, but all to no purpose. I cannot find any place where it can possibly draw in, as the water in the hot well works very steadily; this is free from bubbles. We have no vacuum-gauge attached to the engine, so I cannot give you the amount of vacuum. I shall esteem it a favour if you can direct me to the remedy.—R. T. B.

[45948].—**Nut Making.**—Can this be done with some kind of a lever, size of nuts 3/4 in.? If so, a small sketch will oblige.—CONWAY SMITH.

[45949].—**Copper-bits.**—I am troubled much by the tin on my copper-bits coming off after a few heatings, although I do not overheat them. Will some reader tell me the cause and remedy?—W. T.

[45950].—**Parting-Tools.**—Will some reader give sketches of parting-tools for iron and steel, both hand and slide? I cannot make one to satisfy myself, as they are continually breaking off, a though tempered to dark straw.—W. T.

[45951].—**Shot-Making.**—Will any of our kind correspondents oblige the inquirer by giving in "OURS" really practical information as to the process of shot-making in all its details: buildings, machinery, &c., and also a statement as to cost in arranging a suitable place? The information required is for an Englishman nearly worked up, but could manage such an affair, and is intended for a country in no way connected with the British Government.—W. M.

[45952].—**Intermediate Receiver.**—I should like an opinion as to the best size of intermediate receiver for compound engines with cranks at quarter centres; that is, what proportions should it bear to the high or low-pressure cylinders or to both, without causing too much back pressure in the high-pressure cylinder, or allowing the steam to unduly expand in passing from one to the other, as is the case when the receiver is too large. Also, the greater the receiver the more radiating surface does it expose; and heat once lost, cannot be regained.—J. W. A.

[45953].—**Innkeeper's License.**—To Mr. WETHERFIELD.—If an innkeeper has taken a license from the 10th Oct., 1881, to 10th Oct., 1892, and is under six months' notice to leave from Michaelmas to Lady-day, and refuses to give up his license, can the incoming tenant obtain a special or temporary one for the next six

months? or, in other words, can two licenses be granted in the same year for the same house?—ANONYMOUS.

[45954].—**Melting Zinc.**—I should be very glad if I could through your columns obtain knowledge how to melt zinc so as to be able to form it into solid galvanic-battery purposes. I have tried several times, but always get it in a kind of porous condition, of very little use for that purpose. If the flux used in melting it I should like to know it. I am, ANATHEUS MECHANIC.

[45955].—**Magneto-Electric Machine.**—I have a permanent 6in. horseshoe magnet and a commutator with commutator and small pulley making between two centres, the poles of the electromagnet revolving in front of the horseshoe magnet, almost touching, and two brushes, insulated from each other, touching the commutator. From each brush wire led to two terminals. I can get sparks at once by connecting the terminals, or by connecting with induction coil, but not without. If Mr. Lancaster, or some of our electrical friends, will assist me in this, I shall be greatly obliged.—J. E. W.

[45956].—**Magnetic Variation.**—Can any of our able correspondents give me the exact magnetic variation at Bristol at the present time, and also the best obtaining same at any time, and oblige.—MIST.

[45957].—**Street Cords.**—Would Mr. Lancaster give instructions for making one of these instruments? I want to construct a good one.—F. R. W.

[45958].—**Vitexer.**—Will some of "ours" kindly tell me what kind of oil is this? from what source obtained? and how prepared? I am obliged.—VITEX.

[45959].—**Bourdon-pipes.**—I have in my shop a stop of Bourdon's, some of the deeper notes of which very slow in speaking. I should like to ask Mr. Lancaster or some other organ-builder, whether this is peculiar to such pipes, or whether it can be remedied? scale, pressure of wind, 2 1/2 in.; height of mouth slightly arched.—CYMBO.

[45960].—**Darkness.**—Can any of "ours" tell what substances or chemicals undergo a chemical change, similar to those exposed to the action of light, taking a photograph, &c.—ANONYMOUS.

[45961].—**House front.**—My house is built of brick, stuccoed externally, and has been usually painted. The stucco now, from lapse of time, has become quite rotten, and partially peels away. The paint assumes purple patches in many places, especially by reason of the top parapet hiding the rain taking the wet, damp, and even wet, penetrating into the bedrooms, completely spoiling the wallpaper. Would it be a feasible plan to remove the cement against the existing bricks, either with cement, or a course of thin brick in place of it? It could be neatly jointed, have a good appearance, save the constant expense of painting and repainting stucco? The climate is rather damp, with an annual rainfall of 80in. As the nuisance is very great, any hints will much oblige.—HORSWORTH.

[45962].—**To Mr. Allen.**—I should be much obliged if you would kindly describe the best method of testing the percentage of alizarine in the aqueous solutions that are sold?—ENQUIRE.

[45963].—**Range of a Projectile.**—Will any of your readers kindly give their opinions on the following question, which has given rise to much discussion amongst friends of mine, men of admitted ability engaged on both sides of the argument?—If we take the same calibre, fired with similar charges, and projectiles of equal weight, to give the same velocity, are placed, one at the base of a hill, high, and the other at the top. Both guns are in horizontal position. Will there be any difference in the range of the two projectiles? and if so, what, and to what extent? To take an extreme case, suppose the gun is fired under similar conditions from a height of 10,000ft. What will then be the horizontal range of the projectile, and (b) in practice?—GRAVITY.

[45964].—**Glass Transparencies.**—At the exhibition in Melbourne, some very beautiful transparencies on glass were shown in the British Museum. Many of them were copies of well-known pictures in the Dresden gallery. Some appeared to have been in; others partly etched and partly burned in. I am not sure. The persons in charge of the exhibition, however, could give no further information about them. I should be glad if some of our readers could tell me how they are done, or refer me to some that gives details of the process.—AN OLD FELLOW.

[45965].—**Musical Wire Gongs.**—Will some reader of "E. M." kindly tell me what is the best size musical wire gong that can be produced, and whether it could be heard easily at 200 yards from the open air?—H. T.

[45966].—**Legal.**—Will Mr. Wetherfield assist the following?—A brother died some time back, leaving wife and five children unprovided for. My father-in-law went to live with my father, he being a widower, and having no children; and my father-in-law, who has married my sister-in-law, is now a legal, and who is obliged to maintain the children of his previous marriage—my father or my father-in-law?—S. F. F. H.

[45967].—**Broken Pivots.**—To "PRACTICAL WATCHMAKER."—Your mode of fixing the centre of the arbor, from which a pivot has been removed, seems complicated, and to require expensive tools. You not show a simpler way to find the centre and replace the pivot?—NATURALIZED AMERICAN.

[45968].—**Repairing Large Marble Mortar.**—I have broken a large marble mortar in three pieces by heavy pounding. Will anyone tell me the best way to repair it?—GROVER.

[45969].—**Boiler Power.**—I have a 2 1/2 ft. x 10in. boiler with two flues, 2ft. 6in. each, and 10 Galloway tubes in each. I hope some of our readers will show me a simple way to find the horse-power of the boiler.—O. C.

[45970].—**Drilling Hard Steel.**—Will some

chmaker," or others, kindly let me know if drill hard steel, such as a click spring of and also whether I can buy separately the studs belonging to the turns for drilling the, &c. If so, what would be the probable cost.

Fetal Planing.—Will anyone suggest an alter my planing machine, which works forward on rack and pinion, so that the rack way only, to adjust length of cut, one to machine while working? Bed 24 in. x 10 in.

Flywheel.—Would a flywheel be of much use, backreared lathe instead of by foot? If so, what?—LONG TOM.

Parrot.—My green parrot's nose runs—what is the cure? It lives in the country, goes upstairs to bed on account of cold in ALAN. OLLARD, 136, Fenchurch-street.

Tea and Cotton.—I have a sample of tea mixture of the above. How am I to tell it to ascertain its value.—MICRO.

Boiler for Model Engine.—Could anyone make the sizes for a boiler to work a horizontal steam and air stroke, so as to drive the 4 in. centres, to turn iron? would it not do?—G. M. L.

Hall Marks.—In your No. 706 of much information has been given as to the Goldsmiths' Company, by which the marking and presumably, therefore, the article, can be ascertained. Can anyone tell me what other companies have had this marking, and in what places was it done? The marks! I am from the North (Lancashire) and my ancestors came also from Yorkshire old silver plate with marks which do correspond with those of the Goldsmiths' Company question above.—Z. Y. X.

Artificial Cable.—Will "Sigma," or someone, tell me how I can make an artificial cable out of the Atlantic lines, so far as signals are concerned? Will the tappers of cable answer the same as mirror keys?—

Amateur Geologist.—Will anyone tell me for an amateur geologist, giving me a list of books which will enable me to name rocks in Geology.

Medical.—To Dr. Edmunds.—A little girl, 10 years of age, and remarkably healthy, was suddenly seized with illness five weeks ago after some days declared the case to be obscure brain disease, and while admitted to a peculiar one, and at times during which to think it one of blood-poisoning and fever, still adheres to his first opinion. It was called in, together with first last I think the brain is affected, but directed a negative to be administered, with the idea of was of intestinal origin. No permanent has followed, though temporary remissions place, and the child is getting weaker greatly, except in the face. Great pain in the head and ear, and also in the attack was accompanied at the outset with some of the kind which generally indicates and the case has been more sickness for a month, but not throughout the disease or medical men now think it a case of infant fever, with a touch of ague. One peculiarity is the daily alteration in the highest temperature. Thus, to-day the child will go to bed at 10 p.m. with a temperature of 104°, or thereabouts one or two hours, and then to 100°, or even lower. To-morrow the rise commences four hours later, and the next day later still, and so on. This goes on for the child only the time of highest temperature together, and then another rotation of a period that described follows. At times periods of low temperature there is great tremor and tendency to collapse, and periods of gnashing of the teeth. Alternation of contraction of the pupils, and some not much of the latter lately. Which of these is likely to be right, and what course would be best? Prognosis of first is favourable, of the second, more hopeful.

Legal.—Will Mr. F. N. Wetherfield kindly advise?—A man dies in Melbourne, Australia; amongst his papers is found a memo. of copy of which is sent by his next of kin to his next of kin in this country (nieces) nature of acceptance (these nephews and nieces, not brothers and sisters). Accompanying is a statement to the effect that the heir-nephew, gets the land, &c., as he would in England. Now, the legal advisers of some say that in Australia there is no hereditary estate, and the others say that Australia is subject to English laws. Also, can you say what is the probate estate's estate, nephews and nieces inheritance?

Test for Oils.—Will someone kindly give a simple, test for relative values of olive oil—not one as against another kind, but the best of two samples of each of above.

Photo. Transparencies.—Can a positive be taken direct of any object on ordinary surface? To obviate taking a negative first, so that when one copy only is required, formula.—ALAN.

Lamp for Microscope.—I have used the best paraffin and Helmontine that but find the smell it gives out very disgusting-room? Can any of "ours" recom-

mend any better oil, or can anything be added to it to lessen the unpleasant odour?—OTTER.

[45984].—Condensed Milk.—Two of my friends are feeding their babies on condensed milk—dutch, of course. Would Dr. Edmunds recommend this in the absence of milk from one and the same cow?—BUZZ.

[45985].—Debtors in the Isle of Man.—Will Mr. F. Wetherfield say how I can recover a small amount from a debtor in the Isle of Man (under three pounds) most quickly and inexpensively? I believe the English county-courts have no jurisdiction in the island.—KAPPA (England).

[45986].—Refrigerator.—I want to build a small refrigerator in a store-room, something after the following description, to be built into a recess in the wall, the lower part to contain a block of ice about 2 or 3 cwt., and the upper part to be fitted with shelves and hooks to contain meat, soups, &c., when the weather gets warmer. Will any fellow-reader kindly tell me the best way to construct it, and what materials I must use in order to make it as successful as possible, and the ice not to melt too fast?—CONFECTIONER.

[45987].—Siemens Dynamo-Machine.—Is the core of the armature used in the 70lb. Siemens machine a solid block of iron, or an iron cylinder fitted on a wood block? Is the outer surface furnished with recesses for holding the wire coils, or is it equal all round? What is its length and diameter? Also, if recesses are used, what number, and what depth and width? Is the wire envelope which incloses the field magnets wound directly on the iron bars, or is it wound on wood bobbins?—LANCASHIRE.

[45988].—Microscopical.—I shall be glad to know if a [in. objective of 70" is capable of resolving Pleurosigma fasciola.—CHAMOS.

[45989].—Lake Bottom.—I am anxious to form a small artificial lake of rather less than an acre in extent in the middle of a wood where a space has been cleared. To a considerable depth below the surface it is entirely peat, and in wet weather is frequently covered with water. The only supply besides rain would be the overflow from a small drinking-fountain. Can any of your readers suggest a really practical way of making the bottom in order that the water may keep clear? An answer would greatly oblige.—J.

[45990].—Organ Pipes.—Having partly made a set of wood stopped diapason-pipes for a small chamber-organ of four stops, would "Uranium," or some other of our esteemed organ correspondents, kindly advise me in the following?—The height for cutting up mouth of 4ft. CC, tenor C, and mid C? Thickness of lip for each of those named? and should the lip be left square on edge, or rounded inside and out? Also the depth to cut in cap for windway for each of above, size of hole in block for foot, size of hole through foot? Should the CC pipe be 4ft. long from block, or allow thickness of stopper longer? And what would be a suitable wind-pressure for voicing such pipes, and how is it measured—say, if water fall 1 in. in tube, and rise 1 in. in the other? Is this called 1 or 2 in. pressure? Information on the above would be esteemed a great favour by—D. W. C.

[45991].—Watches.—To "SECONDS' PRACTICAL WATCHMAKER," OR "A FELLOW-WORKMAN."—What is the proper use of the white powder "Diamantine"? Mention a sharp cutting substance to be used after the graver in reducing watch and clock pivots, and arbors; also a finer "stuff" for giving a black gloss and finish.—NEGLECTED APPRENTICE.

[45992].—Compensating Expansion Balances.—Will any watchmaking subscriber tell me how expansion balances are compensated?—P.VOTE.

[45993].—Railway Distant Signals.—I should like the opinion of your railway correspondents upon the question of distant signals. Should they be discs or arms? and in approaching a junction, should there be two "distant" or one? The object of the question is to obtain the best opinions, and to ascertain the latest improvements upon the different lines, because I find the signals in many districts very defective. Should green lights be continued, or not?—A DRIVER.

[45994].—French Polishing Fraternity.—Can anyone inform me how to French polish small fr. work articles, such as cart-de-visite frames, spill cases, &c.? I have tried the ordinary polish, but cannot use it to my satisfaction, as its "dregs" all the fine parts up. Is there such a thing as brush polish, and if so, how is it made and used? I should like to know if anyone has tried ordinary varnish, very fine, and applied two or three times. Any information will oblige.—K. T. T.

[45995].—Embossing and Gilding on Glass.—Would some correspondent give me a few hints on embossing and gilding on glass, and the materials used?—G. W. LEAMINGTON.

[45996].—Watches.—To "SECONDS' PRACTICAL WATCHMAKER," AND "A FELLOW-WORKMAN."—You recently gave some excellent instructions for springing and timing Geneva and lever watches; you give five beats to the second in Geneva watches, and nine beats to the two seconds in lever watches. May I ask does this rule apply to watches of all sizes, say, for instance, may I spring an eighth or tenth size, or an eighteenth or twentieth size watch after the above rate? If the above counts only to apply to one size, how shall I determine all the other counts for the different sizes?—NEGLECTED APPRENTICE.

[45997].—Paper-Making.—How can I make a paper that will not stretch when damp?—W. O. T.

[45998].—Slide-valve.—Can someone inform me if it is possible to apply a slide-valve to a cylinder 6 in. bore, and 6 in. stroke, so as to cut off steam at one-third of the stroke, and to retain it to nearly the end of the stroke? The dimensions of the portholes are:—Exhaust, 1 in. by 2 in.; steam-holes, 3 in. by 2 in.; space between exhaust and each steam-hole; length of steam-chest inside, 6 in.—CARACENT.

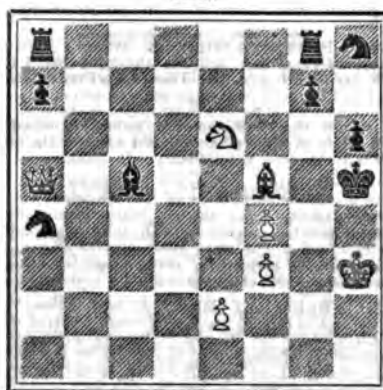
[45999].—Jewellers' Solder.—Can any of your readers tell me if there is any particular solder for making platinum adhere to gold? I have tried both silver and gold solder, and find it breaks away with the least strain. Also, if there is any way to keep it from warping when heated?—JEWELLER.

CHESS.

All Communications for this department must be addressed Chess Editor, 22, Chancery-lane, W.C.

PROBLEM DCCXXIX.—By J. PIERCE, M.A.

Black.



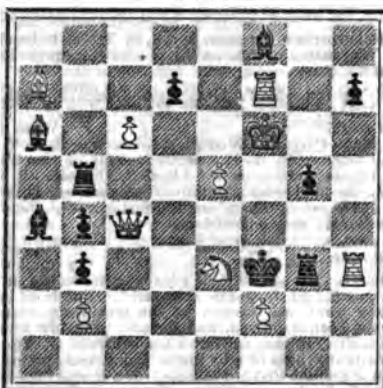
White.

White to play and mate in three moves.

PROBLEM DCCXXX.—By G. HUME.

Prize Problem in the Boy's Newspaper Tourney.

Black.



White.

White to play and mate in two moves.

SOLUTION TO 718.

White.

1. R to Q B 3.
2. Mates acc.

Black.

1. Anything.

SOLUTION TO 720.

White.

1. R to K B 5.
2. Mates acc.

Black.

1. Anything.

SOLUTION TO 721.

White.

1. Q to K B 2.
2. Q to Kt 1.
3. Mate acc.
2. Q to K B 6.
3. Mate acc.
2. Q to Q 4.
3. Mate acc.

Black.

1. B to Kt 1 or (A).
2. Anything.
- (A) 1. B to K 3 or (B).
2. Anything.
- (B) 1. B to Q 4 or B 5.
2. Anything.

SOLUTION TO 722.

White.

1. Q to K B 4.
2. Mates acc.

Black.

1. Anything.

SOLUTION TO 723.

White.

1. K to Q B 6.
2. Mate acc.

Black.

1. Anything.

NOTICES TO CORRESPONDENTS.

CORRECT SOLUTIONS TO 718 by J. Schmucke, W. J. Jubb, H. Planck, and S. L.; to 719 by W. J. Jubb, and S. L.; to 720 by W. J. Jubb, H. Planck, J. Schmucke, S. L., and "Q. P. Q." (two solutions); to 721 by W. J. Jubb, H. Planck, and S. L.; to 722 by W. J. Jubb, H. Planck, J. P. (neat, and not so easy as it looks at first sight), S. L. and J. Schmucke; to 723 by W. J. Jubb, H. Planck, J. P. (very pretty), S. L., and J. Schmucke.

- C. P. (Dalston).—Many thanks for further contributions.
A. WILDE.—Not up to the mark. Have written. Shall be glad to have further attempts.
THE THREE BROTHERS (Yokohama).—You will have seen ere this that you were anticipated. Thanks for communication.
C. H. C.—Thanks. Always welcome.
F. M.—You are quite right—the king should be moved first.

ANSWERS TO CORRESPONDENTS.

*All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, Tavistock-street, Covent Garden, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 1, and unacknowledged elsewhere:—

G. B. STRIDE.—E. P. Alexander.—Lucien Powlett.—F. H. Bolton.—H. Schofield.—Moore and Brown.—Sir F. Macnaghten.—Birch and Co.—J. K. P.—Waes Hael. J. Main.—S. A. L.—Engineer.—J. W.—R. E. V.—F. A. Brooks.—W. H. H.—Brixton.—Manchesterian Ted.—F. W. Mackenzie.—L. W.—W. J. R.—Chelsea.—R. T. B.—J. Kendall.—Xanthidia.—Woodleigh.—A. Driver.—F. Jones.—Alb.—A. Manock.—Sunlight.—A Fellow of the Royal Astronomical Society.

Pr. (Thanks; you will find the process for making artificial indigo on p. 537, Vol. XXXII., the number for Feb. 11, 1881, and Prof. Roscoe's lecture on the subject in Vol. XXXIII., p. 324. The last two questions in the query await an answer, as the manufacture has no doubt been improved, and the cost probably reduced, since Prof. Roscoe delivered his lecture.)—G. HUDSON. (We cannot help you to form mental conceptions. If you can count 100 in a minute, then it will take 10,000 minutes to count a million. You can easily reckon how many weeks. 2. Siemens' method of melting steel by means of electricity was described on p. 555, Vol. XXXII., nearly a year ago.)—IOWLE. (What is it you wish to print out? The boiler will not burst unless it is strained nearly to its bursting point; and the same remark is true of the membrane.)—VALENTINARIAN. (Try whole-meat bread, wheaten groats, or a glass of cold water first thing in the morning. You will find a discussion of the subject in Vol. XV., pp. 365, 390, 441, 467, 491, 517, 544.)—AMATEUR. (More examination questions, answered in any textbook. To the first, however: Richard shortened the length of piston-rod and multiplied the travel of the pencil; but no one thinks of comparing them nowadays.)—A SCISSOR. (Stalybridge. Dissolve pure asphaltum in oil of lavender, or, if common water, grind a little ivory black in some copal varnish. 2. For japanning, see pp. 36 and 236, present volume.)—E. MELDUM. (A good deal would depend on the "lamp"; but 30 possibly would do. See recent numbers.)—KEXKES. (We cannot, because no such book is in existence. See p. 474.)—ALPHA. (Edison's was described on p. 510, Vol. XXIX.; the new Gower on p. 510, Vol. XXXII. See also the indices of recent volumes.)—ANXIOUS. (Do you mean froth?)—A. B. R. (Make one of the machines described on p. 179, Vol. XXXIII., No. 840, or consult the indices, especially that to Vol. XXXII.)—HERCULES. (Keep your diet as much as possible to meat and vegetables, avoiding starchy matters and sugar. To be stout at your age must be constitutional, and it would be advisable to consult a medical man before adopting any of the methods of reducing corpulence. You can do no harm by exercise, in moderation.)—A. J. F. (You will find a full explanation in Nos. 773, 774. It is simply a little apparatus with three plungers or pistons.)—BOIL R. (For model boiler, you must refer to the last two volumes. Perhaps that on p. 286, Vol. XXXII., will suit you.)—COSMOS. (Do you want both, or what? Full directions have been given in back volumes.)—THE DILE, Boston. (Do you mean bronzing (a sort of varnish) or browning, done with acids.)—LAVOYER. (The conditions are too much—lasting, pliable, proof against moisture and heat. See p. 10, Vol. XXIX., or try dermatine.)—HARRIET LANE. (We gave an illustration of the audiphone on p. 42, Vol. XXXI. We do not know the address of the agent. A query on the subject is inserted this week. Watch the replies it may bring forth.)—DUPLEX. (See the index to the last volume. You will find your queries answered in recent numbers.)—F. G. SPENCER. (See answer to "Inquirer" on p. 460, or search the indices.)—IQUINER. (Boil the tar, stirring occasionally until all water has evaporated. Have a heap of clean washed but dry pebbles, and mix the tar with them. When cooled, lay them where wanted, level, and pour over a layer of hot tar, covering with dry sand or crushed flint or limestone. 2. For much valuable information on working in concrete, see pp. 23, 47, 92, 155, 477, 617, 630, Vol. XV.)—F. S. G. (If you can get the glass where bare perfectly clean,

you may be able to manage it. On a perfectly flat surface place a piece of tinfoil, and spread a globule or two of mercury over it. Press the glass firmly down on that, and leave it for several hours with a weight on it.)—EDWARD JACKSON. (You will find a rule in most books on mensuration; but see a discussion of the subject in Vol. XII., pp. 131, 203, 227, 252.)—A FELLOW OF THE GEOLOGICAL SOCIETY. (We have no space for the discussion of "Thought Reading," or whatever you like to call the phenomena just now. We had a fairly lengthy discussion on the subject not long since, which we suppose you read. If not, you had better do so, more especially "Sigma's" letters. There is not much more to be said on the matter than he said then.)—SCOVANDYKE. (We cannot ask Mr. Wetherfield, or any one else, to inquire into or give opinions as to the respectability of public companies or private trading firms. There are inquiry offices—Stubbs', for instance—which furnish such information, but only to subscribers, we believe.)—MANCHESTER. (The best thing is to give the ground a thorough good dressing of hot lime when turning it over, working it well in, and subsequently, as the crops appear, to sprinkle a little lime on the leaves when the slugs are numerous. 2. It depends on the crops, but it should, as a rule, be used sparingly.)—A. M. B. (Use ordinary rubber solution. You will not succeed in re-colouring it. "Sunlight" gave some good instructions on making cheap and handy lantern gas holders on p. 43, No. 831.)—ANNA. (The trustees under the will can surely employ a solicitor. We can hardly spare space to ventilate the grievances of a young lady who, after all, may patiently wait till she is five-and-twenty for the exclusive use of her maid, horse, and groom.)—REV. S. R. CRAIG. (We know nothing at all about the advertiser you inquire about, and cannot answer such questions privately. The first and last of your queries are inserted; we cannot spare space for the others.)—C. J. H. (Possible enough, certainly; but your arguments are of a negative and very nebulous character. It is easy enough to hint that rules of health and the like may be wrong; but have you anything better to offer in their place?)—A. S. R. (There is no "Science of the Weather" yet, and we regret we cannot meet your wishes by opening a corner of the kind you mention. You will find some statistics of the nature asked for in "Whitaker's Almanack.")—M. I. D. (Probably a cold, or caused by an abscess at the root of a decayed tooth. If the latter, have the tooth extracted at once.)—H. HABMAN. (Nothing that we know of will enable you to utilise ordinary water-colours for dyeing kid gloves.)—CYRUS. (Vellum is of the same colour as parchment, or a shade deeper.)—DREA. (There is no book of the kind, and we do not see how such knowledge is to be obtained except by long experience in the trade. Even experienced buyers in large city houses are at fault sometimes with unfamiliar materials.)—ONE IN TROUBLE. (Try Rendle's "Electric Paint Remover," advertised in these pages.)—H. CHIFFRS. (Try benzoline.)—THOMAS. (The "theories" are rubbish, and the practice a delusion. There is no beneficial action at all, except that which is caused by the effect produced on the imagination of the patient. Do not waste your money on any such appliances.)—JOHN THOMAS. ("A." is certainly liable morally, and legally, too, if the agreement was stamped afterwards. How does he know it has not been?)—A. N. J. (Tea is not a good thing to take with meat. It hinders digestion. Plain water is best; but beer in moderation will not interfere with your riding. No special diet is necessary beyond a general adherence to the principles enunciated in the letter you refer to.)—H. T. (We never saw the prize puzzle referred to, and should say it was a hoax.)—CARISO. (We believe we shall describe and illustrate the engine referred to shortly. There are several peculiarities about Scotch law that render it advisable that you should take local legal advice on the subject. A Scottish landlord has, we believe, powers that he would not be allowed to exercise our side of the Tweed.)—LIBER. (Try a liberal application of paraffin.)—P. W. R. (Your own medical man will prescribe a tonic equal in every way to the high-priced advertised preparation at a fourth of its cost, or get 30 grains of citrate of iron and quinine at any good chemist's; dissolve in a six-ounce bottle of water, and take one tablespoonful three times a day.)—B. E. A. (The damp, in all probability, rises from the foundations, and nothing but the insertion of a damp-proof course will have any permanent good effect.)—A. W. CARLEY. (Fourpence, through any newsagent.)—COURTYMAN. (The best medium for advertisements for situations of all kinds in connection with the building trades is the *Building News*, published at this office. The charge is twenty words for one shilling.)—GAS EXORISE. (Yes; because the power is applied steadily, and the explosion is not so violent. With plain gas and air, a great deal of heat is imparted to the cylinder, which has to be extracted by means of water.)—DANIEL. (Put cuttings of zinc in hydrochloric acid until it will dissolve no more. Some add a little sal-ammoniac.)—G. GROVE. (Merely a theoretical term. You will find diagrams in Molesworth's Pocket-book.)—AMATEUR. (We are not aware that such a book is published; but you will find ample directions in back volumes.)—A CONSTANT SUBSCRIBER. (Vary with the speed and weight of train. See p. 136, present vol. for a diagram. 2. You can use rubber solution by roughening the glass, or dissolve powdered shellac in strong ammonia solution. The latter must be kept some time before it is ready for use.)—SIX YEARS' READER. (See a similar query, and search the replies.)—S. HUGG. ("A Gem" is not suited for such work. You could, however, cover the parts you do not want, and take the rest in the ordinary way.)—AN AMATEUR PHOTOGRAPHER. (Must consult back volumes, or procure one of the many manuals of the subject. The question is too indefinite.)—W. P. H. (See p. 384, No. 692. Plenty of power with such a pressure. 2. He used what is known as the injector. Ten feet or more, but not with advantage—that is, vertical distance. The horizontal is limited only by the friction of the water in the pipe, which might be very long.)—DAVID. (Dissolve 25 lb. of soda in a gallon and a half of water. Melt 10 lb. of tallow, and as it cools gradually pour in the soda solution, stirring all the time until it becomes "greasy.")—C. TAPPOUSE. (The subject dropped at the time owing to the decision of the Courts; but when space allows we may take it up again.)—H. P. (See pp. 36 and 236, present volume, for hints on japanning.)—A RECENT SUBSCRIBER. (For hard soldering, see pp. 170,

264, 331, 455, last volume. Look through the index, too.)—G. FAYEN. (Petter wait for Mr. D.'s reply. The other matter is really nothing more than such a description as can be found in the prospectus, and is rather too much of an advertisement.)—S. W. F. (Sprague's "Electricity," published by E. and F. N. Spon. Plenty of classes in London. Inquire at one of the Board Schools, where they are often held.)—A LAD. (We do not know the cell named.)—MEXICAN. (Yes, to most of your questions; but see the article on p. 413. By using glass cells it can be seen when the hydrogen is given off, and you cannot charge too much, though you may waste current. It is a question of experience with the individual battery.)—R. A. G. (The old form of Leclanché; saturated solution of sal-ammoniac and water. You must melt the pitch out of "Weak eyes" are not necessarily synonymous with short sight. If the latter, spectacles are certainly needed, and they should be adapted to the sight. If the child can read this at a distance of 10 in., she is nearly short-sighted.)—A NEW READER. (We do not see what you can have. It must be piano or harmonium—the other. Ample information for the construction of either will be found in our back volumes; but we have yet to hear of any instrument between the two which you ask for.)—C. G. (You will certainly not get a cheaper instrument if you want a reliable record temperature.)—T. M. (Possibly a polypus; you'd better see a surgeon.)—J. S. G. (They are drawn, but the process could not be worked economically on so small a scale, and a description would occupy several pages with illustrations of plant, &c.)—T. H. (Instructions for galvanising iron will be found on p. 273, No. 739, and in many other back numbers, and japanning iron on p. 693, No. 726, and p. 611, No. 712.)—J. GREGG. (See Newton's Principia III. 10. He judges the earth to be between five and six times as massive as the same bulk of water, which is the truth. We do not know to what ancient "geographer" you can be referred.)—AN OLD READER. (That you cannot be, or you would know how many times your query has been answered. However, here you are again, though the "storm-glass" is really of little use when made. Take a glass tube 18 in. long and 1 in. in diameter, closed at the bottom, and nearly fill it with the following:—Camphor, 1 dr. sal-ammoniac, 1 dr. Dissolve the above in six of pure spirits of wine, then add distilled water, drop by drop, until enough of a white precipitate is thrown down. The top of the tube may be corked or covered with a bit of wet bladder. In fine weather the fluid clears, and the precipitate lies at the bottom of the tube, but rises gradually on the approach of stormy weather.)—J. HOOPER. (Rub down a new surface to it, or, if another—cheaper, perhaps, than wasting your time.)—ALPHA. (Dissolve solid paraffin in benzoline oil; it will take up no more, and give the cardboard a coating each side. The benzoline must be placed in a small jar or gallipot, and the cup placed in a larger vessel of water.)—W. H. B. (No, you must have special apparatus.)—YOUNG HAND. (Of course you will have to get the consent of owners of property, and of the local authorities as well. If resident in a large town, you had better employ the company.)—A. H. GOOPER. ("Sigma's" book is published by E. and F. N. Spon, Charing-cross.)—J. C. A. (You mean provisional position. Cost about £8 to £10 10s., including agent's fee and giving protection for six months.)—B. H. (There is no book of the kind. The one mentioned gives principles, but not practical details, except as examples. You will not be able to get anything better than what is found in back volumes.)

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English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, FEBRUARY 10, 1882.

THE ROSE-CUTTING FRAME.

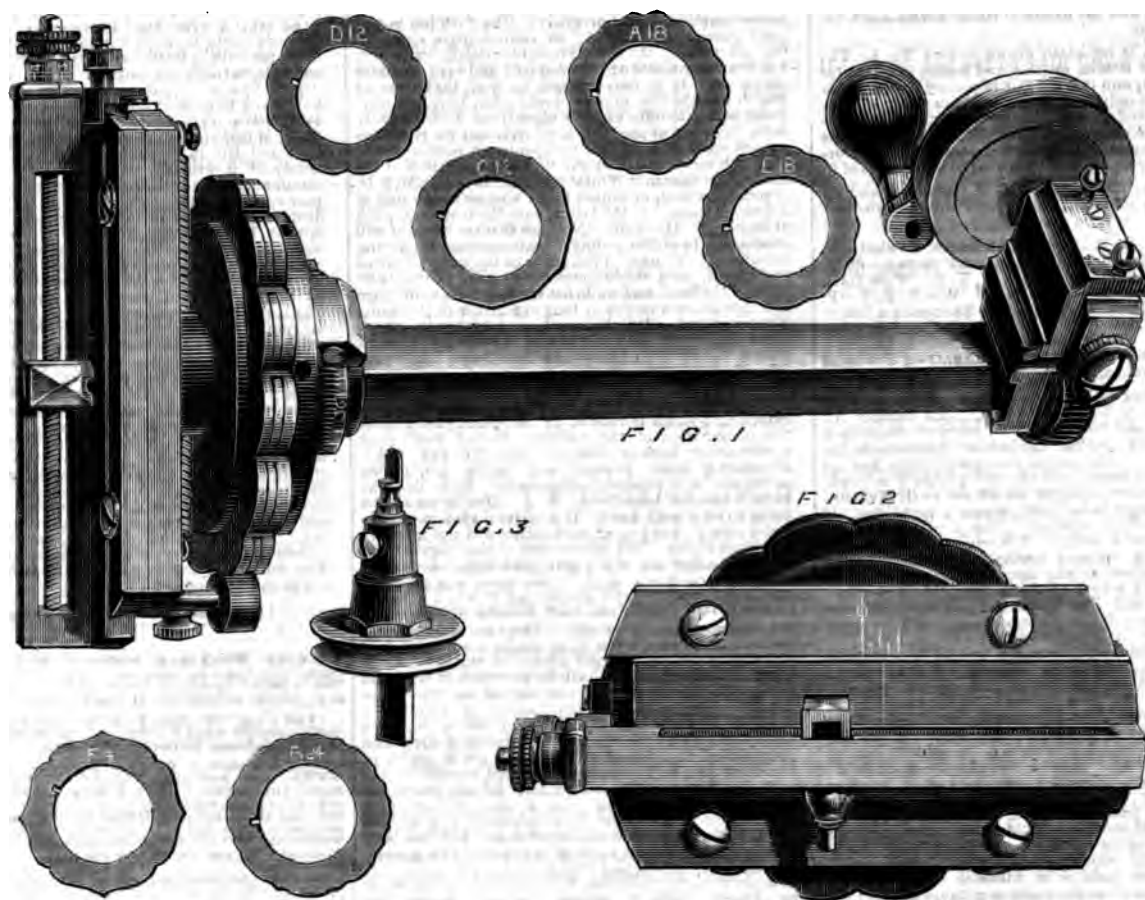
By J. H. EVANS.

now arrive at a more extensive and, consequently, more expensive, branch—namely, mental turning, and one requiring a complicated assortment of tools. The present illustration is of an instrument for the production of patterns on wood, is a very interesting tool to work

slide, which forms the eccentric cutter, is worked by a strong spring, which keeps the small steel roller always on the rosette, and as the spindle upon which it is all fixed is moved round by aid of the tangent-wheel and screw at the back, the front slide oscillates, and the roller or rubber, as it follows the figure, whichever it is that is on the instrument, will cause the cutter to follow out the same kind of pattern on the face of the wood, or whatever may be the material to be worked. The production on the wood will not be a facsimile of the rosette, because the diameter of the steel roller will not allow it to go to the bottom of sharp corners. The tension on the spring is strengthened by adjusting the small milled head upon the end of it; and, if the spring be made stronger, it will naturally admit of its cutting a deeper pattern with the fixed tool. When this instrument was first introduced, the eccentric cutter in the front only

And now a few words on what I claim as a great improvement in this particular instrument. Fig. 3, it will be seen, is a small drilling instrument, into which drills of any shape may be fitted, on precisely the same principle as any other ornamental drill; and the great advantage derived from it is that the drill, which becomes the cutter, can be driven at a high speed, and by means of the winch-handle, seen in Fig. 1, the whole apparatus is moved over the same ground, as it were, only at a very reduced speed, which gives the drill time to make a clean cut; the depth of the pattern is, of course, governed by the stop-screws in the tool-box of the slide-rest in the same way as for ordinary eccentric pattern.

As there are overhead motions of different kinds, it will not be out of place to refer to this particular adjunct to the lathe. Provided the band has to lead from the bar on which the driving-pulley runs, a difficulty



and the number of different patterns produced with it are, I may say, end— or a very considerable time I have difficulty with regard to the rose-cutting, simply because, as many amateurs find, it would only do face-work—that is, it could only be applied to a flat surface. Seeing that this was somewhat vital to its value, I set about devising an arrangement for the purpose of using the instrument to cut its patterns, and some of them, of a deeper nature could possibly be done without the aid of an additional drill-spindle (Fig. 3). This was invented and introduced by myself ten or eight years ago, and would now be duly appreciated, judging from the number of them I have made for dilettante turners, who have all spoken of it as an improvement to the instrument. Before beginning the description of the new tool, I will endeavour to give a brief outline of the principle upon which it works.

When, then, it will be seen that the front

extended on one side of the centre; but it was soon found that to carry the same equally on each side would be a great improvement, as the fact of setting the cutter the reverse side to which it has been to cut one pattern, will cause it to be in exactly the opposite direction. There are, of course, a great many nice points in using this instrument, so that one can only become well acquainted with it by experience; the reason why, without the new addition, only line patterns can be cut is, that the action of the cutter is necessarily slow, as it has to be worked by the tangent screw at the back, on the pulley of which the band goes. On the back of the front part will be seen another tangent screw. This is for the purpose of altering the position of the rosette, the effect of which will be to cross the pattern in different directions, and some very beautiful lace patterns may be accomplished; and, if carefully worked out, it is an instrument that, I am sure, will give a large amount of interesting productions to any amateur ornamental turner.

will present itself on account of the different and unequal positions the instrument must take in its course round the rosette. With the improved overhead motion I now make, this is overcome by the counterbalance weight, which will allow the band to give and take almost any amount; but in the other case it is different, the band is to a certain extent rigid. This I found a considerable drawback to my improvement, because scarcely anyone would be disposed to have a new overhead motion for the sake of one instrument only, and to overcome this obstacle I had some strong bands of small diameter made in vulcanite india-rubber, and they answered so well that I found them very useful. I have now stated briefly the object of this instrument, and how it works, and for the benefit of our readers I will endeavour to tell anyone caring to do so, how to make one for himself, as it is a very intricate thing to do, and requires a deal of explanation. I hope I shall not be blamed if I occupy a somewhat lengthened space in giving the various

which I consider essential to the success of the instrument.

In the first place, bearings and castings of all the necessary parts must be prepared. Now, there is a difficult matter to be solved, and I am sorry to say that I am at a disadvantage in helping my readers. I will at least remove all obstacles in the way of making patterns by stating that any one desirous of making such a tool may have all the necessary parts from my patterns and whatever information not contained in this article that may be required, upon further application to me, either through the columns of the paper or privately.

Having, then, all the different parts at hand, the steel square stem will be the first thing to do. The square should be filed up in the rough, and then centred as correctly as possible. The collar on the front must be turned true to the square, and rounded off to go into the boring collar, wherein it should be placed to bore the hole. This hole should be about 5-16 in. in diameter at the small end, and then branch to full 3/4 at the large end and a long gradual taper. This done, the spindle, which passes through it, should be fitted to it, and the square tipped on the corners and filed to the turning tail it is perfectly true to the hole. The spindle that fits into the square need not be hardened, as it never makes a quick revolution and wears very little. The bearing should be eased away in the centre, leaving only about 1 in. at each end that actually fits the hole. Having this part done, the back part may be all fitted up—not that it matters much whether the back or front is done first. The metal piece that fits on to the rear end to which the tangent frame is fixed should be filed into shape, and a round hole bored in the centre of that part which butts against the end of the square stem, and in the four corners are fitted two steel screws and two steady pins, to hold it firmly to its place. The spindle passes right through this, and where the tangent-wheel is fitted on to it it must be filed hexagon; the wheel itself must also have a hole drilled the same shape, and be well fitted on to its place; and as it must work perfectly accurate, it should have the thread cut in it while it is on its fitting. There are 96 threads in this tangent, and, to be cut well, should be cut with a single-tooth cutter, before the hob is used. To keep this wheel on its place, the end of the steel spindle has a hole tapped in the end, and a screw fitted to it about 8-16 in. diameter, and about 30 threads to the inch; although, as I have often said, practically, it does not matter what the thread is. Having this part so far advanced, the tangent-screw and frame must be made: the frame of metal, and the screw of steel. At one end, it will be seen, a centre-screw and lock-nut are fitted; at the other end the hole is cut right out, so that the recess in the screw may be passed into its fitting, which will allow the collar of the screw to bear against the inner face of the frame, and the centre screw will then keep the collar against the face. It will also be observed that on the end of the screw a pulley is fitted, and it is the band working upon this that gives the action to all the work in the front. The winch-handle, seen in Fig. 1, is part of the improvement I have made, as it is by means of it that the instrument is moved slowly while the small drill-stock runs at a high speed, for deep cutting. I will return to this at another part as we go on, and proceed with the making of the instrument. The next part to do will be to fit the block which carries the rosettes. This is fitted to the projecting part of the steel stem, and the centre spindle passes clean through it. On this piece is another tangent wheel of 96 teeth; but being of smaller diameter, it is naturally a finer thread. This is the wheel from which the action is derived for shifting the rosette to

the eccentric cutter, which is a multiple thread of four, which is equal to the thread screws in slide-rest and other chucks, &c., and, being a long and slender screw, will require great care. We have special dies for cutting these threads, and use the chasers as little as possible, the steel being so slender, springs so much; but with the aid of the slender guide, cutting may be avoided, and such screws can be cut in a self-acting screw-cutting lathe. Under any circumstance, the utmost care must be exercised, as the thread may be somewhat in the entire length. After fitting the nut in is concerned, full dimensions will be found in my article on the screw-cutting frame, so I need not take up space needlessly. The micrometer head and plate also must be fitted in the same manner.

We now come to the spiral guide, which is also an important feature, as this that causes the slide to follow in and-outs of the various rosettes. At the end of the slide, where the micrometer is fitted, a steel stud is screwed into a metal plate for the spring to loop at, and, at the other end, a pin is fitted through which a small pin, with a nut at one end, passes freely, and, at the other end, a small screw is cut, and milled head fitted on. This is for the purpose of adjusting the tension of the spring, as some of the patterns are not so deep as others, and these of lesser depth do not require the spring so strong. The pin it will be seen, passes through the spindle freely, so that it does not jam in any way; if it did, it would, of course, stop its working. The make of the spring is a somewhat different process to an ordinary spring. It must be milled close together, and then it is filed to a steel spindle, and will serve as a means of holding it, and the top of it is turned off flat. It is made of small wire, must be very much extended before it is hardened. Also, at each end must be turned over; but this, the end must be made hot, and blowpipe is the best thing to use for purpose. When ready, it should be heated in a good bath of oil and blued off, which means that after it has been made hot, it is dipped in the oil it should be held in clear fire until it catches light all over, then cooled in water. It is not at all certain whether it will not break when tested; or, if not hard enough, it will. If the latter, it must go through the process again; if the former, a screw must be made. But I must ask those meet with this misfortune not to be discouraged, but make another, as we very frequently have to do. One more addition, and the instrument will be complete—that is, the stop at the end of the slide. This is a steel piece fitted to the end of the metal slide, through which a screw passes, its object being to stop the steel patterns at a given point, and by this means patterns may be varied to a very great extent. For example, we will assume the slide without the stop-screw and follow the rosette entirely, which will in result a copy of it on the wood; but the stop-screw is set forward so that the roller which runs over the rosette reaches the bottom of the figure, and cause the tool to cut a concentric circle between each space, and not complete exact figure; this may be altered in a number of different styles, and a variety of patterns be produced. A small reader which is made as a screw-head, which is divided, and the amount of difference in each I make, as a rule, seven different of rosettes; but the number of patterns they will produce is seventy times seven; at the same pattern could be made as an end if required; but I think it best

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The centre, then, being found, a small hole about a thirty-second part of an inch should be drilled an eighth of an inch deep, and now the filing of this slide quite true to the exact half of this centre hole is not at all an easy matter, and will try the skill of the vice-man. When finished to satisfaction, the slot in which the tool-box slides must be got out, and the most simple method to adopt is to drill a series of round holes the entire length of the slot required, and, with a round file, break them one into the other, and then, with pillar files, it must be got up parallel, and the tool-box fitted. The screw for this is precisely the same as that

are brought into use, a sufficient of work can be executed to satisfy an ambitious mind.

Far, then, I have endeavoured to give a brief explanation of how this instrument is to be made; and I hope what instruction I have given will be sufficiently to help any of my readers who feel disposed to set about making one; but I have always been, quite ready to do that one hour's practical instruction to all the reading that can be written. A model is better than a drawing to learn, and as the instrument is always seen at my establishment, I shall be glad to give personal instruction to any one who cares to pay me a visit.

Small drilling-instrument, Fig. 3. I will fully explain, as it is a new addition to the rose-cutting frame, and greatly increases the value of it, as it is for cutting patterns deeply into the material, and for a description of work it is much more useful. It will be seen that this little instrument is made to fit into the tool-box cutter, and is made, therefore, the same size as the latter in the stem, and when worked, the band from the overhead is conveyed to it, instead of the one on the tangent-wheel at the back; the key of the drill-stock being small, a seed is, of course, obtained, and the tool to the instrument itself is given by the winch-handle at the back. It will be seen that, although the motion of the rosette portion is slow, the work goes over exactly the same ground, so that, as when worked by the band from the overhead; and the drill running at a high speed, it is almost as deep as can be desired; small moulding drills of any shape can be made, some of the most beautiful can be accomplished with it.

Not one of the easiest things to make, and being small adds nothing to its utility; a piece of round steel, $\frac{1}{4}$ in. in diameter, will do for the body of it—the part, which is turned to a cone, with a part $\frac{1}{4}$ in. long. This done, and a hole drilled in the end of it, it must be run in the lathe exactly to the centre, the side of the stem filed accurately to a point, and then the back of it made to the same size as the ordinary eccentric cut. The object of one side of the stem made to the centre, is to bring the tool precisely to the centre of the instrument; and, in using the rose-cutting frame, it is always better to have the instrument all at centre, and if it is made and adjusted, a small dot will be the result if the tool is pressed on wood; if it makes a small hole, it is not true. I mention this as a warning, the reason I give for filing the flat side to the centre line. When this is done it must be made as hard as possible, as the collar. The best way to do this is to have a shallow vessel with the water of a sufficient depth to reach the flat part to be hardened. Make it a shallow dish, and dip it, moving it about in the water. Being so small, there is no fear of its becoming very much distorted in shape by the process of hardening, and it always grinds them up perfectly true. A small emery-wheel; this, however, may be dispensed with. Provided no work has taken place, it will be ready for use to be fitted. This is made from a piece of $\frac{1}{4}$ in. round steel, and is $\frac{1}{4}$ in. of an inch; the back part is turned out to fit on the stem, and on the front of the pulley a small nose is cut with a fine thread about 30 to the inch, and a V-thread, because there is nothing between the part on which the pulley is cut and internal fitting. The pulley itself is about 3-16 wide, with a V-thread. For the band. This must also be

hardened, and the two cones ground well together. The small screw which is fitted into the stem to keep the pulley up to its bearing is better if it is tight enough in its place without going home to a shoulder, as it can be adjusted more easily.

To finish this tool the front part into which the drills are fitted is all that has to be done; this is also made from a piece of round steel, and should be made as short as possible, in order that as little vibration as possible may arise. When screwed and fitted to its place, the small stem should be held in a chuck made to the lathe, the instrument put together and driven from the overhead motion to drill the hole in the front where the drills fit. This is an important matter, as it is most essential that it should be quite true. It will be seen that the front is filed hexagon where it goes against the face of the pulley; this is to facilitate the removing of it when necessary. The drills also should be turned in their place in the same way as ordinary ornamental drills.

I am quite convinced that this addition will be duly appreciated by those who try it. I have had the pleasure of making a great many, and they have always given satisfaction. A careful inspection of the original would help materially, and I shall be glad to show it, or lend it to anyone for that purpose. In conclusion, I hope that these details, though somewhat lengthened, may be of as much service as many others have, judging from the correspondence I have received relative to them.

HOW TO MAKE A 2IN. ASTRONOMICAL TELESCOPE.

I WAS very glad to see the subject of the "effectiveness of a 2 in. telescope" so ably dealt with by Mr. Bridle. There are doubtless many of your more fortunate readers who will smile at the fervour displayed over so small an aperture; but they should remember that valuable work has been done with telescopes no larger than this; and also, that with a great many would-be students, the choice lies simply between a telescope of that size or none at all. For my own part I am acquainted with many who have already made considerable progress in practical astronomy, and who would certainly never have been tempted to provide themselves with telescopes had they not been able to gratify their tastes for star-gazing at a very reasonable rate, much lower in fact than the usual retail price of even such modest instruments. My object in writing, therefore, is to describe to others, who may be similarly situated, how they may very easily put together a thoroughly reliable 2 in. achromatic telescope with two powers, brass tubes, and altazimuth mounting for a tripod-stand, and still have some change out of a sovereign.

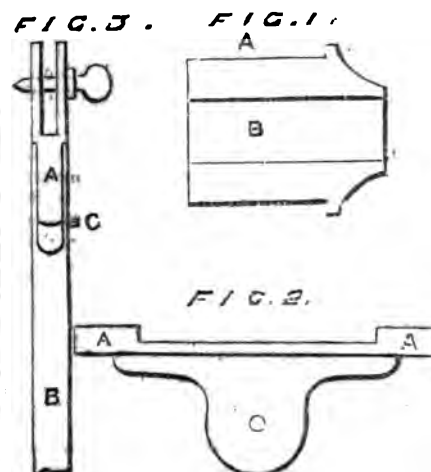
But, though I am desirous of showing how the luxury of an astronomical telescope may be indulged in for so small an outlay, I should be sorry to urge this as the only reason why its manufacture should be attempted. There must be, for example, many of our readers to whom the highest price for such a telescope would be but a mere trifle, but who would no less be keenly alive to the pleasure they would derive from the thought that it was to a successful issue of their own endeavours, rather than to the accidental possession of a long purse, that they were enabled to penetrate into the far depths of space. Nor is this all, for the experience gained in this manner will be of lasting benefit, and cannot fail to be of value in the future selection and management of any other instrument they may hereafter possess.

As regards the choice of material, I should also like to say a few words. A great deal has been written about the unnecessary expense entailed by the use of "polished mahogany and brass" in both the microscope and telescope; but I may say I have yet to be convinced that either a tin tube or a roll of brown paper is at all suitable for the purpose. If a telescope is worth making at all, it is surely worth while to lay out an extra couple of shillings to give it a decent appearance, to say nothing of the

superior solidity or of the convenience in getting a tube of just the right size, ready for immediate use at the nearest metal-merchant's.

The selection of the O. G. will first engage the attention of the operator. This should be of not less than 30 inches focus (solar), and should throw a clear-cut image of a gas or candle-flame without blur or flare at the edges. In testing for focus it must be remembered, that the nearer the flame is to the lens, the longer the focus will appear to be; some allowance should be made, therefore, for this peculiarity if the testing takes place, as it very likely will do, in the crowded interior of an optician's shop, and a still further allowance of about 2 inches must be made for the difference of focus between celestial and terrestrial objects; indeed, taking it altogether, an amateur would err on the safe side if, under the circumstances, he allowed a margin of 6 inches. The price of such an O. G. of Paris make, should not exceed 7s. or 8s.

The next step will be to procure a length (corresponding to the focus of the O. G.) of 2 in. rolled tubing; 6 inches of 2 in. and 12 inches of 1 in.—for the eyepiece tube—costing altogether about 3s., a socket to carry the eyepiece tube will also be necessary (see Fig. 1). The finished



socket, it must be remembered, should fit tightly into the 2-in. tube at A, and be just of sufficient bore at B to allow the eye-tube to pass easily through. The pattern for this will have to be made by a turner, who must be warned to make the necessary allowances for the shrinking and chucking of the brass casting. This portion of the telescope is, perhaps, the most particular and difficult of the whole affair, so, to save trouble and expense to such as do not possess a lathe of their own, I shall be glad to forward a rough casting—chucked for the inner tube—on receipt of 1s. in stamps. The patterns for the Altazimuth mountings (Figs. 2 and 3), are much more easily made. The projecting ends at A, Fig. 2, must be left concave to fit the telescope and allow it to bed firmly upon them. The pin A, Fig. 3, may be sunk into a piece of brass tubing, and should fit sufficiently free to allow of an easy rotary motion. A safety pin and groove may be placed at C, if thought necessary.

The parts of the telescope are now ready for cleaning and putting together. The cleaning may safely be left to the discretion of the amateur, or since it is, as regards its efficiency, quite a work of supererogation, he may if he pleases dispense with it altogether, or try its definition first and deal with it afterwards according to its merits.

Aldebaran.

(To be concluded.)

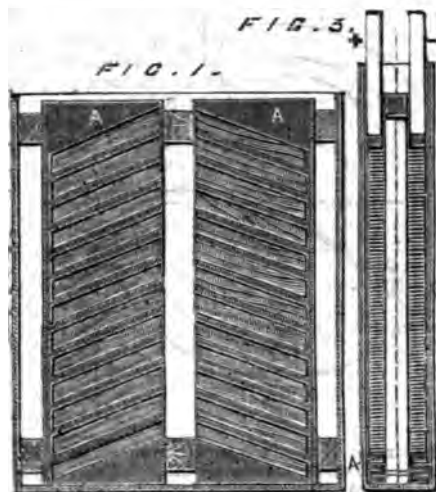
THE TOMMASI SECONDARY BATTERY.

THE annexed illustrations show the construction of the Tommasi secondary batteries which have been patented by the Société Universelle d'Electricité Tommasi, of Paris. One of the modifications described is especially interesting, but the practical value of the invention obviously depends on its cost in actual working. It has been found by experience that

the amount of electricity accumulated in a secondary battery depends upon the extent of surface attacked by the current and the thickness of the layer of peroxide formed. Further, the prompt charging of the secondary element depends upon the facility with which the metal is attacked and rendered spongy. The object of this invention is to produce a secondary battery in which the above-mentioned conditions will be realised. In the engravings Fig. 1 is a cross section of a Tommasi secondary battery of the simple form.

A, A, represent a pair of flanged lead plates of about two millimetres in thickness, cast with a series of shelves of corresponding thickness inclining upwards. The shelves are arranged about five millimetres apart, and the angle at which they are set is from thirty to forty degrees. These flanged plates are placed opposite one another, about one centimetre apart, in a vulcanite or other suitable vessel. The spaces between the shelves are filled with sheets of lead-foil of about one-tenth of a millimetre in thickness. These sheets of lead-foil may be placed regularly or irregularly in the spaces, and the cell is filled with water and sulphuric acid, mixed in the proportion of one to ten; the battery is then charged like an ordinary Planté battery. Owing to the extreme thinness of the lead-foil carried by the shelves, the extent of surface to be chemically attacked is very great, and the metal, which before being placed in the spaces is almost equal to spongy lead, dissolves freely. The inclination of the shelves prevents the peroxide, which is formed under the action of the electric current, falling to the bottom of the cell.

As a modification of the above arrangement of secondary battery the lead-foil is dispensed with, and the plates A, A, with their shelves, are made of an alloy of lead and tin. In this case the shelves are arranged closer together, viz., about two millimetres apart instead of five. The plates are severally treated to extract the tin from the alloy and leave the metal porous. This treatment consists in placing each plate in connection with the positive pole of a battery, and immersing it in a bath of water acidulated with sulphuric acid in the proportion of one to ten, and passing an electric current through the bath. All the tin will thus be dissolved out, and there will remain a spongy metal which constitutes the best secondary element, and one

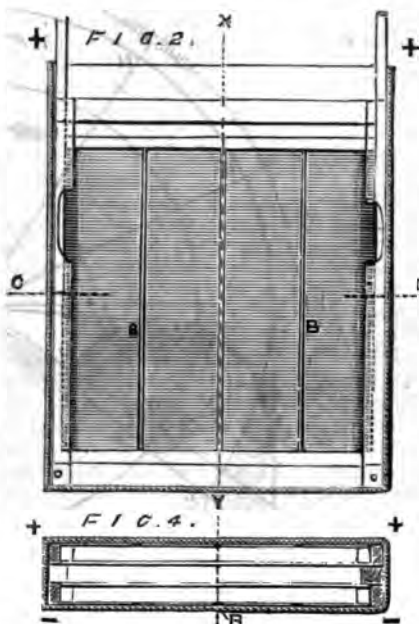


capable of being rapidly charged. The spaces between the shelves of the two plates A, A, are filled with pure lead-filings, or with lead precipitated from one of its salts by iron, zinc, or copper. This preparation, which is known to chemists under the name of "Saturn's tree," presents the metal in the most finely-divided and permeable condition possible.

As a further modification, and in order to simplify the construction of the battery and obtain a still greater extent of useful surface, the shelves may be dispensed with, the sheets of lead-foil (say one-fifth millimetre in thickness) being retained. The sheet-lead is cut into strips of suitable width and length, and the strips are piled one upon another on the lower flange of the plates until the required height is obtained. The pile of strips is then soldered to its supporting plate, which may be better described as a

frame, the vertical wall of the plate as well as the shelves being in this case dispensed with. The depth and breadth of the frame will correspond with the width and length of the strips.

This arrangement is shown in Figs. 2, 3, and 4, Fig. 2 being a longitudinal section of a battery fitted according to the modification; Fig. 3, a cross section on the line X, Y, of Fig. 2; and Fig. 4, a sectional plan on the line C, D, of Fig. 2. Two of these frames containing strips are



placed in a vulcanite or other suitable vessel about one centimetre apart, and each frame rests on blocks of vulcanite, wood, or other suitable material, also placed about one centimetre apart. The object of leaving this space is that anything falling from either pole may accumulate therein without placing the two poles in communication. As before stated, each strip is soldered to the frame A; but in addition the strips may be soldered at one, two, or more points in their length to bands B.

As will be seen from Figs. 2 and 4, it is preferred that the ends of each strip shall be turned back, so that a small space will be left between the strips, into which the exciting agent may freely enter.

PRACTICAL NOTES ON PLUMBING.—XXVI.*

By P. J. DAVIES, H.M.A.S.P., &c.

Pan-Closets, Ventilation, Wiring, and Flushing.

IN the last chapter I have described the siphon arrangement, which is also applicable to valve or pan closets, and shall now fully describe the service-boxwork, both with and without "trapping stand-pipes." First let us examine the box 30, Fig. 146. This is an oblong lead box, made tapering, so that the bottom may drop through the hole cut in the lead cistern, and the top of the box being made larger prevents it dropping through. Of course, the bottom of the box is wiped to the bottom of the cistern. Now examine the valve 33, fixed over the box, also the air-pipe 31 next the down-pipe 28; this pipe runs to the basin, and is made good by a putty joint (see Fig. 37, chap. 7), or it may be connected to the basin with an india-rubber cone. Next refer to the top part of the down-pipe at 28, where you will see the pipe brought nearly to the top of the box; the reason for this is that the valve 33 is a kind of waste-preventing valve—that is, that it closes after about two gallons of water is discharged, and should the valve be dropped before the handle of the closet, the water-box, 30, will only empty itself slowly, by reason of the pipe 28 having only a small hole, about $\frac{1}{4}$ in. in diameter, in the side of stand-pipe, as shown at A. Now, a very large majority of persons would, on seeing that

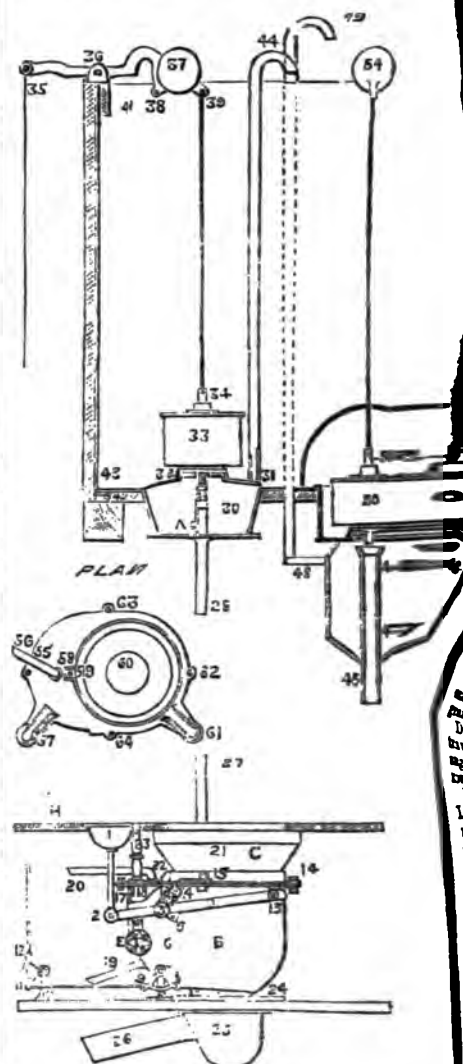
the water stopped running, immediately drop the handle, and would be perfectly right, as the small dribble would empty the service box of the running water into the pan. But this kind of stand-pipe is only wanted when waste-preventers are used, and when people are apt to hold the handle longer than necessary.

50, Fig. 146 illustrates the same kind of stand-pipe service-box, but of different construction. It is generally made of a piece of $\frac{1}{4}$ in. soil-pipe and the ends worked to a tapering shape, or otherwise, at the discretion of the workman. The reason why the valve is fixed below the bottom of the cistern is to allow all the useful effects of the cistern to be utilised.

52 is a leaden domicile strainer, intended to keep back tea-leaves, &c., from entering and clogging the valve.

Judging a Pan-Closet, and How to Ventilate it.

B, Fig. 146, is the container of a pan-closet; C, the basin. The bottom rim is first painted, as also the iron-work, then bedded with putty upon the container; 19 is the fresh-air inlet, and 22 is the ventilating pipe off the top of the container (see Plan at 55 and 56). There is nothing new in this, as I showed it in the Exhibition of 1871.



1 is the dish; 2 the pull; 3, the tumbler pin, 4, the cam crank or lock; 16 the axle riveted into the cam-crank or lock 15; 13, the lever-lug. This lug is one of the principal points to be watched, for on the proper fitting of this depends the locking of the copper pan; as there should be a pull between the tumbler-pin and the rivet 13, which is caused by the fall of the weight 13, pulling in a downward direction, in turn causing the tumbler-pin to press firmly against the front part of the inner cam at F. When this is properly fitted, the copper pan cannot be pressed downward with pressure from the hand; the axle should sooner break, because the lower the tumbler-pin drops down the cam, the greater will be the pull on the axle. This is the proper

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closets, for, should the pan spring open when pressed downward by a closet is not properly made or other point is that the tumbler-pin down thump upon the bottom of softly and without noise, and act an hope-lever. When making these for the pin 13 described, after tumbler-pin are properly adjusted, lar, 23, and fix the dish and pull of this pan-closet, see Fig. 128 G.

of the axle, I the copper pan this axle, having the heads sol- thin the pan. Caution must be the right-sized copper-pan to fit container—the modern size is 9½ in., 10 in. But you must be sure not to that it will bump against the bot- ainer, near the out-go or trunk. See properly bedded down, and that f leather, known as the "muffle," e and ½ in. thick, is fixed between er of the container, at the little r P. This is for the copper pan it without making a noise. The rates very distinctly the wiring closet. H.H. shows the seat in

(To be continued.)

PROPORTION SLIDE-VALVES.*

HUGO BIGRAM, M.E.

the proper proportioning of slide- to show the effects of the laps valve, and the angular advance of quite a number of methods have and used, one of which is shown ar to avoid misunderstanding, it is e the rule by definitions.

l-proportioned slide-valve is in its 1 (when the eccentric is at right ve-face overlaps the steam-ports. g on the steam side of either port, p of the valve for that particular lapping on the exhaust side is the he exhaust lap is frequently made me cases even negative—i.e., when its neutral position the ports are ned for exhaust. The laps are not al for both ports; on the contrary, s, a small difference in the laps for of advantage. Lead is the linear ening of the ports for steam or ex- e crank is on its centre, and the e, or angular advance, is the angle centric is ahead of its right-angular the crank is on its centre. This res called the angle of lap and lead, ous.

operation of a given slide-valve on orts can be represented by the dia- follows:

le Z with a diameter equal to the lve, and the line Q, Q', forming an the angular advance with the hori- of the circle Z.

Q' as centres, draw the circles L, ith radii respectively equal to the ust laps of the valve, relative to the sideration. Imagine the centre O, to be the centre of the main shaft hich in this case is assumed to be of type) the crank rotating in the ted by the arrow. The diagram is pted or read as follows:— itted while the crank moves from A the circles L' and L, and is ex- he crank moves from R to C. A is the crank when the steam is first E expansion begins. R is the opening for exhaust is effected, and the moment when compression

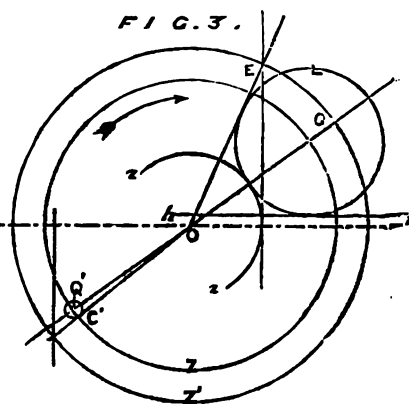
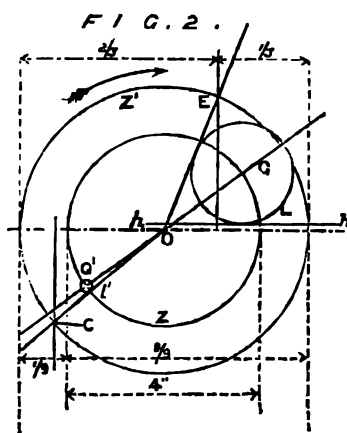
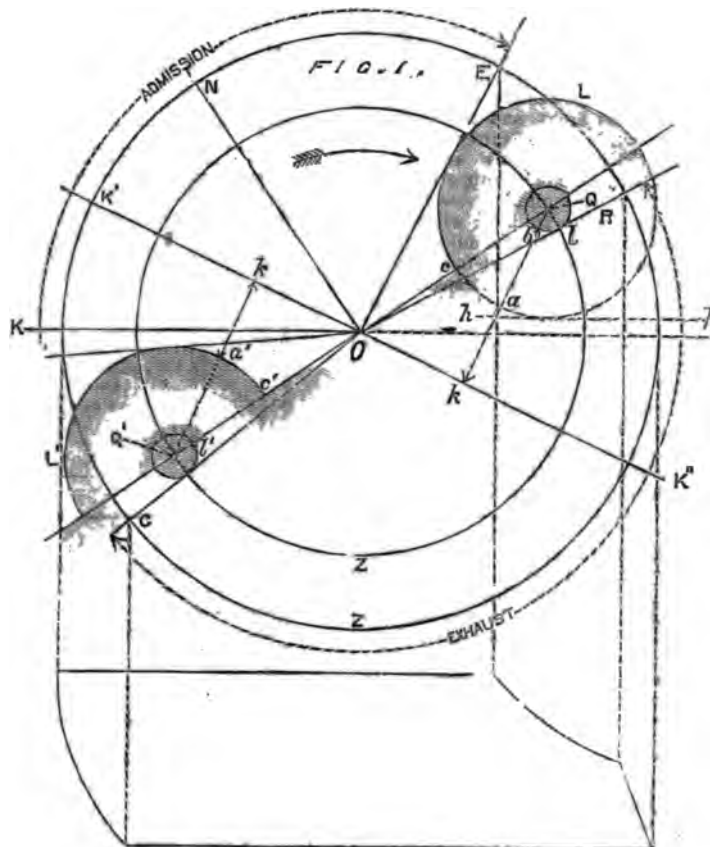
cal indicator diagram taken from ing side of the cylinder (assuming ould appear as indicated below am, provided no account is taken of of the connecting-rod. The diagram this: When the crank is in any K'), the corresponding linear open- can be found by dropping from Q ne O K', a perpendicular line Q k, at portion of either of these lines line of the crank, and the circum- lap circle represents the opening hus, for the position of the crank : opening for admission is repre- length $a'k'$; for the position opening for exhaust by the length

Thus, when the crank is on its centre, the port opening is equal to the shortest vertical distance of the circle L from the line O K. This distance, therefore, represents the lead of the valve. When the crank has a position, N, at right angles to the line Q Q', the opening of the port is represented by the line O c or O c', which is the greatest port opening attainable by this valve.

Thus, when a valve of known dimensions is to be examined, the diagram at once reveals the

Its radius is the required lap. Then find Q', diametrically opposite Q, and draw the circle L' to touch the line O C. The radius of this circle is the required inside lap. The horizontal inclination of Q Q' represents the angular advance of the eccen- tric, and other questions can be answered as before in Fig. 1.

Or, say a valve is to be designed to cut off at 7-10ths with a lead ½ in., to have a greatest port opening of ½ in., and to cushion for one-ninth of



point of admission, of cut off, of release and of cushioning, the lead, the greatest port opening, the port opening for any position of the crank, and, in short, gives answers to every pertinent question.

The greatest advantage of this diagram is, how- ever, that its application can be inverted. Suppose a valve having a known travel, say 4 in., is to cut off at a given point, say two-thirds of the stroke, to have a certain linear lead, say ½ in., and to cushion the steam for the last one-ninth of the stroke—

Question: How much lap should be given to the valve on the steam as well as on the exhaust side, or what will be the angular advance of the eccen- tric, &c.?

Solution: Draw the diagram from the dimen- sions given and shown in Fig. 2 as follows: Draw the circle Z, diameter 4 in., the line O E for cut off corresponding with two-thirds of the stroke, and the line O C for cushioning, representing eight- ninths of the stroke. Draw the line, $h h$, ½ in. above the horizontal centre line, representing the lead. It is, then, not difficult to draw the circle L, as its centre Q must be in the circle line Z, and it must touch both the line $h h$ and the line O E.

the stroke. How much travel must the valve have, &c.? All questions can be answered if it is possi- ble to draw the diagram from the given dimen- sions. To accomplish this, draw (see Fig. 3) the lines O E and O C representing the crank for the given moments of cutting off and compression, draw the line $h h$ ½ in. (the lead) above the hori- zontal centre line, and the circle $z z$, with a radius equal to the greatest port opening ½ in. The whole difficulty is now reduced to the simple problem of drawing a circle L, that will at the same time touch the lines $h h$, O E, and the circle $z z$. From O as a centre, the circle Z may be drawn through Q, the centre of that circle L, and the diagram completed by drawing the exhaust lap circle as before (in Fig. 2).

The application of this diagram is so simple that it deserves to be more generally known and ap- plied.

INFLUENCE OF HEAT ON ZINC.

WHEN rolled zinc is heated to a high tem- perature (says Herr Kalischer, in a recent paper to the Berlin Chemical Society) it undergoes a number of constant changes, without

the external aspect becoming immediately different. It loses its clear ring and becomes nearly mute, like lead; it can be more easily bent, but is also more easily broken, and in bending makes a noise almost exactly like the "cry" of tin. All these changes are due to the zinc being altered in molecular structure under the influence of heat—becoming, in fact, crystalline. This crystallisation is easily rendered visible if a strip of zinc, after being heated, is dipped in a solution of sulphate of copper. The action is instantaneous; one has merely to dip the zinc about half a minute in a concentrated solution, then wash off the copper precipitated on it, to obtain distinct indication of crystallisation on the surface.

That this is not a mere surface action appears from the fact that rolled zinc, after being heated, proves to be crystalline on fracture, and however small the extent to which it is corroded by the sulphate of copper solution, it retains its crystalline structure. The mode of cooling has here no marked influence; whether the zinc is slowly cooled or chilled by being plunged hot into the cold solution, the result is always the same, and I have often obtained this action with zinc-plate of only 1-20mm. to over 5mm. thickness (i.e., about 1-500in. to 1-4in.). I had no thicker plates. Whether foreign admixtures of zinc have an influence I am not in a position to say, as I had not an opportunity of trying different kinds of zinc. The kind I used is Silesian.

To determine approximately the temperature at which the change to the crystalline state occurs, I heated the zinc strips in an air-bath, and took them out whenever a given temperature was reached. The results obtained thus were not always quite uniform. In any case the zinc must be heated over 150° C. to afford distinct signs of crystallisation on corrosion. Sometimes I have only got such signs on heating to 170°; but crystallisation was often evident between 150° and 160°, and beyond that it becomes even more distinct, and continues to the temperature of fusion. But previously to the proof of crystallisation by corrosion, one finds proof in the "cry," which is perceived, as a rule, when heating has proceeded to about 130°. The higher the temperature, the stronger is the "cry," and the duller the "clang." The crystalline character, further, is apparently dependent on the temperature to which the zinc has been heated. In general, at temperatures under 300°, it appears like ice-flowers, or moire, whereas, at a higher temperature, the crystals are more sharply formed and individualised.

The observation here communicated is not only interesting itself, as an instance of a direct and rapid change of the molecular structure of a metal through heat, but also, inasmuch as "crying" zinc takes place by the side of another metal behaving similarly, and the supposition that the "cry" of tin is the result of a crystalline structure, finds a new confirmation in the behaviour of zinc. As the entire process for demonstrating crystallisation does not take more than a minute, this makes a suitable lecture experiment for illustrating the influence of heat on the molecular structure of a solid body.

Perhaps it is not superfluous to point out that the observation in question may possibly be not without significance for technical work; for, since the tenacity of rolled zinc is diminished with the change to the crystalline state, and this change is produced by heating, it may be important in rolling, to see that the temperature does not become too high. And as the "cry" is undoubtedly an indication of beginning crystallisation, and, as a rule, is perceived after heating to 130°, it will be well to keep the temperature under 130°. It will also be possible to find an indication of the state of tenacity by examining whether the zinc "cries" or not. Of course, the question still remains open, whether the mechanical action of rolling does not, in all circumstances, prevent the occurrence or the continuance of a crystalline structure.

It was probable that the change of the molecular structure of zinc would affect other physical properties of the metal, and Herr Kalischer first compared the specific gravity of zinc that had been heated to 320° to 330°, and then cooled. With that of ordinary rolled zinc four determinations were made, and with the remarkable result of a slight increase of density in the zinc rendered crystalline by heat. The ratio of the specific gravity of zinc in the crystalline, to that in the ordinary state = 1.0001 : 1, or an increase of the former about 4-100th per cent.

Next, the author, after satisfying himself that zinc wire also becomes and continues crystalline through heat, compared the electric resistance of wire 0.45mm. in diameter, in this state, with that of the same wire in the ordinary state. The limit of temperature was here 300°. The ratio of resistance of the ordinary to the crystalline wire was found on an average to be = 1.0302 : 1, showing a decrease of the latter about 3 per cent. The change of volume through heating must here have been inconsiderable. Herr Kalischer draws attention, however, to the fact that the separate results in the series of experiments are too divergent, and he

attributes this to the great extensibility of zinc-wire.

Some other physical properties of zinc rendered crystalline through heat the author hopes shortly to investigate.

"More important," he proceeds, "is the question, whether other metals show a behaviour similar to that of zinc. I have therefore examined, from this point of view, plates of copper, brass, iron, and aluminium, but without being able to demonstrate crystallisation. I do not, however, regard this matter as closed; the less so, that in the case of iron, when heated to a red glow, there appear to be some traces of crystallisation; and that rolled copper, when heated to an initial red glow or more, always loses its ring, like zinc. Copper, it is known, becomes soft through heating; but the loss of the 'clang' cannot be attributed to this, for brass or aluminium also become soft through heating, and yet their 'clang' continues unaltered. Thus the view gains, probably, that copper also may behave similarly to zinc, and perhaps I have merely not yet found the right corrosive liquid for proving the crystallisation in copper. The use of dilute acids gave a negative result. For the rest, it would not be very surprising if other metals were not easily found, which present the phenomenon described in the case of zinc, as this metal is known to have an extraordinary tendency to crystallise in solidifying. The case may be conceived to be, that zinc loses, in rolling, the crystalline structure which it acquires in solidifying; and, if it be heated to a temperature exceeding that which it obtains in rolling, it gets back the crystalline structure. Cadmium offers the greatest likelihood of a behaviour similar to that of zinc."

What led Herr Kalischer into this investigation was the observation, that when a zinc strip, coated with graphite on one side, was immersed in sulphate of copper solution, and the precipitated copper was afterwards washed off, the metallic surface was become crystalline. Thinking, first, it was a galvanic phenomenon, he said to himself, that in that case, the more convenient lampblack must have the same action. The result corresponded to expectation; and having blackened the zinc on one side in a flame, and written in the lampblack, he obtained the writing in crystalline form by means of the sulphate of copper solution. It was only after he observed the loss of "clang," and the "cry" of zinc, that he came to be of opinion that heat was the cause of this phenomenon, as he remembered that for attachment of the graphite he had covered the zinc with shellac solution, and passed it several times through the flame to get the right consistency. That the lampblack had no influence, he convinced himself, on applying it as cold as possible, the zinc being held at a distance over burning camphor. There was then no trace of crystallisation.

THE MICROSCOPE AT HOME.*

THE title of my lecture will no doubt suggest the idea that it is not my intention to give a high and dry scientific dissertation on the microscope and its uses, although such might fairly be expected from one who lectures before a purely scientific society like the one I have the honour of addressing. Scientific microscopy necessarily forms an almost daily part of your natural-history work, and I am afraid that, when such is the case, the microscope begins to be regarded purely as a working tool, and its uses as an instrument in promoting social pleasures and general education are lost sight of. That no branch of natural history can be thoroughly studied without the use of the microscope is, I think, generally admitted; but I am disposed to go further, and say that no education is complete which has not been aided by the microscope; and even further still, and say that no instrument, hardly any book, has such important educational value, or conduces more to the education of the higher mental faculties, and at the same time leads itself to the purely so-called recreative phases of life, and whilst it is a working tool for our working hours, is the most interesting companion of our playtime.

My idea of the "Microscope at Home" includes two lines of thought arising out of my notion as to what a home is and should be. The Englishman's house long since was defined to be his castle, into which no intruder could go without lawful warrant, and in which the Englishman himself was safe, and free to follow his own devices. That definition has been held to be a purely English and an insular notion. Probably, even at this moment, it holds good if extended to English-speaking peoples. The word home is, however, still more strictly English; it has no definition. An Englishman's "home" is his *home*, and only a true Englishman knows what it is. For the purposes of my lecture, I will take it that you can all define it for yourselves as a place which, amongst others,

has the attribute that it is the place where you are happy with your wife, friends, or children, not free from the cares of life, perhaps, but with those cares sweetened and softened by the influences around you. The truest home is that of the man in his own family circle with his wife and children, and in such a home I suppose my microscope belongs. What are the conditions in which it finds itself? There is the man, the bread-winner of the family, with his hands and his head closely occupied all the day long in the endeavour to secure sustenance and comfort for those he loves. His day's work done, he requires rest of body and change of thought. If his labour be chiefly mechanical, he will find his rest in intellectual work; if chiefly mental, he will find his recreation in light mechanical work, entire change of mental occupation, and perhaps best, in the observation of beautiful things that evoke his powers of imagination, and draws out the poetry there is in him. The man, troubled about many things, vexed and worried with the many details and petty trials which his daily round of unvarying monotony, and which the average man despises as trivial, he could not endure for an hour himself—such a man, and such are almost all wives, requires change of society, talk about things out of herself and her surroundings, and above all, to have another in the quiet eventide a happy group of husband and children engaged in some common employment in which she herself can take her part how and when she chooses. She does not want to play the prominent part—she has done that all day long; she does not want to lead the conversation, to find amusement for her children—she has had enough of that; she wants rest and quietness, without stagnation, and she wants society. Then there are the children, of ages between sixteen and five, the responsibility of the household, not its "incumbrances." The future lies wrapped up in the present. What "likes" and "dislikes" are now will largely determine their after-life. Whatever else education includes, it comprises that much. It is probably all attending school acquiring "three R's" with their ramifications, and, on Saturdays, Sundays, and holidays, have no time for play or amusement; their time is all occupied in the work of being "educated," as a word I detest, because so grossly misapplied, but, nevertheless, they find time to acquire taste, i.e., a liking for something, and it rests with their parents, whether these tastes shall be of high or a low type—of the body sensual, or of mind spiritual. Whilst it would obviously be much to claim for science that it is the only, even the chief, means by which the tastes can be cultivated, we may claim this, that the tendency of scientific study is to raise and develop the intellectual powers, and when other means are able to ennoble the mind and place it on a very high level. What I have to do, then, is to take the microscope as an instrument engaged on a mission of culture, and apply it to the circumstances indicated; make it at once conducive to the education and recreation of the elder, the amusement of the younger, and an educational agent to all. It perhaps, may best be done by imagining ourselves for the time being as forming such a family group, with all sorts of likings, in all stages of intellectual development, and with a certain practical vein running through us prompting us to ask the ever recurring question, What is the good of it?—i.e., the ever-making good of it? One word about the last sentence. Science has been much hindered, and scientific men much pestered with that old spirit we Englishmen take such pride in showing for ourselves, and Science has so abundantly answered it, that perhaps the danger of the next generation may lie in a too complete neglect of the principle underlying it.

Our text now is amusement and recreation, education, money-profit. We will restrict ourselves within the limits allowed by the use of a five-guinea microscope: we will, as much as possible, avoid all technicalities, and we will only examine such things as are likely to be found near an average household, or a not very distant pond.

We will take a gathering from the pond first, and shall probably find in it the wherewithal to touch our threefold text. For the sake of the children we will look out for an interesting object first, and so select a piece of water-weed, which we place on a glass slip having a hollowed-out cell in it, or preferably in a small zoophyte-trough, for examination under a moderate power, say an inch or an inch and a half objective. We have been fortunate enough to secure with other things a fine specimen of *Meliceria ringens*, one of the most interesting and almost the loveliest of our fresh-water animals. Charles Kingsley's words may best describe it to the youngsters. "There was one wonderful little fellow, too, who peeped out of the top of his house built of round bricks. He had two big wheels and one little one, all over teeth, and

* A lecture delivered before the Wakefield Naturalists' Society, February 1, 1882, by HENRY FOCKINGTON, F.R.M.S.

land round like the wheels in a thrashing-machine; and Tom stood and stared at him, to see he was going to make with his machinery. And do you think he was doing? Brick-making. His two big wheels he swept together all the high-floated in the water; all that was nice in it into his stomach and ate; and all the mud he to the little wheel at his breast, which really round hole set with teeth; and then he spun a neat, hard, round brick; and then he took it on the top of his house-wall and set it to make another." With this brick-making fellow we, perhaps, may see, with Tom, flowers, too, in thousands, which, when to pick them, draw themselves in and turn into jelly; little flowers standing alone, under stalks, with lily bells when fully out, but retracting at the slightest alarm by drawing their stalks into spirals. These flowers, as all see, if we closely examine them, are wheel-bearers also; but they are not brickmakers. We look minutely into the two organisms, all see that whilst they have a few things in common, they differ widely in detail, and that the one of the brickmaker is vastly more complicated than that of the lily-flower (vorticella). We almost certainly find other wheel-bearers (are) in our gathering—notably the common (R. vulgaris) either swimming with his expanded, rooted by his foot, or crawling and tail-fashion along a weed, or on the glass. We also be fortunate enough to discover a dweller, such as Floscule, with his finely d arms glowing with iris colours in the field of microscope, when light is sent obliquely at it; or the more rare and prince of rotifers, significant Stephanoceros (Eichornii), with its long tentacles beset with tufts of short, bristly and body inserted in an almost transparent oval cell. If we are fond of the beautiful, creatures will occupy us all the evening; but to-morrow we will look more closely at the wheel-bearers. The first thing we notice is that the so-called s are really fine hair-like things, which we see. They are almost constantly in motion, giving the water with such rapidity that the eye is deceived, and we suffer an optical illusion. Looking our rotifer a little more closely—not exactly, because that would deprive you of the unity of doing so, were it possible for me to do either my present knowledge or the time at disposal—we have, first of all, to disabuse our of the notion that the little hairs are hairs; for we shall find, on carefully examining that they in no way differ from the living of the animal: of its protoplasm—to use a we shall have to use more fully presently: are merely "protrusions of the more active al protoplasm" of the cells. These cilia are means confined to our wheel-bearers. We find them in some part or another of all life, from the highest to the lowest, and in portions of some plants at some stage or in their life-history.† We next notice in our : two little red spots, situate on a prominence on the wheels. This prominence may be called the head of the creature. In it are set the very rudimentary eyes (the red spots), nervous system, "certain spots beset with tactile bristles, as well as a tubular process, called respiratory tube," all receiving nerves probably, sensory organs. Beneath this sense is situate an organ which at once attracts attention, from the fact that it is constantly in motion. This is the so-called gizzard, and was fully studied many years since by Mr. P. H. and consists of several parts enclosed in a large bulb situate between the funnel-mouth and a tubular canal which serves as a stomach. Three principal parts are a pair of organs lying on a third like a hammer on an anvil. "Hammer" consists of two parts placed at right angles to each other: the one the "blade," the other the "hook," furnished with like processes at the edge, where it meets the food; these processes are five or six in number and are set parallel to each other, like teeth in a comb. The anvil also consists of distinct lateral portions—viz., two stout "branches" resting on what seems to be a slender stalk, termed the fulcrum; when viewed from above, however, the fulcrum is seen to be a single, having the "branches" so jointed to the fulcrum that they can open and close like the jaws of shears. The "hook" of each hammer is connected with it by a stout triangular s. The function of this organ is obviously to crush up and disintegrate the food which is into the mouth-tube by the little whirlpool sed by the vibrating cilia, the food being then

passed into the simple stomach, and thence, what remains of it, out of the anal aperture. A few general notes on rotifer structure, and I must pass on. First, the rotifers have no heart; there are no specialised organs of respiration, the male rotifer has no stomach, they are much smaller than the females, and are much fewer in number. Rotifers are either solitary or social, chiefly inhabitants of fresh water, but a few are marine—a few are found parasitic on animal or vegetable organisms. One genus has neither anus nor intestine; some live free, and are generally furnished with a segmented and sometimes telescopically-jointed foot, usually terminated by two styles, which can be approximated or divaricated like pincers, and serve to anchor the body; and finally, the exact position of the group in the scale of being is hardly yet definitely settled, and in many ways there is ample room for careful work to be done in the investigation of them by such of us as desire to relieve the cares of life by a change of work in our leisure hours.

The next object to which I will call your attention whilst we are in our educational frame of mind, is something that does not look like anything so much as a tiny spot of dirty jelly on the stage. We can only just see it with the inch objective, so we'll view it with a 1/4 (if we have one) and recognise our find as the *proteus animalculus*, so called because it is ever changing its shape. It is known in science as the amoeba, an animal of almost the lowest grade.* Our careful examination, we find that though the general character of the amoeba is that of a structureless jelly called protoplasm, more or less granular; yet, towards its outside, it becomes clearer and more transparent, and of a firmer consistency. Watching its changes of form, we observe that they are produced by the protrusion—now from one part, now from the other—of finger-like prolongations of the external portion; these prolongations are called pseudopodia, and differ only in degree from the filia found in the rotifers and other animals. Sometimes "a particular region of the body is constantly free from pseudopodia," and, therefore, forms its hinder part when it moves. Each pseudopodium is evidently, at first, at extension of the denser clear substance only; but as it enlarges the central granular, more fluid, matter flows into its interior, often with a sudden rush. In some amoeba a clear space makes its appearance at intervals in a particular region of the external matter, and then disappears by the rapid approach of its walls. After a while, a small, clear speck appears at the same spot, and slowly dilates until it attains its full size, when it again rapidly disappears as before. Sometimes two or three small clear spots arise close together, and run into one another to form the single large cavity. The structure thus described is called the "contractile vesicle," and its dilatation and contraction often succeed each other with great regularity. What the function of the vacuole is has not yet been determined. There is nothing like a bounding membrane to the body; a substance may be passed into or out of it, the body opening as it goes in, and closing as it is removed. It feeds by flowing or creeping over various substances which enter the body, if alimentary, they are absorbed; if not, they are extruded in process of time, or left behind as the amoeba moves. The creature is susceptible of stimuli. A weak galvanic current causes it to assume a spherical form, from which it recovers in time. A strong current kills it (Huxley); we have here, in short, living matter in nearly its simplest form, uncomplicated by its environment and unspatialised.

In our bottle of water we may very likely find little green bodies (more probably if we take a bottle filled from a long-used rain-water tub). They are rather small, 1-350 to 1-10,000 of an inch in diameter. Examining them closely, we find that they consist of a transparent, structureless membrane, composed of a substance called cellulose (the same material as cotton fibres are made of) in the form of a sphere, enclosing a viscid granular substance, in which are embedded granules coloured either red or green. The granular substance is identical with the granular substance forming the entire body of the amoeba; the green or red granules are of a more or less waxy nature, and are called chlorophyll granules (because the green colour of leaves is due to similar granules). The presence of these coloured granules, and the investing wall, form two marked points of difference between the amoeba and the protozoous we are examining; the point in common is the granular substance, called here, as in the amoeba, protoplasm. In the specimen of protozoous under view we can detect no motion in this substance; but, if we watch day by day, we shall find that it divides into two and four; that, round each of these divided portions a membrane is formed; and

that, finally, four protozooids are formed by the subdivision of the first one. Again watching and examining day by day the contents of our bottle, we shall find individual protozooids in which the protoplasm has withdrawn itself from the bounding membrane at all but two points, where it protrudes through the wall in the form of long cilia, and, by the lashing of these cilia, the protozoous is propelled with a rolling motion through the water. Sometimes the cell-wall entirely vanishes, and the naked protoplasm swims about free.

One more look at the contents of the bottle of water, and we must pass on. We take a leaf of the American water-weed, which is so abundantly found in our rivers and canals, often to the vexation of boatmen and fisherman. Placing the leaf on a glass slide, and examining it with the highest power available (jin. will do), we find that it is composed of little square, oblong, or oval cells, passing into almost circular cells at parts. Each of these cells is bounded by a transparent wall, like that in protozoous, and inside the wall is a mass of viscid protoplasm, in which are imbedded green granules, as in protozoous. This is all we notice at first, except, perhaps, that we observe that the green mass does not come quite up to the cell wall; but as we watch, we see that the contents of the cell begin to move; that, soon, there is a steady procession of green granules along the sides of the cell, up one side, across the end, down the opposite side, across the end, and up the side again; in contiguous cells the same thing goes on, not always in the same direction as in the cell first seen, but in all cells the circulation or procession is restricted to the cell in which it originates; no granule goes from cell to cell. With a very high power we should see that the moving granules are floating in, or carried by, an almost clear and transparent fluid (protoplasm again), which streams along the cell-walls between them and the central mass of the cell. We can poison this protoplasm and we kill it. We can send a weak galvanic current through it, and we quicken its course; we can send a mimic flash of lightning through it from an induction coil, and we stop its march, as the walk of a man is stopped by a flash from the thundercloud; but examine it as we will, analyse it as we may, we can neither tell what causes the motion or the exact composition of the fluid which moves. Here, as in the case of the amoeba, of the protozoous, and many times in our observations of living plants and animals, we find ourselves, as it were, face to face with the mystery of life—we reach "our utmost, and it is veiled." If we had time we could describe this same phenomenon of streaming protoplasm in the stinging hairs of the nettle (made classical by Huxley), in Tradescantia, in the hairs of various thistles, and in other plants; and, as has been so well done by a member of the family to whom Science owes so much, experiment upon them by stimuli and foods of various kinds; but I must pass on, only asking you to work the subject out for yourselves, and further, to apply the knowledge you thus gain of protoplasm, and its phenomena, to the observation of the structure of animals and plants generally.

(To be continued.)

HOW SPIDERS FLY.

By PROFESSOR C. A. YOUNG.

I WAS very much interested, a few days ago, in hearing a friend give an account of a manuscript she had seen, which was written by Jonathan Edwards when nine years old. It was an account of the behaviour of certain small New England spiders, the manner they fly through the air, and the way to see them best, by getting into the edge of a shadow, and looking toward the sun. It is neatly and carefully written, and illustrated by little drawings, very nicely done. The philosophical tendencies of the young writer already appear, for his conclusion as to the "final cause" of spiders and their flying is this: the little animals are scavengers, and since, in New England, the prevailing winds are west, they are carried to the sea in their flight with whatever filth they have consumed, and so the land is cleansed.

Every one knows how, in sunny weather, the little creatures, standing on their heads, project from their spinnerets fine filaments of gossamer, which are caught by the breeze, and float off into the air, though still attached to the spider. When she perceives that the thread is long enough, and the pull of the wind sufficient, she releases her hold and flies away on her gossamer like a witch on her broomstick; by watching her chance, and letting go only when the breeze is favourable, she is carried to her desired haven. Experiments have been tried by placing the animal on a chip floated in a pool of water. So long as the air was in motion about them they were able very soon to escape from their island; but when a bell glass was placed over the

* Vallisneria is far better, but is not found in our coast all houses.

† Carpenter "On the Microscope"; Rolleston's "Of Animal Life"; Huxley's "Anatomy of Invertebrates," and Scott's "Articles in the Microscopical

† antherozoids of ferns, nauplius, &c., and in most cases.

† Rolleston, op. cit. CXXXIX.

* For the best account of Amoeba, in popular language at all events, see Huxley and Martin's "Elementary Biology," vol. 16 (1875 ed.). See also Schäfer's "Article Histology," in Encyc. Brit., 9th ed.

† Chiefly abridged from Huxley and Martin.

rail, thus preventing air currents, they could not get from the island to the surrounding shore.

But how does it happen that, on setting out for a voyage, the spider almost invariably ascends with her web, and continues to rise, until, by pulling in her thread, she reduces her floating power, and so comes down? Spider-web, in and of itself, is no lighter than air, how, then, is its buoyancy to be explained?

In two ways, I think. When the sun is shining, every projecting object, like a twig or stick, absorbs heat more rapidly than the air, becomes warmer than the air, and thus acts like an independent source of heat in generating an ascending current, so that when the spider lets go her hold she and her thread are carried up partly by the action of this current.

But this is not all. Unless I am much mistaken, the action of the sun's rays on the thread itself and its surrounding envelope of air is the main cause of its buoyancy. Air is nearly diathermanous, or transparent to heat, so that the solar rays, in traversing it, warm it only slightly. The spider's thread is not so; but in the sunshine warms up almost instantly, heating the air in immediate contact with it; and then, although the spider thread alone is heavier than air, yet the thread and adhering envelope, of warmed and expanded air taken together, are lighter than the same bulk of the cooler air around, and thus constitute a quasi-balloon, on which the spider sails away. Of course, if this is so, the poor creatures cannot sail much on cloudy days, and I think, in fact, they do not.

I have tried a few experiments to verify the idea, and so far as they go they all confirm it. For instance, one day in the autumn of 1880, when the air was full of floating gossamer, and there was no wind blowing, I caught some of the filaments at the end of a little stick, to see how they would behave. So long as I stood in the sunshine they streamed straight upward, tugging with almost a breaking strain; as soon as I stepped into the shadow of a building, they lost their spirit, and dropped abjectly; the moment I put them in the light again they resumed their buoyancy. It is of course possible that in the shade there were local downward air currents to account for their behaviour: but once a cloud passed across the sun, and they dropped then, just as they did behind the building.

The same theory will explain the buoyancy of any minute particles of dust or smoke. So long as the sun shines, they will absorb its rays, become warmer than the air, and surround themselves with a buoyant envelope, which will carry them up, if they are not too heavy in proportion to their surface. But if the air is still and the sun obscured, they will settle down near the earth, in the way we are all familiar with in muggy weather. Of course, if there is much wind, this will mainly control their movements, and neither their buoyancy in sunshine, nor their gravity in shadow, will be particularly noticeable. — *Boston Journal of Chemistry*.

USEFUL AND SCIENTIFIC NOTES.

Storm Warnings.—M. Dufourcet informs us, in *Les Mondes*, that he has in his yard two bars of iron planted in the earth, to which is fixed a conductor of coated copper wire terminating in his receiver, apparently a telephone. These he says, never fail to give notice twelve to fifteen hours in advance of every storm which bursts over the town.

Colour of Water.—The colour of water forms the subject of a recent inaugural dissertation by Herr Boas, in Kiel (*Wied. Beibl.* No. 11). After reviewing previous observations, he describes his own experiments, the first of which were qualitative, sunlight being sent through water in a zinc tube about 46 ft. long, closed with glass plates. Distilled water thus gave a fine deep blue-green colour: the red was quite gone, the yellow feeble, while the maximum brightness was in the green. Water of the Kiel supply let no light through the length of the tube stated; with half the length it appeared deep orange; blue and green failed. In his quantitative experiments the author illuminated two screens with the same light-source (sodium light or a gas-flame), before which was placed red glass, or sulphate of copper solution. The light from one screen went through water in a tube; that from the other along the tube outside. Both beams were brought into a position for comparison by means of total-reflection prisms; the screens were shifted till equal brightness was reached, and from their position the coefficients of absorption could be approximately inferred. The decrease of absorption towards the blue in the case of distilled water is thus clearly shown. Herr Boas further studied the polarisation of the light issuing from the water, by depolarising it. It was weakly polarised in a plane passing through the sun and the direction of the beam. Experiments with a view of detecting fluorescence had a negative result.

SCIENTIFIC NEWS.

ANOTHER small planet—the first for 1882—was discovered by Dr. J. Palisa at Vienna, on the 18th ult. It is No. 221. Dr. Palisa has given names to the four planets he discovered when at Pola in 1879. Their numbers and dates are, No. 205, Oct. 13; 207, Oct. 17; 208, Oct. 21; and 210, discovered on Nov. 12. The names are, respectively, Martha, Hedda, Lacrimosa, and Isabella. The *Astronomische Nachrichten*, No. 2412, contains the results of a large number of observations of the small planets made at Düsseldorf last year by Dr. Luther, and some by M. Pomerantzoff at Tashkend.

The American Association for the Advancement of Science will hold its annual meeting in Montreal during the week commencing Aug. 23, under the presidency of J. W. Dawson, LL.D., F.R.S. The Allan and Dominion Steamship Companies have placed at the disposal of the local committee a number of return tickets at reduced rates between Liverpool and Quebec, and it is hoped that they will be utilised. Those who can make up their minds thus early to take a pleasant trip should communicate as soon as convenient with Dr. T. Sterry Hunt, Montreal.

The exhibition of photographic apparatus and specimens at the rooms of the Society of Arts is attractive alike to the student of the art of photography and to the general public, for while the former is interested in the display of instruments and other appliances, the latter find pleasure in examining the beautiful specimens of the art. Scientific men will be interested in the exhibits of the Physical Observatory at Meudon, and those of Dr. Huggins. F. Galton, F.R.S., shows his composite portraits, the Kew Committee specimens of the tracings taken by the meteorological instruments at Kew, and the School of Military Engineering some special apparatus, including one for measuring the height of clouds.

At the general meeting of the Liverpool Association of Science and Arts, held on the 2nd inst., Mr. T. Farmer, F.C.S., read a paper on Lubricants, an abstract of which we shall probably give next week. Mr. E. Carter delivered an interesting lecture on Microscopical Pond Life. The Association has a very promising list of papers to be read, and we note that at the second concert to be given on the 16th inst., the "Cat's Fugue" will be given by Mr. W. H. Davies, on an upright spinet, copied from an antique model by his firm expressly for the occasion. The fugue was suggested to Scarlatti by a cat walking across the keys of his harp-ichord.

One of the telephone patent cases has been settled; the United Telephone Co., who hold Bell's and Edison's patents, obtaining judgment against McLean, of Edinburgh.

The case of Otto v. Linford, settled in favour of the plaintiff, will long be remembered for the clear and elaborate exposition of Patent Law given by the Master of the Rolls, and Lords Justices Brett and Holker.

An interesting lecture on the use of gas as a workshop tool was delivered by Mr. Thomas Fletcher, to the Manchester Scientific Students' Association on the 1st inst. It has been published at Warrington by the *Guardian* Works.

The exhibition of the Stanley Bicycle Club opened in the galleries of the Agricultural Hall on the 9th inst. The ground-floor is occupied with the Sportsman Exhibition, which has been extensively patronised by the representatives of sport and those who supply the various requirements, from carriages to cricket-bats.

Col. Laussedat, Director of the Conservatoire des Arts et Métiers, Paris, has issued a programme of the lectures on applied science which are to be delivered, free of any charge, during the present session. They are as follows:—Col. Laussedat on Applied Geology; M. de la Gournerie, Descriptive Geometry; M. Tresca, Mechanics applied to the Arts; M. E. Becquerel, Applied Physics; M. E. Trelat, Civil Construction; Prof. Pélignot, General Chemistry; Prof. Aimé Girard, Industrial Chemistry; Prof. de Lugnes, Chemistry applied to Dyeing, Glass, &c.; Prof. Bousisingault, Agricultural Chemistry.

The phenomena of explosion, lately studied by M. Berthelot, invite attention to an undulatory movement in gases that is quite distinct from a sound-wave. The velocity of the sound-wave depends merely on the physical nature of the gas; but in "the explosive wave," which travels at a different rate, it is a change of chemical constitution that is propagated. In an oxyhydric mixture, while sound travels at a velocity of 514 metres, the explosive wave has a velocity of 2841 metres. The principal properties of the explosive wave are briefly these:—(1) It is propagated uniformly; (there may be slight perturbations at the ends of the tube). (2) The velocity depends essentially on the nature of the gaseous mixture, not on the material of the tube. (3) The influence of the diameter of the tube is manifest in capillary tubes, the velocity being reduced in these; but the velocity probably becomes less and less dependent on the diameter, the wider the tubes. (4) The velocity is independent of pressure (at least between 1 and 10). M. Berthelot investigates, in his paper to the French Academy, the theoretical relation between the velocity of the wave and the chemical nature of the gas, and finds the experimental results in harmony with those of theory. It would seem that in the act of explosion a certain number of gaseous molecules in the section first inflamed are driven forward with all the velocity corresponding to the maximum temperature developed by the chemical combination. Their shock causes the propagation of the latter to the next portion, and the motion is successively reproduced with a velocity equal, or at least comparable, to that of the molecules themselves.

A schoolmaster in Nice, M. Fournier, has instituted among children a *Société protection des Produits de la Terre*. The members are to devote some of their leisure hours to destroying injurious larvae and protecting useful birds. Lemures are elected and prizes awarded. The operations of this society are indicated by the following figures:—From April 1 to Aug. 1, 1881, the members destroyed 4,555 beetles, eggs, representing no fewer than 1,368,540 larvae; 134,328 cabbage larvae; 1,583 grasshoppers; 629 butterflies; 56,911 slugs and snails; 1,274 grubs; and 35,721 insects of various kinds. This is perhaps a doubtful kind of penance to encourage boys in (who are not conspicuous as a class for tenderheartedness); but the other section of the society's work may be confidently commended. While the total of insects destroyed was 1,665,578, the members succeeded in protecting 96 nests with 329 birds.

The danger of fire in theatres has vividly impressed the public mind of late, and proposals of reform are rife. The question of forbidding the use of gas in Paris theatres gains in importance (*L'Electricité* says) every day. It appears that nineteen fires have occurred in those theatres from 1826 to 1881, or 55 years (excluding those due to criminal acts.) Notwithstanding careful precautions and surveillance, of seventeen fires in the provinces, fifteen have been since 1860, when gas came into use. The *Gazette* has proposed, for rapid extinction of fires, that boilers should be kept near the theatre, and at full pressure during the performances; steam-pipes being led to the more dangerous parts of the building. The *Deutsche Industrie Zeitung* advocates a largely extended use of iron and other metals, in place of wood, in the construction of theatres.

The wonderful wooden tunnels, or snow-sheds of the Pacific railway, cover forty miles of the road. They are of two kinds, one with very steep roofs, the other with flat roofs; and are firmly made to support the great weight of snow, and resist the rush of avalanches. Corrugated plates of iron separate the buildings into sections (as a precaution in view of fire), and in the great ten-mile shed there are automatic electric fire-alarms. At the summit is an engine and tank always ready to flood the ignited spot in an instant. The sheds cost per mile \$,000 to 12,000 dollars; and in some places, where heavy masonry was needed, as much as 30,000 dollars. While these sheds shut out a grand view, travel without them would be impossible. Sometimes five feet of snow falls on them in a day, and often thirty feet lies on the ground at one time. In many places snow accumulates to a depth of fifty feet above these great wooden arches.

An interesting physical application of the microphone has been made by M. Serra-Carp-

termining, that is, the position of the nodes ventral segments in a sounding-pipe. To the elastic membrane on a small ring is attached a light rod of graphite, one end of which is oscillate in a hole made in a small piece of board, supported by a semicircular piece of board. When this instrument is at a node, it has a roll in the telephone, like that arising in induced currents. On moving from this along a segment, the sounds become further

The musical sound of the tube is not in the telephone. With a small ordinary phone (without membrane) introduced into a tube, one hears the musical note; but the instrument does not enable one to distinguish the note and the ventral segments.

An submarine telegraph line is being completed between Paris and Lyons (by Lyons), and it will be ultimately extended to Marseilles. The line is composed of three insulated cables, each containing seven distinct wires. It is divided into sections of 500 metres, and of rapid detection of any part needing repaired. The whole is inclosed in iron tubes 30cm. in diameter, buried at a depth of 2 metres. A military and strategic significance is attached by some to this scheme; but too difficult (*La Nature* says) to conceal a line for it to be long serviceable in case of war. Its real advantage lies in protection from atmospheric electricity and inclement weather (not to speak of malicious injury).

Standards kept in the Paris Observatory are the subject of a lengthy paper of historical interest, by M. Wolf, in the January number of *Annales de Chimie et de Physique*.

Remarkable lowering of the sea-level was observed at Antibes and neighbouring ports on the southern French coast. It was about 0.30m. (say 1 foot) and lasted about 10 days. (It is known that there is hardly any tide in the Mediterranean.) The shore was laid in parts over which small boats can pass, and various marine animals were seen by the direct solar rays. M. Renou, who wrote to M. Faye about the phenomenon, suggested an elevation of the barometer as the probable cause, but the latter ascribes the effect rather to the recent high atmospheric pressure. Particulars of this pressure, experienced in France, have been published by M. Renou. The maximum on the Paris coast occurred at 10 a.m. on January 10th, when 782.13mm. was registered; this corresponds to 786.92mm. at sea-level. With exception (viz., the observatory-reading of 782.13mm. on February 6th, 1881), this is the highest pressure that has occurred for nearly a century. M. Faye takes legitimate exception to the word *anti-cyclone* as denoting the state of the atmosphere to which the recent high pressure is due.

A combination of a quartz prism with a prism of benzene or benzolene (refracting 75°) is recommended as a very advanced method of observing the solar spectrum and spots or the reversed colours of the chromosphere. With one combination of extreme red light is eliminated; with the other extreme violet. He wishes the Venus transit committee would try the system with an astronomical transit, to verify the extreme precision and distinctness of the images thus obtained, and the enormous dispersion and the most exaggerated magnifying power. Irradiation is got rid of, the confusion produced by interference falls away (the light being monochromatic).

Get hens to lay well, it is often thought necessary to put them on a dung-heap. The advantage, M. Lemoine says (*Journal de Médecine*), is providing heat, and this is often lost, as hens get wet with the liquid manure about them. On the other hand, in seeking in the fowls spread out the dung and destroy its fertilising properties. The farm yard is soiled, and becomes dirty and repulsive. M. Pasteur's researches, prove that cholera is produced by small parasites deposited in the intestines; these are evacuated by the dung, and multiply in the dung-heap, and ally in the liquid round it. The dung-heap should be kept near the stables, &c., on an impenetrable or paved base, and surrounded by a little wall, which will prevent rainwater running away its valuable qualities.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the *ENGLISH MECHANIC*, 21, Finsbury-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made Payable to J. FASSBENDER EDWARDS.

* * * In order to facilitate references, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pitance of his, will undertake to write the whole body of physics: a vice from whence great inconveniences derive their original." — *Montaigne's Essays*.

REPORT OF THE HARVARD COLLEGE OBSERVATORY—THE TESTING, MOUNTING, &c., OF A 21in. TELESCOPE—THE SPECTROSCOPE AND METEOROLOGY—FINDING THE MOON'S POSITION, &c.—THE SELENOGRAPHICAL SOCIETY—SPECTRA OF METEORITES—OUTFIT FOR AN AMATEUR GEOLOGIST.

[19701.]—ANOTHER year brings its record of honest, zealous, painstaking, and valuable scientific work, in the shape of the Thirty-sixth Annual Report of the Director of the Harvard College Observatory, Professor E. C. Pickering. The report commences with a reference to the financial position of the Observatory, and its author expresses an opinion that any addition to the available funds of an established institution in full work must necessarily be indefinitely more valuable than the devotion of the money to the founding of a fresh one. He goes on to illustrate and enforce this by referring to the excellent work which has been performed at Harvard since the raising of a subscription in 1878 for the support of the observatory for five years; the fund thus created having enabled him as director to increase the number of his assistants, and so allow their work to be more advantageously directed. Truly this is a noble and praiseworthy form of endowment. Be it, though, carefully noted that it is wholly the result of private effort, and that the subscribers have given their money with a distinct and perfect knowledge of the objects to be effected with it. Professor Pickering has by no means whatever gone whining to Congress to "endow" him on the mendacious ground that the study of telescopic nebulae will enable him to predict hurricanes, or that commercial crises may be foretold by the methods of stellar photometry! He is too genuine and earnest a man of science to descend to such low arts as these; and his fellow-citizens, knowing right well that in providing him with funds, they are ministering to the interests of true science, are liberal from their own resources to an extent which is as praiseworthy as it is gratifying. It is time, though, to turn to the details of the work contained in the report before me. Beginning with Jupiter's Satellites, we find that 64 eclipses of Jupiter's Satellites were photometrically observed during the year 1881. In another branch of research carried on at Harvard, the observation of objects having singular spectra, the amount of work, from pressure upon the observers' time, and unfavourable atmospheric conditions combined, has been limited. It has, however, been found that the star L1. 13412 exhibits a spectrum of three bright lines, the second probably coinciding with the F line of hydrogen, while the two others were found in the spectrum of Comet 3, 1881. The star L² Puppis was found to have a banded spectrum; and, what is particularly interesting, the colour and spectra of two stars, one in Puppis and the other in Ursa Minor, induced the belief that they must be variables of long period, a prediction subsequently verified by observation. In the photometry of variable stars β Persei and D M 81°, 25 have been particularly studied, no less than 2,748 comparisons of Algol and ω Persei having been made. On one occasion 600 observations were made between the hours of 6h. 45m. p.m. and 3h. 30m. a.m. in one single night. In like manner 3,276 comparisons were made of D M 81°, 25, and 26. Elements and ephemerides of the various comets appear to have been computed by Mr. Chandler, as soon after their respective appearances as a sufficient number of observations could be obtained. On the work of the Meridian instruments generally there is no need for me to dwell here, as they differ in no important respect from those carried on in all standard observatories: a word may, though, be given to the Meridian Photometer, by the aid of

which the light of every star visible to the naked eye in latitude 42° 23' has been rigidly determined. About 76,000 measures have been made in all, 36,000 since Nov. 1st, 1880. The report concludes with a description of the system of time signalling, a list of papers issued during the year by the officers of the observatory, and some miscellaneous details as to the instruments, &c., belonging to the Observatory. A more interesting illustration of what may be effected by disinterested devotion to science than Professor Pickering's report affords, it would be difficult to discover.

As Mr. M. Herbert Bridle appeals to me in letter 19664 p. 496, I am very pleased indeed to render him such assistance as it is in my power to give him within the limits of a paragraph in a letter. First, then, let me answer his question concerning the Trapezium formed by the components of θ Orionis. There is nothing at all wonderful in seeing four stars in this with a power of 120 on a 2in. achromatic, inasmuch as the smallest star of the four is of the 8th magnitude. What is really very much more extraordinary is that Mr. Bridle should be able to divide Saturn's ring with so small an aperture. This speaks volumes for the excellence both of his instrument and his eyesight. He is, though, mistaken about seeing four of Saturn's Moons. Two of them, at least, must have been fixed stars. And now for his request for some really severe tests for his telescope. He may begin with Rigel, and see if he can detect the *comet*. I presume that he knows where to look and what to look for. γ Leonis will require a fine night and the highest power he possesses to see it double; and θ Leonis, a very pretty triple, will not be too easy. ζ Cancri (really a triple) he should see as a double star without difficulty. 66 Cancri will tax his powers of vision from the minuteness of the companion. My quarrel should get that most admirable little book, Webb's "Celestial Objects for Common Telescopes," he will find it a perfect mine of information on objects suitable for telescopes from 2in. up to 12in. in aperture.

No combination of lenses placed between the eyepiece of a telescope and the screen on to which the Solar image it forms is cast would make the latter sharper. It could only have the precisely opposite effect. The secret is to use as low an eyepiece as possible for this sort of work, and to cease to move the screen away from the eyepiece as soon as the image shows a tendency to become fuzzy.

With reference to the question concerning the circles of an Equatorial, the hour-circle must read XIIh. or XXIVh. when the declination on axis is level and the instrument is in the Meridian; and the Declination circle read 0° 0' when the telescope points to the celestial Equator. To find a star though requires, strictly speaking, a clock showing sidereal time—that is to say, the Right Ascension of the Meridian. Suppose, then, that we have such a clock, and looking at it at Mean Noon on February 24th, we find that it shows 22h. 17m. 3s. How are we to set our Equatorial to point upon β Cygni. The real Right Ascension of this star is 21h. 1m. 36s., and taking this from 22h. 17m. 3s. we get 1h. 15m. 27s. Causing the verniers of the Declination circle then to read 38° 10' N., and turning the telescope so that the hour-circle reads 1h. 15m. 27s. Past or west of the Meridian, the star ought to be in the field. Or suppose that on the same night we find that the Clock indicates the Sidereal time to be 6h. 30m. 14s., and we want to find Castor. The Right Ascension of Castor is 7h. 27m. 7s., and its Declination 32° 9'. Setting the Declination circle to this latter reading we merely take 6h. 30m. 14s. from 7h. 27m. 7s., and the R.A. of the Star being greater than that of the Meridian, now turn the telescope so that the hour-circle reads 57m. 53s. East of the Meridian, and then, as before, Castor should be in the field.

I think that Mr. Tippinge (query 45866, p. 605) will find information on the subject of Spectroscopical Meteorology in Vol. XIV. of the "Edinburgh Astronomical Observations." The use of a pocket spectroscope may be acquired in a period varying from 90 seconds to 4 minutes in the shop at which it is purchased. I believe that the Scottish Astronomer Royal is the inventor of the method. You look at the sky, and should rain be approaching, it is, I believe, alleged that numerous dark absorption lines made their appearance in the neighbourhood of B. As I never use a big, big B for this purpose, though, I am unable to say from personal experience how far this is to be relied upon as a means of weather prediction.

I am very sorry that I failed to be entirely intelligible and explicit in the reply to which "W. L. O." refers in query 45883 (p. 506). Now, in my turn, I cannot understand how by bringing the hour of new or full moon to the Greenwich meridian of his map, "the position of Sun and Moon at these times becomes known." As for the angular distance of the Sun and Moon, it means the angle subtended at the Earth's centre by a line joining the centres of the Sun and Moon. In practice it is measured with the sextant, the actual distance observed being that of the Solar and Lunar

Quinine will be given best to children by getting from a druggist some soft pills each containing one grain of quinine and made up with confection of roses. The pill, if put into a piece of bread and butter or into a grape, will be swallowed without tasting it. Or, if the child be laid upon its back and the pill dropped into its throat with one hand while, with the other, a dessert-spoonful of thin food or sweet milk-and-water be tipped in after the pill, the child will swallow it without trouble. This method of giving medicines to young children is better, then by way of powders, for if a pill be spit out another can at once be given, whereas with a powder there is no knowing how much has been swallowed and how much has been lost, and often it is not safe to repeat the dose, although, probably the child has not had what was intended to be administered.

As to lotion for such an eye, it is useless, and will probably only irritate the eye. Let the eye be kept closed and covered up warm, and thrice a day bathe it with warm water. The disease, although apparently local, depends for its cure upon constitutional measures.

ACNE (45894).—Acne is a very annoying and disfiguring disease which lasts for many years unless properly treated. But it is very easily remedied. It is a purely local disease of the skin, occurring generally at the period of adolescence, but sometimes lasting through life. The health should be carefully attended to; but that alone will not cure acne, which is a local obstruction of the sebaceous follicles of the skin. Among other appendages the skin is furnished with sac-like follicles, more or less branched, in the substance of the skin, but opening upon the surface of the skin by a tubular mouth. The function of these sebaceous follicles is to secrete fatty matter which oozes out upon the roots of the hair and upon the area of the skin surrounding each particular follicle. Upon the nose and skin of the face, and often about the cartilage of the ear, these glands are very large, probably to protect the exposed parts of the face. The secretion which they form is not oily, but greasy. At times, for want of proper cleansing of the skin, the orifices of these glands become blocked by particles of dirt, which are rubbed into the orifices and, combining with the dense fatty matter oozing from the orifices, produce obstruction. This obstruction of dirt and fat grows larger, and constitutes the black spot which is so disfiguring. The fatty matter secreted by the follicle thenceforth accumulates behind, distending the sacculus into a pouch, which, the larger it becomes the faster it grows by accumulation of fat from its lining membrane. Thus a little knob forms beneath the black point, and completes the first stage. In the scalp this stage often goes on till actual tumours are formed in the substance of the skin, and which may often be seen projecting as smooth lumps, as large as a walnut or larger, and often in groups of considerable numbers scattered over the scalp, and in all stages of growth. In the skin of the face they rarely grow to the size of palpable tumours, but remain as little knobs beneath the black point until the skin around them becomes irritated and inflamed and the obstructed follicle becomes the centre of a pimple. This inflames and breaks, and amidst the matter which it discharges will be found a white speck, which, under a lens, proves to be exactly like a minute bladder of lard, the neck of the bladder being represented by the black point at which the original obstruction occurred. The inflamed pimple, having burst and discharged itself, heals up like any other small abscess, leaving a permanent scar in its place, the sebaceous follicle having been entirely destroyed and extruded. Now, upon the face of a person suffering from acne may be seen these follicles in all stages of obstruction, inflammation, and residual scar, and by inspection every phase of the process which I have described may be followed if the description which I have given be fully understood. This process goes on until the skin of the face has had its follicles destroyed, and the surface is permanently damaged by minute residual scars; and during this process, which lasts for years, the face is continually in a state of pustulation, which is painful and unsightly. So much for the disease.

As to the remedy. For glands already pustulating, the only remedy is to let them run their course. But sometimes this course may be precipitated and shortened if the pustule be squeezed between two finger-nails so as to burst the pustule and force out the obstructed gland, which will be seen as a white core. This mechanical squeezing is better than puncturing with a lancet or needle. It is not more painful, and it is much more efficient. The pressure should be applied by getting the nails under the pustule, doubling the skin into a ruck, on the crest of which the point of the pustule is placed; and then, with an instant skilful pressure, out come the contents. For such follicles as have not passed beyond their first stage, that of simple obstruction and enlargement, there is often cure without destruction of the follicle, and without residual scar. In some cases shampooing the skin so as to roll the skin along in waves with firm kneading pressure upon the under

parts of the skin, applied so as not in any way to abrade or injure the surface of the skin, will have the effect of forcing out the obstructing plugs; and then, if night and morning this shampooing process be kept up, the distended glands will continue to discharge themselves freely, and will gradually contract and recover their original tone and dimensions. This process I have found to be vastly aided by greasing the face thoroughly with a little pure paraffin-lamp oil, which soaks in and liquefies the fatty matter at the orifices of the glands, where it is hardened to a waxy consistency and condensed by particles of dirt. If the paraffin be rubbed well into the skin at bedtime, and then in the morning the face be washed and shampooed vigorously with hot water and a firm, but not scratchy, towel, the obstructed glands may be entirely relieved. This process may be repeated twice a week until they have all disappeared. Of course, the action upon glands incurably obstructed, and about to pustulate, will be to bring them all rapidly forward. When the face is restored, the rolling, kneading pressure upon the skin should be continued at the daily ablutions, so as to prevent new obstructions arising.

To "KOSMOS" (45979).—My commenting upon a case of acute disease already under the care of two medical men would be unprofessional, and more likely to do harm than good. Get a consultation with some well-known physician near to you, who will arrange to meet your local medical men, and advise fully. After the consultation, when the physician delivers his opinion, you are entitled to ask for any explanation that you may wish for. The abler the physician the readier he will be to make everything clear to you.

James Edmunds, M.D., M.R.C.P. Lond.
Grafton-street, Bond-street.

THE CONSTRUCTION OF DYNAMO-MACHINES.

[19707.]—THOUGH the discussion on this subject has not been very lively, yet it seems already on the decline, and the vanity horse, the cycle, takes its place again. Serious readers will view this with regret. Electricity and its production is as worthy of the first place in our pages as any other. I am rather surprised that the dynamo has enlisted so few contributors. Is this due to a want of experience, to cross interests, to fear of criticism, to right down indifference, or to all these causes together? If so, they should not exist. Unless we commence, we shall never acquire experience. Those who are in the secret of construction need not be afraid of the dabbling of amateurs. No harm will accrue to their interests. On the contrary, if amateurs are led to keep up the excitement their interests will be promoted. As to criticism, I think most of us would be ready and willing to accept correction, if offered in a kindly spirit. Besides, few are as yet so well grounded on this subject as to be able to treat their less well-informed brethren with discourtesy.

We are far yet from the ideal machine. The dynamo of the future will probably be composed of the good points of the present ones with a good many more added. If every inventor rushes to the Patent-office with his new idea, it will become a rather difficult matter to compose this future machine. So many rights will have to be bought up, that the richest inventor will be discouraged. Patents may have their good effects on the development of industry, but they have also their bad ones. A. has no natural right to limit or trammel B.'s field of research.

I deem the present time especially appropriate to discuss the construction and merits of the different dynamo machines in our pages.

Before many of our readers will be able to properly profit by the great exhibition now opening, they will require a good deal of coaching. And to allow such a valuable and rare opportunity to pass without making the most of it would be a great pity. Those who must content themselves with a mere dumb admiration, without understanding how electricity, the great Prometheus of modern times, has been chained and made to administer to our daily wants, will have but a poor enjoyment, compared with those who are able to grasp the methods by which feeble man can command the forces of nature to do his behests.

Looking at the part the electro-dynamo machine will henceforth play in the social economy, those who can enlist their services in its promotion will have a chance of doing good service; so, like many others have done, I would invite them to come forward and help us with their knowledge and experience.

What has hitherto appeared referred rather to large machines, such as not every amateur can afford to experiment with. An outlay of some £20 or £30 on a mere trial of our skill, and that on a subject where we have had no experience, and but imperfect instruction, is scarcely advisable. Besides, it will require tools few amateurs possess. A fourth that sum might well be ventured, and, with

£5 outlay for parts and materials, a very interesting machine may be made, one that will light up fairly well an average room when driven by hand or foot power only. Such machines I have had and experimented with, and I, therefore, speak of facts, not mere theory or exaggeration. If no one better able will describe such a machine, I will do it.

A. Caplatzi.

[19708.]—In answer to "Questor's" letter, if he will look back, he will find my specification of weight of wire, &c., was for a machine to give a current of about 10 amperes through 4 ohms external R., that is with an E.M.F. of 40 volts between the binding-screws of the machine, and I calculate that this quantity of current should give a light of about 2,000 candles; at any rate, the "Brush" lamps with this current and E.M.F. are said to do so. My machine, at about 800 revs. per minute, gives a current of about 15 amperes with 50 volts E.M.F. But in giving particulars I thought a smaller machine would be generally preferred.

With regard to the R. of the lamp, I certainly do not see what difference in each lamp's R. can be made by having one, two, or three in series, provided, of course, that the machine is arranged to suit the different conditions, and the same current passes. Why should one lamp have a R. of 1 ohm and two have four times as much? It seems to me that if it costs 6d. to get through one toll-gate it would cost a shilling to go through two (unless there was a reduction on taking a quantity): it would not be more. But the R. varies with the size of the lamps. As far as I can gather from the few experiments that have been made, it seems that the E.M.F. required to overcome R. of any arc lamp varies through somewhat narrow limits—viz., from 35 to 40 volts. Now, it is evident that, if a current of 10 amperes passed, the R. will be somewhere between 3.5 to 4 ohms; but if the light be a large one, with a current of, say, 40 amperes, the R., to give an equal difference of potential between the terminals, will only be about an ohm.

A little consideration will show how the R. of a double wire is only one-quarter of the whole. If a wire having a R. of, say, 4 ohms, is halved, each piece has manifestly a R. of 2 ohms; but if the current is allowed to pass through both these pieces in parallel circuit, the R. must be again halved, and becomes 1 ohm, or one-quarter of the original R.

The failure of "Questor" to see this point explains the difficulty he has found with regard to Mr. Hanson's figures. The 1,200ft. of 15 B.W.G. wire would have almost exactly 2 ohms R., which, divided by 4, gives about $\frac{1}{2}$ ohm, as stated, the R. of the F.M. being the same, or $\frac{1}{2}$ ohm. There would be 1,300ft. of No. 8, or about 1,000ft. of No. 9, as "Questor" calculates, weighing, as he states, about 84lb. Now about the price. I don't know who "Questor" can have got his quotations from; but if he is one of the largest manufacturers, he must, indeed, be doing a good trade if he succeeds in getting 1s. 9d. a pound. I don't pay so much.

The machines of which Dr. Siemens speaks, in which the R. of the F.M. is made ten times that of the armature, are not worked on the same plan as that usually adopted; the F.M. form, in these machines, a shunt or by-pass circuit; and they are altogether differently proportioned.

In *Engineering* of January 20th there is a very complete description of a very nicely-designed Gramme made by the Spanish Electric Company, which for the weight of wire gives extremely good results. There is 24lb. of wire on the armature, R. 1.5 ohm; it must, therefore, be No. 16 B.W.G., or a little finer, and 140lb. on the field-magnets, with 3 ohms R.; this would, therefore, be about No. 12. This machine, at 1,300 revs. per minute, gave 5 arc lights, each having a length of 2.5mm. The power of the light is not stated; I suppose they would be about 2,600 candles each.

This is, as far as I have been able to discover, the best result for weight of wire that has been attained, the next best of which I have any record being the Brush 16-light machine, which has 160lb. of 14 wire on armature, and about 600lb. of wire on F.M., or 10lb. per light on armature, 37lb. per light on magnets, the Gramme described having only 5lb. per light on armature and 28lb. per light on magnets.

I hope this will help to put "Questor" on the right track, and I shall be only too happy to explain further any points he or any others may not quite understand.

R. P.

SOCIETY OF ARTS PHOTOGRAPHIC EXHIBITION.

[19709.]—By the kindness of Mr. H. L. Wood, Secretary of the Society of Arts, I have had placed at my disposal a number of tickets for the above exhibition, and it will give me pleasure to forward a ticket to anyone interested in photography. The exhibition is an interesting and instructive one, well worth a visit. I shall be there on Tuesday, the 14th February, and shall be pleased to receive

any of our readers. Letters addressed to me at Birmingham will be in time up to the 11th, after that at Ridler's Hotel, Holborn, London. I may add that the exhibition will be open from 10 till 4 o'clock.
W. J. Lancaster.

THE PATENT IMPROVED VELOCIMAN OR MANUPEDE.

[19710.]—In your issue of April 15 last year you gave a short description of this new tricycle. Since then many, both at home and abroad, referring to your publication, have written to ask me to describe the calculations on which I based the machine. I give them below. It will be exhibited by the makers at the Stanley show of bicycles and tricycles.

Let A B be the hand-lever, bent at the upper extremity, and having a movable fulcrum B; E O,



the crank; C B a radius-rod working on a fixed pivot C; D a treadle fixed on radius-rod produced. We have then two combinations of the lever and

the mechanical power of the machine, as far as each foot is concerned—namely,

$$\frac{R}{Q} = \frac{R}{Q'} \times \frac{Q'}{Q} = \frac{O E}{O F} \times \frac{D C}{G C} = \frac{5}{25} \times \frac{30}{21} = \frac{2}{7}$$

Now, in each revolution, each hand exerts its power twice—namely, when the crank is above the axle, and below it, and each foot once; so that when all are at work, we have the total mechanical power of the machine equal to

$$4 \times \frac{8}{15} + 2 \times \frac{2}{7} = 2\frac{2}{3} \text{ nearly.}$$

It is found, however, that, in working, it is best to use one foot only, while the other rests on a stretcher, as in rowing.

We can only estimate the mechanical power at its true value by comparing it with that of other tricycles calculated in the same way.

We will take an ordinary tricycle, with 50in. wheels and 5in. cranks, with the chain-wheels on the crank-axle, and the wheel-axle the same diameter, recollecting that gearing-up lessens the power at the same speed. We have here, then, a simple wheel and axle, of which the mechanical power for each foot is

$$\frac{5\frac{1}{2}}{25} = \frac{11}{50}$$

therefore the total mechanical power of the machine in each revolution is

$$2 \times \frac{11}{50} = \frac{11}{25}$$

The proportion, then, of the power of the two tricycles in favour of the Velociman, when one foot only is used, is

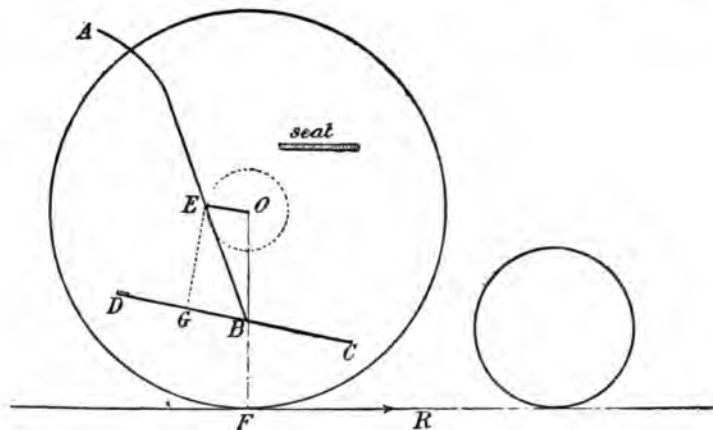
$$\frac{254}{103} : \frac{11}{25} \text{ or } 1270 : 231$$

i.e., a little more than 5 : 1.

It may be said that the feet are more powerful than the hands. This is granted, but we must recollect that equations (1) and (2) show us that the mechanical advantage of the hand-lever is nearly double that of the foot-lever, i.e., as 28 : 15. Then, again, one foot may be set against one foot, and there are four hand-powers to set against the other foot.

Can it be wondered at, then, that the Velociman will mount hills which no other tricycle can touch?

If anyone should wish to understand the action



wheel and axle—one for the feet and the other for the hands.

Let P represent the pressure of the hand at A
P' " power produced by it at E
R " resistance to be overcome acting at F
Q " pressure of the foot at D
Q' " power produced by it at G or F, which is in perpendicular.

First, for the hand, taking the moments at B,

$$P \times A B = P' \times B E, \text{ or } \frac{P'}{P} = \frac{A B}{B E} \dots\dots (1)$$

Then for the wheel and axle

$$R \times O F = P' \times O E, \text{ or } \frac{R}{P'} = \frac{O E}{O F} \dots\dots (2)$$

Compounding the ratios (1) and (2) we get the mechanical power of the machine as far as each hand is concerned—namely,

$$\frac{R}{P} = \frac{R}{P'} \times \frac{P'}{P} = \frac{O E}{O F} \times \frac{A B}{B E} = \frac{5}{25} \times \frac{40}{15} = \frac{8}{15} \text{ (see note below).}$$

Secondly, for the foot, taking the moments at C—

$$Q \times D C = Q' \times G C; \text{ or } \frac{Q'}{Q} = \frac{D C}{G C} \dots\dots (3)$$

and, as above—

$$R \times O F = Q' \times O E; \text{ or } \frac{R}{Q'} = \frac{O E}{O F} \dots\dots (4)$$

Combining the ratios (3) and (4), we get

of this tricycle, let him take an ordinary treadle-lathe, and seat himself above the crank-axle with his back to the bed, and let him suppose the connecting-rod between the crank and the treadle to be prolonged for the hand-lever. The treadle will represent the treadle of the machine, and the fly-wheel will represent the driving-wheel.

NOTE.—The figures here substituted are the measurements calculated to give the maximum mechanical advantage to the combinations. They are those of the first machine manufactured.

R. H. Charsley.

Oriel College, Oxford, January 27.

TRICYCLES.

[19711.]—I should have liked to have said a word or two on this subject ere this; but time did not permit. I, however, would like to very briefly touch on one or two points which have cropped up in the last few numbers of the "E. M."

To go back to No. 878, Mr. Blood gives us a brief description of a machine that he has ridden much, and with great satisfaction. Apparently, his machine is a modified form of the open front kind. With the great difference, that the small back wheel is replaced by a large driver. Now, when a gentleman with Mr. Blood's experience and knowledge tells us that he rides a machine of this kind, I take it that it is a very strong argument in favour of the open front and rear-steered

machines. Amongst the varied requirements in a good tricycle may be enumerated the necessity of having as large a percentage as possible of the weight on the drivers. And this Mr. Blood's machine evidently conforms to, as he tells us that "the seat is in part off and partly over the driver." Therefore, it is hardly to be wondered at that he finds it satisfactory. And to go further still, it is no doubt due to this fact that the "Salvo" owes its popularity. The rider is certainly placed well over his work; in fact, a little behind it, as he will quickly find, if he takes his seat fairly, by the machine "kicking up" in front, and gracefully subsiding on to the safety-wheel behind. From this fact alone, I would not ride a "Salvo" myself, as the over-balanced position of the seat would always keep me in a state of doubt as to whether the machine was about to pitch me off over the back of the seat or not. I take this to be a great point against this class, and in favour of the open-front machines. No doubt one can ride up hill or over obstacles better by practically standing on the treadles. But I must confess a great weakness for comfort, and this is, as far as the seat goes, best gained by the use of a rear-steered machine. I do not care to lean forward as if riding in a race all the time, neither do I care to walk on the treadle. On the contrary, I like to sit at ease on a well-cushioned seat, without fear of the steering-wheel lifting off the ground when one sits back in comfort. And, let me add, that the question of steering, which is an important element, cannot be so well gained by a machine that has so little weight on its steering as to tilt up so easily. What the result would be if, when running fast, the rider sat back, and thus lifted his steers off the ground, I will not predict. It might be as ugly spill, as the guiding-power would be, of course, gone for the moment. It may be all very well for racing men, but it does not come up to my ideas of comfort, and as I ride not for racing, but for health, pleasure, and business, I certainly agree with Mr. Blood and his type of machine.

"Clerical Bicyclist" asks a question that I have frequently put to bicyclists: How is it that in bad weather one never meets one, or very rarely? Does not this show that, with all its supposed advantages, it is not able to face all weathers and conditions of the road? I ride in all weathers, and through mud, or what not, whilst the gentlemen of the two wheels appear to fear to face the hard driving. The great question, in my mind, is, that what is wanted, is to so modify the tricycle that it should be able to run fast on good roads, and yet have plenty of power if passing through mud or slush. Hill-climbing gear partly meets the requirement; but not in the way I fancy it will eventually. And in Messrs. Ellis and Co.'s reply they touch on a point of great moment—viz., the improvement of the road themselves. Truly, this is greatly wanted. We want men of the MacAdam stamp; not the modern shallowpates who, at least in my district, spend the ratepayers' money, not in mending the roads, but in destroying all pleasure of locomotion.

Amongst the new forms of machine out this year is an arrangement applied to Messrs. Rudge's Coventry Rotary, in which the usual chain is used, but in a very novel way. The frame carries as extension with a forked end, which carries a short shaft and a pair of bicycle cranks, and the whole is so arranged that the real axle of the driver is brought to the centre of the machine. It appears to me to be likely to possess several advantages, inasmuch as that is a two-track machine, has as open front, and drives from the centre line. Some friend, in past numbers of the "E. M.," greatly advocated the old form of this machine. And the new arrangement surely must further add to its utility.

The question of single v. double drivers seems far from being settled yet. I should much like to try my hand on a really good double-driving machine. One that would enable one to pedal forwards, backwards, and yet, going down hill, allow the treadles to be used as foot-rests. But it must have the greatly-desired property of driving both wheels equally in a straight track, and not transfer the driving-power to the wheel doing the least work.
Sunlight.

LATHES AND LATHE-MAKING.

[19712.]—My attention has been called to Dr. Edmunds's rejoinder to a previous correspondent, appearing in your last issue.

Dr. Edmunds is well known as a physician of mark; he is also an enthusiast, as evidenced by the style of his letter, and, while I agree in much that he says, and would consider any of his utterances with respect, I venture to think he shows that he is not yet exhaustively acquainted with the vast subject of screw-threads, and that consequently he sometimes soars into the clouds.

I do not propose to enter into a discussion upon screw-threads, upon which prolific question so much has been already written and published, neither have I the time—my every spare moment being

devoted to Vol. V., which, Dr. Edmunds, I know, will be glad to hear, has now made considerable progress,—but I venture to trouble you with this letter to convey a word or two that I hope may afford the information your correspondent has been unable to obtain.

For about the last fifty years, Holtzapffel and Co. have made the threads of all their measuring and leading screws, and numberless others, aliquot parts of the inch; they have also made continuously the corresponding screw-tools from 4 to 100 threads to the inch, as part of their ordinary stock. Dr. Edmunds is correct in his views that our firm has never made any single thing an enigma, neither, on the other hand, do they propound conundrums, and I willingly answer his questions.

All the taps and dies designated and marked from D to U, are of J. J. Holtzapffel's twelve selected screw-threads. Table, page 673, Vol. II., "Turning and Mechanical Manipulation."—The two largest diameters, D and E, are both of No. 4 thread; the next largest, F, is No. 5; H and G are No. 6; I, J, and K are No. 8; M is No. 9; L, N, and P are No. 10; O and Q are No. 11; and the four smallest, R, S, T, and U, are all No. 12 thread. The letter is, therefore, simply a convenient workshop mark, and one that soon becomes familiar to the mind as representing both the thread and the size of the tap. That there may be something to be said in favour of these particular taps and dies—beyond their "charming" working, so gracefully alluded to by your correspondent—albeit they are not aliquot parts of the inch, lies in the circumstance that they are largely employed for those numerous cases for which Whitworth's threads of small diameters prove too coarse, as shown by an unabated demand for them from the Government, eminent engineers, and others.

Dr. Edmunds makes merry at some length on an insignificant detail, i.e., the numbers 1 to 6 marked on the screw-guides of traversing mandrills, and having quoted a foot-note from my fourth volume, asks questions, the replies to which I conceive are answered by that note. Further explanation is simple. Most ornamental turners find the six screw-guides, and the six pairs of screw-tools that match them, ample for their wants, and, therefore, desire to possess no more. The numbers 1 to 6 are only engraved as a matter of convenience to select, say, the coarsest or the finest at the first glance as the guides may lie in their case or drawer, and I have never heard that they have given inconvenience to intellects even far less acute than that of Dr. Edmunds.

To my mind one part of his joke falls rather flat—viz., "that the work may run at one pitch, and the screw-tool cut another, and so necessarily spoil the work." No one will deny the impossibility of cutting a screw when the screw-guide and the screw-tool are of two different threads; but most people take care that they are of one and the same before they begin, by the very obvious process of matching them; that is, applying the teeth of the tool to the threads of the guide about to be used, and observing that the one drop into the other. I might almost call this an intuitive proceeding, and it is certainly nearly invariable with guides or taps by practical men, and I hope I shall not be indecorous in reminding Dr. Edmunds that in the course of a recent conversation with him on the subject, he admitted that he "had never thought of that." May I now be permitted to thank you by anticipation for inserting these replies to your correspondent's queries.

John J. Holtzapffel.

64, Charing-cross, Feb. 6.

[Every reader will, we are sure, thank Mr. Holtzapffel for the above letter, and endorse our appeal to him to say a word or two occasionally in our columns, on the art of which he is the acknowledged master.—ED.]

ORNAMENTAL LATHE-THREADS—SPIRAL APPARATUS, &c.

[19713.]—I REGRET that Dr. Edmunds, in letter 19691, should have thought it right to stigmatise me as "a victimiser of my clients," simply because I do not make the nose of my lathes of the particular thread that he thinks the best, or use special screws for other purposes. As he has done so, I decline to have any further discussion with him upon this or any other subject. To our readers generally, I would say, in the first place, I was not asked to give the exact value of each thread, but simply what the meaning of the letters N., R., &c., were, and I did not give a page of details because I did not consider it necessary. I freely offered to lend the actual tools instead, and I cannot see that my papers have been in any way "degraded," as Dr. Edmunds asserts.

In answer to "Orderic Vital," relative to the fixing of the nut on to plate, the two screws which adjust the nut to take up the back-lash must be set up before the nut is drawn up tightly to the plate, both screws being on one side of the nut where it is cut. The best way to hold the nut to cut the groove is upon a steel arbor, with a nut upon the

end, and with a rose-end cutter in the drill-stock, the groove may be cut out very neatly.

In answer to "Spiral" (letter 19690), I can only say that it is my intention to finish the spiral as I said; but I have so many private letters asking for different illustrations, that I scarcely know which to do first. It may, however, be expected very shortly. The drawings, page 101, are half-size, and the wheels that are bored out to the 1½ in. diameter are all the higher numbers down to 48. If "Spiral" is making such an apparatus, and would like any information, I shall be pleased to help him in every way possible, and should advise him to call and see the apparatus at work.

J. H. Evans.

[19714.]—REFERRING to my letter on page 518, I find the printer has rather exaggerated measurements given by me with regard to the bore of certain wheels. My words were, "which numbers (wheels) are to be bored out to 1½ in.": not as stated, 1½ in. Spiral.

THE ARMSTRONG LATHE.

[19715.]—If Fred. Carre allows, as his letter appears to state, that the Armstrong lathe is to be understood to be a metal-working machine, then I am ready to admit that it will probably answer its intended purpose; and that if necessity compels to have many machines united in one, this is at least as good as any in the market. But what then? If we agree that of combination lathes this is even the best, it does not disprove the fact that all such tools are terribly costly, necessarily clumsy and inconvenient, and are generally condemned by practical workmen. Personally, I am too fond of mechanics and machinery not to feel great interest in all novelties, and am at the present time corresponding with one firm about the application of milling apparatus to a lathe; but here again difficulties arise which only a practical mechanic would foresee, and which need no little ingenuity to overcome. I think I may as well state that I have been corresponding with the Britannia Co., as well as with Major Armstrong, about this combination lathe; and its probable cost, as well as its merits and defects, have been subjects of discussion, so that Fred. Carre need not think I am counsel on the other side while he is for plaintiff. I have no wish to oppose its introduction, and, on the other hand, I should be sorry if Major Armstrong were to risk money by having it manufactured for sale, because I know it would be a hazardous venture to do so. Ingeniously-planned machines are not always marketable, for self-evident reasons. I fear that Fred. Carre has much mistaken the drift of my letters. He seems to think that I desire, for some reason, to write down this lathe and oppose its introduction. Probably my opinion would have little influence either way, nor do I desire such influence; but in discussing a new tool one can't avoid pointing out its weak points as well as its strong ones—and the weak points here are those I have laid down: prime cost; heavy apparatus to shift; and that a lathe made sufficiently massive to carry the various appliances intended for metal-working cannot very well be suitable for wood and ivory and ornamental apparatus. I do wish to turn penholders, shirt-studs, and 4 in. or 5 in. woodwork; also to bore a 2 in. or 3 in. engine-cylinder once in a way. Ergo, I know as a fact that a lathe suitable for the latter job will not be so for the former, although made to do it under compulsion. But this strengthens my argument. It is only the amateur who is so unreasonable as to require a lathe capable of light and heavy work, or a lathe capable of "diversity of operations." A workman is not so hard upon lathe-makers, because he is either a metal-turner or soft or hardwood turner—never a combination man needing a combination lathe. The reason I am working out a milling appliance is because it would, in very many cases, answer as well as a planer and shaper for amateurs, and would not be a lot to shift about. A plain spindle like that of a circular saw would carry the cutters; and nothing is apparently easier than to use it in combination with the slide-rest. There would be nothing to unrig but the spindle—an instantaneous job. But directly you begin to work it out, the necessity of a vertical slide appears, and there is no room between the tool-plate of the slide-rest and lathe-centres. I am more and more convinced that a lathe should be kept to its special work alone, and that even in cost a separate machine is cheapest in the long run, as it is undoubtedly the most efficient. The principle, too, applies equally to the workmen. It is a pity that amateurs do not stick more generally to one class of work—metal, plain wood, or ornamental, as the case may be. I include myself in this stricture.

O. J. L.

[19716.]—I HAVE one or two remarks to make on the letter of "E. P." (No. 19688). "E. P." thinks this "overdone combination lathe a mistake, very costly to make," and "very troublesome

to use." I think he is assuming a little too much here, and, till we know what it will cost, it is a little too soon to assert it will be very costly. A look at Major Armstrong's illustration in September 30 will show at once that there is not "something always in the way to want moving or fixing."

If the lathe is to be used for plain turning or screw-cutting, the whole of the shaping and drilling frame slides off the rest, and can be quite as easily removed as the arrangement he proposes for drilling.

That it would be troublesome to use is a statement equally without foundation. The slide-rest is converted into a shaping head by merely loosening one pinching screw. This shaping-head is put in action by simply sliding the gear-frame into its groove in the saddle, and fitting driving-shaft between centres.

The drill is even simpler, for it is always ready, only needing shaft to be placed between centres. I have, from the first, felt the number of gear-wheels to be a drawback. There will, doubtless, be noise, but not more than in screw-cutting or sliding, nor, perhaps, as much, except when drilling at a high speed.

As to objections on the head of ornamental work I have little to say; let others speak here.

Just a word, now, on "E. P.'s" combination lathe. He would fit up a lathe with "an iron or a wood gantry plated with iron." I can only say I would not give much for the planing done on such a wooden bed.

This plan of using the bed for the planer-table to work on has been, I think, attempted by several inventors, J. N. Northcott amongst others, and I see no objection to it as far as the bed goes; but "E. P." has given us no idea of how the standards are to be fitted to the bed, where the cross slide and lifting and lowering screws are to be got—besides a lot of other things. And though he talks as if he knew a lot about constructive mechanics, if he thinks this would be a simpler and less costly got-up attachment than Major Armstrong's for shaping, he is very much astray.

Brackets would have to be cast specially on sides of bed to take the standards, a boss cast on each side of bed for the shaft to work in; in fact, it would cost quite as much as a complete planer, and be more troublesome to fit up. Whereas any decent amateur could fit up the Armstrong, and the only additional cost would be the few castings necessary, which can be made to fit any existing lathe-bed.

His drill-attachment seems to me little better in design. But, as above, it is an easy matter to say in general terms, "You can do it easily thus." But these sort of people are generally only willing to give general directions without any particulars. What kind of a spindle would "E. P." put in his drilling apparatus? And what does he mean by "driving it by a small band and small pulley from a crank-shaft?" Fredk. Carre.

CHEAP MICROSCOPES.

[19717.]—I VENTURE to call the attention of your readers to the "Society of Arts Prize Student's Microscope at £3 3s." I think they will find it a most reliable and serviceable instrument; only let my working friends be sure that they get the genuine article, as there are several so-called Society of Arts Student's Microscopes, which only resemble the genuine one in price. For those who do not care to expend three guineas, the same firm make an achromatic instrument at £2 2s., but I have no personal knowledge of it. Of their prize "school" microscope, with the addition of a Wollaston doublet and body, I cannot speak too highly. It will, I venture to think, meet the requirements of nine-tenths of my fellow-workmen who desire to look further into the hidden secrets of animal and vegetable life. It can be used as a simple dissecting microscope, and with the body and Wollaston doublet forms a really useful and powerful instrument, nearly achromatic—sufficiently so for most amateur work. The price is only 15s. 6d. Medehamstade.

SCREW PROPELLERS.

[19718.]—I CAN inform our old contributor, "Khoda Bux" that, so far from the placing of the screw and part of the shaft at an angle to the keel being anything new, Messrs. Harland and Wolf, of Belfast, patented this plan, and, if I am not greatly mistaken, during a stay in that town I saw it in process of being applied to the *Britannic* screw steamer; but so little noise has been made about it since, it appears to be (as I would decidedly think that it would prove) "a failure."

Why should a thrust at any angle have as much power as one in a straight line with the keel? but the idea evidently was to get the screw down into the denser water when at sea, and to raise it up out of danger when nearer the bottom contiguous to land. It is clear to me that, what would be gained in the one case would be lost in the other. I maintain that the action of "sculling" is simply a bad method of screwing, the use of an inclined

plane, whose motion is constantly reversed; whereas in the true screw the inclined plane is always moving in the same direction. Pressure downward upon the boat's stern, more than is sufficient to keep the oar in situ, would besmily power thrown away. Moral: Any man who "goes in" for a mode of motion which fails to keep up the push continually, is well wasting his time.

J. J. A., Liverpool.

[19719].—I AM glad to find from "Khoda Bux's" communication, which appears in your column of the 3rd inst., that your admirable article on "The Problem of the Screw Propeller," under date of the 2nd Dec. last, has been appreciated.

I fully endorse "Khoda Bux's" remarks and inferences, that the present system of propulsion by screw propeller, is capable of very considerable improvement. For my part, I am astonished that in this age of running to and fro, with the acknowledged shortcomings of the screw-propeller, and constant serious disasters occurring from shaft-breaking, that a more natural and effective mode of propelling steamers has not been brought to the front. With especial reference to your article of the 2nd December, it is admitted that this question has baffled the highest intellects for 40 years, and the simple rule of thumb is the only guide, the beaten tracks being still pursued.

I affirm that the "Screw" is not a natural law of propulsion, for, as far as we know, there is no created thing in heaven above, or earth beneath, or waters around the earth, endowed with a similar motion. It stands to reason that a motive power, going transversely, cannot possibly propel so quickly as one running parallel with the course of the vessel. It is obvious, moreover, that the churning and commotion of air and water, which the screw engenders, most seriously retards the progress of the vessel. A propeller, proceeding noiselessly without disturbance or agitation of the water, and running parallel with the ship's course, it must be admitted, would be a most natural and effective one, independent of incidental advantages, such as absence of vibration, &c.

Recurring to your article of the 2nd December, you justly remark that, "as the screw revolves, each blade impinges on water that has been put in motion by the preceding, reducing the apparent speed one-half per second; and, as you very forcibly argue, if each blade as it revolves could enter water not put in motion by the preceding, each blade striking far enough ahead of the preceding one would obtain greater velocity, and consequently greater thrust. I maintain that direct "thrust" is the natural propelling law which should be applied to steamers; and a propeller based on that principle must, of necessity, be infinitely superior to the screw principle working crosswise.

I have given the matter very considerable attention, and have now before me a model propeller based on the principles I have set forth, consisting of three blades, with a fore and aft action, attached to connecting-rods, uniting a pair of crank-shafts. Each blade enters and leaves the water perpendicularly, the return of the blades, duly protected, being effected above the water. The blades overlap each other, occupying very little space; but, striking far enough ahead of one another, come into fresh unbroken water each stroke. The form of the apparatus is exceptionally strong, giving great immunity from breakage of shaft, or damage in heavy seas, incidental to the screw propeller.

The model I have before me has the propeller fixed at the stern of a ship (inside the sternpost), but it can also be applied at the sides of a ship, or in a central water-way. I tried the propeller, with a small engine fixed on a bridge, between two outriggers, 28ft. long, and the results were eminently successful, not only in point of speed, but also from the noiseless motion and entire absence of agitation of the water, leaving simply a slight track, like that of a duck. I have several testimonials in favour of the propeller from men of high position, and many years' experience in nautical and engineering matters.

I am now having the propeller put in a launch; but as "Khoda Bux" remarks of his East Indian friend, my pocket is not strong enough for much expense. "Khoda Bux" seems to be much interested in steam propulsion, and, if younger, would be apparently plucky, and I would be happy to show him the model propeller, or to "Sunlight," or to any other of your contributors interested in the matter. Great achievements of this nature are only carried out by co-operation, and I am fully persuaded that the propelling power would, in a large vessel, maintain a speed of over 25 miles an hour.

White Swallow.

TO "F. I. C."—JAPAN WAX—CHEESE—ARTIFICIAL INDIGO—LACTO BUTYROMETER—ALIZARIN.

[19720].—DOUBTLESS many of the readers of the ENGLISH MECHANIC are aware that professional chemists some years ago formed a society called

"The Institute of Chemistry of Great Britain," and that many chemists are in the habit of informing the public that they possess the guarantee of respectability and competency which the membership of the Institute is supposed to confer by appending the letters "F.I.C." (Fellow of the Institute of Chemistry) to their signatures. Hence we are apt to regard the use of these letters with some amount of jealousy. The correspondent who contributes so largely and usefully to these columns, and who signs his answers "F. I. C.," will, I trust, not feel offended if I ask him, in the name of his brother-chemists, to be a little more careful as to the accuracy of the replies to which he appends these suggestive letters. If he used his own name, or employed any other initials, I should not have a word to say; but as it is, I must disclaim, on the part of myself and other "F.I.C.'s," any responsibility for several of his recent replies. Thus, as I recently pointed out, his reply on the estimation of arsenic in copper (No. 45678, page 456) was useless and misleading. On page 504 he gives a reply to query 45840 which is very wide of the mark, and on the previous page he apparently confounds spermaceti with paraffin-wax, or, at any rate, mistakes the hydrocarbon *celene* for the ether *celin*. "F. I. C." gives so much really useful and reliable information, that it seems a pity that want of care should detract from the value of his other replies.

I may supplement the reply of F. Barker Cooke, on page 505, to query No. 45858, by saying that I think it is very doubtful whether the constitution of "Japan-wax" is at present properly understood. As stated by Mr. Cooke, it is generally alleged to yield glycerine and palmitic acid on saponification. I have no doubt that glycerine is formed, but I doubt whether the fatty acid is palmitic. Besides, the density of Japan-wax is in excess of what one would expect from such a constitution. Whatever its true nature, Japan-wax is not a wax—that is, it does not resemble other waxes in yielding one of the higher alcohols of the ethylic series when saponified.

I am sorry I cannot assist "Aconite" in his "cheese" experiments (No. 45889, page 506).

"Artificial Indigo" (query 45897, page 506) is prepared by the following series of reactions:—By the action of chlorine on toluene, there is produced benzene dichloride, $C_6H_4Cl_2$; and this reacts with sodium acetate to form cinnamic acid, $C_6H_5CH=CH.CO_2H$. By the action of nitric acid, this is converted into ortho-nitro-cinnamic acid, which by treatment with bromine yields a dibromide of nitro-cinnamic acid, $C_6H_4(NO_2)CHBr.CHBr.CO_2H$. By careful treatment with caustic soda, this body yields ortho-nitro-phenyl propionic acid, $C_6H_4(NO_2)CH_2.CO_2H$; which, by the action of reducing agents, yields indigo-blue. $C_6H_5NO_2 + H_2 = C_6H_5NO + CO_2 + H_2O$. In practice, a quantity of useless para-nitro-cinnamic acid is produced simultaneously with the ortho-variety. The two acids are separated by the different solubilities of their ethylic ethers. At present, the price of artificial indigo is not low enough to allow of its competing with the natural product. Last June, Dr. R. Schönbauer estimated its cost as double that of the vegetable product.

I have not seen the advertisements of the Aylesbury Dairy Company referred to by "Aconite" in his query addressed "To Mr. Allen or any Correspondent" (No. 45821, page 483), but presume the instrument in question is one for ascertaining the quantity of fat in milk by estimating the extent of the opacity produced by the suspended fat-globules. There are many sources of error in such a method; but it would probably give useful results in certain cases, and certainly would be much more rapid than any process based on the extraction of the fat.

In answer to query No. 45952, page 530, headed "To Mr. Allen," I may say that the best method of assaying samples of alizarin liquor and paste is to compare their dyeing powers side by side with a standard specimen. Pieces of mordanted cotton cloth of equal size are placed in each of the diluted solutions, which are gradually heated with frequent stirring. The mordants and details of the operation must be varied according to the intended mode of employing the dyes represented by the samples. I think a direct estimation of the amount of alizarin in a sample might be made by acidulating the solution with dilute hydrochloric acid, and agitating with ether; the ethereal layer, when separated and evaporated to dryness, would leave the alizarin. I only throw this out as a suggestion, and, if tried, shall be glad to know how it works. Sheffield, Feb. 4.

Alfred H. Allen.

THE TAYPORT ACCIDENT.

[19721].—THE details of the disastrous collision at Tayport are in the remembrance of your readers. I am very glad to be able to state that I have just received a telegram informing me that to-day (3rd inst.) the signalman, Thomas Dippie, was tried before Mr. Sheriff Crichton at Cupar, Fife, and the jury returned a verdict of "Not Guilty." In cross-examination, it was proved that Dippie

was sixty-four years of age, and that this poor old man had been thirty years a railway servant, and was daily kept on duty no fewer than sixteen hours.

This case adds another precedent to the already important list which proves that "a simple mistake is not manslaughter," and that if a railway company neglects to provide proper appliances for safety, that the servants ought not to be punished for the faults of those who employ them.

The fact that the jury acquitted the signalman shows at once that a great injustice was done to him when he was arrested and placed in Cupar Prison, instead of being admitted to bail at first. When I entered into correspondence with the officials, they were quite unable to produce any law or reason why they unjustly kept the man in prison for several days. However, the final result is most satisfactory.

Feb. 3.

Clement E. Stretton.

COAL-GAS, AND HOW TO USE IT.—IV.

[19722].—IT is manifestly impossible, in a series of letters like the present, to express any preference for the burners of any particular maker. The names that have been mentioned are well-known and extensively advertised, but the reference to them is more to illustrate the principles involved than to advertise their wares, however excellent they may be.

The most effectual way of controlling the consumption of gas is undoubtedly to have a separate governor at every burner, as is usual in street lighting. The pressure is then controlled to that which with each burner will give the best result, independent of the burner's means of supply, which will cause the higher burners to have more pressure than the lower ones in the same building. This is somewhat an expensive plan, even if the cheaper makes of governor-burners are used; but in the principal rooms of private houses the comfort of a steady light is a very great consideration, and burners fitted with small governors are now very extensively employed.

Argand burners, though very beautiful and sound in theory, are especially sensitive to changes of pressure, and other disturbing causes. Some very large double and triple argands have been brought out for the illumination of large spaces.

In planning out how a room is to be lighted, different people will choose different methods. No rule can therefore be given; but it may be remarked that if a central chandelier be chosen, a fixed one is much safer than one in which the burners can be raised or lowered by a slide. If, on pulling down the chandelier, a bubbling noise is heard, a little water should be poured in at the top until it no longer bubbles when pulled quite down. There is a danger of the chains breaking, and the affair tumbling down, leaving an open pipe end, which, if this should take place (as sometimes happens) in the night, the room may be full of a highly-explosive mixture by morning; and although this is happily not a common occurrence, yet it is as well to be forewarned.

Having now touched upon the principal pipes and pieces of apparatus used in an ordinary gas supply, something may be said as to the defects to which the supply is liable. The principal faults are—jumping of lights, total or partial stoppage of gas, and leakages; and the causes are mainly improper or unskilful laying of pipes, and want of attention to the meter.

Jumping lights are usually caused by water lodging in some low place in the pipe, so that the gas has to force the water aside in order to get past, so that it comes through intermittently. The remedy in this case is to send for a plumber, the one who did the job, if a recent one; and not pay him until it is made right. If only one, or a portion of the lights jump, the pipe that supplies these only will want looking to. If all the lights jump, it may be caused by water in the service leading in from the street. A very common temporary remedy is to blow down the offending burner; this blows the water into another part of the pipe from which it may fall to the meter, but does not hinder it from forming again in the same place.

In case of shortness of gas, the same cause may operate, or there may be a deposit of solid matter in the service; but the most common cause in places where the meters are not well attended to, is shortness of water in the meter. When the meter becomes short of water, a valve closes and shuts off the gas; if the meter be overcharged, a water-seal prevents the gas from entering the drum. Those who wish to water their own meters may do so in the following manner:—The inlet for gas is usually to the left of the index-box; on the right the filling screw is usually placed. The gas must be turned off at the stopcock, and the screw closing the filling tube taken out; and also a small screw which will be found near the bottom of the meter, either in front or at the side. This is the waterbox screw. Water is now poured in carefully at the filling screw until it overflows at the

waterbox screw, when all that will is allowed to run out, both screws replaced and the gas turned on. In some cases, water may run out at the lower screw as soon as it is unscrewed; in this case the meter has either been overcharged previously, or there is an internal leakage into the water-box. Dry meters are liable to stick fast, and shut off the gas through a deposit of tarry matter on the faces of the slide-valves, especially after a period of disuse.

Should a leakage be suspected, the gas should be carefully turned off at every burner tap and left on at the meter for as long as convenient, say from morning until required at night. By noticing the pointer on the meter, it can easily be seen whether there is any perceptible escape. The pointer to be noticed will be found at the top of the dial in a dry meter, and in a wet meter there is a small cheese-shaped drum just above the right-hand end of the dial with figures on it, the position of which can be noted with respect to a piece of wire projecting from the dial.

A curious fact with regard to leakages is, that a leak of gas will occasionally cause considerable annoyance in the next house, and yet be scarcely perceptible, except by reading the meter in the house in which it occurs. The pipe being covered with plaster, the gas finds its way through the wall along the joints of the next house, and there comes up through the floor, causing a smell. This can only happen where houses are built rather for cheapness than for durability.

Ploni Almoni.

[19723].—In reply to Thos. Fletcher, (letter 19623, p. 450), the burners with which the experiment was tried, which gave rise to the statement in letter 19599, the accuracy of which he questions, were two large-sized Bray's special, in which the gas is burnt still more economically than in the smaller sizes. The result was a very smoky flame, of diminished brightness. On repeating the experiment with smaller burners, Nos. 4 and 2, a brighter light is obtained, as noted by your correspondent, but the effect is not so marked as when less economical burners are used. I cannot accept altogether, the rather sweeping assertion that, "The larger quantity of gas you can burn in one single flame, the higher the duty obtained." With regard to the efficiency of these burners, a room, 16ft. by 14ft. is amply lighted by a No. 4 Bray's special, while a No. 2 lights a small sitting-room 15ft. by 12ft. The No. 4 burns, at 1in. pressure, about 4½ft. per hour; the No. 2 burns 3½ or 3ft. per hour. On visiting a friend lately I found him burning not less than 6 or 7ft. per hour out of an old burner, the hole of which had been broken, probably by pin-poking, so that it gave a single straight jet, and scarcely light enough to read by. On sending him a No. 4 Bray, it was straightway dubbed a "beauty." The Bray's patent enamel regulators are an older and inferior make, which are much used on account of the celebrity of the maker's name, and because they are cheaper than the Special. The Special burners are screwed with a taper thread, which easily enters the modern size of fitting. A burner-tap can be had at most ironmongers which will tap the correct thread.

Ploni Almoni.

THE DANGERS OF OXYGEN MAKING.

[19724].—MAY I refer your readers to a book called "Practical Chemistry," by Harcourt and Madan (Oxford: Clarendon Press); where, in reference to the danger of an explosion, it says, page 64, "Of course the only possible risk would arise from the delivery tube not being sufficiently large to carry off the rapid current of gas, or becoming obstructed by particles of the mixture mechanically carried over with the gas. It is found, however, that all inconvenience and risk from this cause may be obviated by adding to the mixture, before it is placed in the flask, an equal bulk of dry sand. The decomposition then proceeds with perfect regularity from beginning to end."

I may say that I heard only the other day of a fatal accident from the explosion of an oxygen retort, and my informant told me that he had had an explosion (not a serious one, fortunately) occur when making oxygen himself; another friend had similar experience. So these accidents seem common.

R. E. V.

Spot and Pinhole Mode of Adjustment.—**ERRATUM** (letter 19694, p. 520). I must ask your readers to put a small black spot in the centre of Fig. 2. This is the spot on mirror (Fig. 1) seen in the reflection of the flat. Fig. 2 represents the appearance looking through the two pinholes. The outer circle is the pinhole, the shaded part the reflection of the flat with a ring of light round it, and the spot in the centre the reflection of the spot which has been made on the mirror.

Fordingbridge.

T. Westlake.

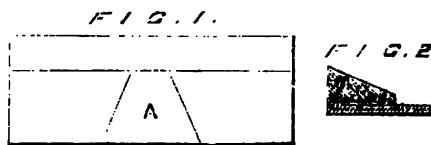
REPLIES TO QUERIES.

* * In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[37583].—**Railway Gradients (U.Q.)**—The ruling gradient on the L. B. and S. C. Ry. is 1 in 264. The steepest bank is one about 2 miles 53 chains long, beginning about 5½ miles out of London, rising 1 in 100. Going south there are three banks of 1 in 264, extending for 8 miles, 4½ miles and 3 miles respectively. Coming northward again, you ascend four banks rising 1 in 264, measuring 4½, 1, 5½, and 7 miles 12 chains respectively. There are 4 miles 10 chains of level rail. Summing up, in travelling from London to Brighton, you have a rising gradient for 23 miles 53 chains, and a falling one for 23 miles 57 chains. If this is not concise enough, I will endeavour to give the gradients in a more complete form. The ruling gradient on the L.S.W. is 1 in 250. On the Southampton and Dorchester section I believe the steepest gradient to be 1 in 100, and smallest radius of curve 15 chains.—CARSTAIRS.

[37584].—**Sharp's Railway Engines (U.Q.)**—The old Sharp's on G.E.R. weighed 18 tons. Of this, 6 tons 6 cwt. rested on the leading-wheels, 9 tons 6 cwt. on the driving-wheels, and 2 tons 18 cwt. on the trailing-wheels.—CARSTAIRS.

[45271].—**Hexagon Card Tray (U.Q.)**—As this has not been answered, I venture to send the following: Fig. 1 is the plan, and Fig. 2 the end



view, of a shooting-board which I think will answer. In Fig. 1, A is a raised block, the same as in an ordinary mitre-shoot. I think the sketches are clear, without more description, but the angles are not correct. I am away from home, and have no means of finding them.—JOURNEYMAN ORGAN BUILDER.

[45452].—**To "Clerkenwell Clockmaker."**—The number of wheels and pinions for a gravity regulator are: Great wheel, 144; pinion, 12; centre wheel, 80; pinion, 10; third wheel, 75; pinion, 10; fourth wheel, 75; pinion, 10. This makes a very good train. With regard to my promised articles on chime clocks, I have been so full of business lately that I have not been able to complete them. They will, however, appear very shortly.—A CLERKENWELL CLOCKMAKER.

[45553].—**To "Clerkenwell Clockmaker."**—The pivots should be hardened. First rough them down nearly to the size, then harden; temper by flaring them over a gas-jet or candle until you can just file them with a smooth file. The arbors will most likely now be considerably out of truth; to get them true again, put them between the lathe-centres, and with a piece of chalk mark the high side; lay this high side of the arbor on a smooth stake, and with a light peneing hammer give it a few light blows. Try it between the centres again, and if still out of truth continue the peneing until the arbor runs true. Some skill is needed to do this quickly; but after a few trials I have no doubt you will succeed. The pivots are about the following sizes, B. W. G.: Front barrel pivot, 3; back barrel pivot, 8; front centre pivot, 6; back centre pivot, 14; third wheel pivot, 16; front fourth pivot, 11; back fourth pivot, 13; scape wheel pivot, 20. For latter part of query kindly see reply to 45452.—A CLERKENWELL CLOCKMAKER.

[45592].—**Automatic Musical Instruments.**—The answers to the six queries of "Enquirer" are:—1. The cards are placed by hand on the table of the pianists, in a recess inclined outwards, which holds a volume of 12 to 15 yards. Understand, they never pass into the instrument, but over the table and between the rollers. 2. The side of each card is joined at each end by pieces of narrow tape, each tape crossing; that is, glued to the underside of one card and the underside of the next, thus keeping their edges close and parallel to each other, and forming a hinge acting both ways, something after the fashion of the cards in the Jacquard loom. 3. The "Old Hundredth" would take 1½ yards. Unacquainted with music, I should not like to state the exact length of a hundred bars of common time, but may mention that the best makers of mechanical pianos make six airs to each barrel, as those of Gavrioli or Leape, of Paris. An overture, for instance, that of "Zampa," requires the entire use of one barrel, or six revolutions. With the pianists cards it is 12 yards, so that a barrel containing six airs may be deemed equivalent to from 12 to 18

yards, according to manufacture. The overture in "William Tell" takes 18 yards, probably the longest of any of the great operas. 4. The pianists can play as fast as any violinist, or any piece, however elaborate; it is equivalent to ten years' practice on the piano; it also gives the effect of two players on the same instrument, with the same nerve or stamina that an accomplished pianist possesses. 5. The turning of the handle in connection with the rollers, between which the cards pass, is under the control of the player, and the cards must pass out as they pass in, being all hinged together. Neither do they require any rearrangement, for as they pass over the notes, described a few weeks back in the "E. M.," they re-fold themselves automatically in an inclined recess opposite the other. No attention is needed except for the "expression." This, being the soul of music, cannot be produced except by hand by pressing a stop, and following the directions printed on the cards as they pass from one side to the other, like reading the title of a book. 6. Any ordinary mechanic may make the music better or easier with a knowledge of the notes, though this is not strictly necessary; always beginning, however, with a waltz or a march, where the time is regular. The elaborate pieces of sentiment, as some of the airs of Mozart or Beethoven, are more difficult. It was not intended to state that a barrel does not keep perfect time; but the pianist has a certain delicacy of its own, and the convenience of storing the card-volumes has an immense advantage, not requiring above one-twentieth of the space necessary for barrels, and not liable to damage in changing one for another.—W. H. H., Brixton.

[45634].—**Pedals for Piano.**—If "A New Subscriber" will procure Nos. 602, 604, and 768, he will find several methods of adding pedals to pianos. The last-mentioned No. contains Mr. Davies's article on the matter.—NUN. DOB.

[45641].—**Danish Butter-Casks.**—If the information is wanted for any special purposes, a letter to the British Consul at the principal market town, or at Copenhagen, would, no doubt, produce the required answer. Beech-trees exist in Denmark, however, and, presumably, the butter-casks are made of home-grown wood; but the tree also grows in Norway, and, perhaps, some of the casks may be made there. However, if I wanted particulars, I should adopt the course above indicated.—NUN. DOB.

[45646].—**Berliner's Violin.**—The wood of the pear-tree is, I imagine, no better than that of the beech for violin-bridges; for all that is necessary is that it should be hard and tough, and transmit the vibrations of the strings to the soundboard. Pearwood is close and solid; hence is well-suited to the duty.—J. G.

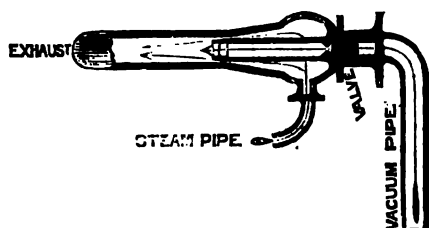
[45674].—**L. and N.W. Engines.**—In answer to "Clyde," I beg to hand you the principal details of one of the same class as "Pegasus," 1810, which was one of the latest classes built for the Northern Division by Trevithick:—Cylinders 15in. by 20in., leading and trailing-wheels 3ft. 6in., drivers 7ft.; firebox: length (inside) 3ft., width (inside) 3ft. 6in., grate area 10½; heating-surface (tubes) 658 sq. ft., firebox 56 sq. ft., weight of engine 20 tons, tender 10 tons; total 30 tons.—CARSTAIRS.

[45700].—**Tools for Bending Iron.**—NOTE.—The diagram of a hook shown on page 521 is not properly proportioned. It ought to be considerably thicker about midway between the eye and the bottom bend. It is no wonder that we read of railway hooks giving way if this is a correct drawing of one.—J. J. A., Liverpool.

[45701].—**G. E. R. Engines.**—No. 305 is an inside cylinder bogie express, with 4-coupled wheels, 6ft. 6in. in diameter (Mr. Johnson); not, as stated by "C. R. M.," one of Mr. Sinclair's 7ft. singles. There are only two of these engines on the Great Eastern—Nos. 305 and 306. No. 291 is one of Mr. Sinclair's 7ft. singles, but has been rebuilt, and has a bogie in front.—DONOTHY.

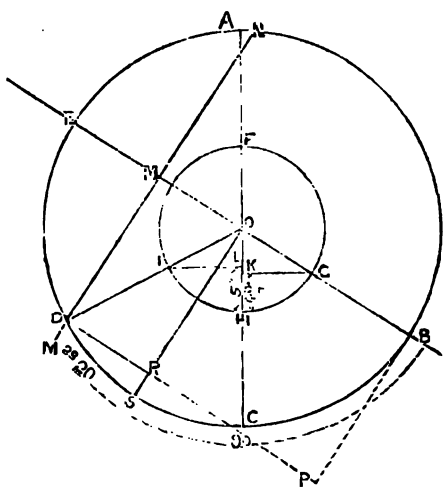
[45712].—**Continuous Vacuum Brakes.**—I gather from the letter of "Visjante" that the answer sent by "E. P." page 478, does not furnish details of ejector which your correspondents require. The sketch by "E. P." is correct so far as showing the usual position of ejector on right-hand side of a locomotive smoke-box. I send a section of the said ejector. In the first place, I ought to say that the apparatus was invented by a French engineer in 1860, and it is, so to speak, between a blast-pipe and a boiler injector. Steam from the boiler rushes down the steam-pipe, through the narrow cone, and up into the chimney of the engine; the force of the steam carries with it, or in fact drags out, the air from the vacuum brake-pipe, and a valve shown prevents the air from returning. The same form of ejector is used for either the simple Smith or the Automatic Sanders Vacuum. The Midland and G. W. R. use steam-brakes on engines because the vacuum apparatus to give the necessary power would be much too large to be placed under the foot-plates. Descriptions of the steam

brake were given in the *MECHANIC* less than a year ago. The Heberlein brake is an improved form or modification of the chain-brake system. The Hardy-vacuum is practically Smith's; but drums



are used in place of leather sacks, and two ejectors are employed—one for the engine and tender, and the other for the carriages; both however placed side by side on the engine. As "Brakeblock" wishes to learn about continuous brakes, I would strongly recommend him to study the last few Vols. of the *ENGLISH MECHANIC*. As your correspondents wished for a section of an ejector, I furnish the above; but I ought to say that, after very considerable experience with vacuum brakes, I find that they are all much inferior to the automatic air system, and the noise created by the ejectors is very disagreeable.—A DRIVER.

[45713].—Trigonometry.—The annexed dia-



gram was, unfortunately, omitted last week, p. 524.—BUTTERSHAW.

[45735].—Water in Gas-Pipes.—I hope no one will take "H. O'B.'s" advice, and put wooden pegs or corks into holes in gas-pipes, especially under boards. After letting the water out, have a proper siphon, with a tap, soldered into the hole in a proper manner by a gasfitter, at a cost of about 2s. or 3s.—J. SNELL.

[45738].—Thermometer.—Jos. Rawlinson has misunderstood my meaning—perhaps because he is not acquainted with the name of the thermometer he mentions. Boxwood thermometers are those in ordinary use, ranging from (say) 0° to 150°. The one that he refers to is called a chemical thermometer, and should hinge about 2in. from bulb so that the boxwood can be turned up and the bulb and part of stem only immersed into the boiling liquid. These thermometers are seldom used, and I doubt whether there is one chemical thermometer of this kind sold to 10,000 ordinary boxwood thermometers, such as the original querist possessed. The chemical thermometers we make now are engraved on the stem, and need no case at all.—W. J. LANCASTER.

[45747].—Platinum Amalgam.—Experimenting some years ago with a friend, we tried to make the above; but, after many attempts, failed. We then thought we would write to the great Faraday himself to help us with a hint. I need scarcely say we received a prompt and courteous reply. His advice was to mix a small quantity of the metal sodium with the mercury before adding the platinum. This was just the thing, and the amalgam was soon made.—SOLUS.

[45747].—Platinum Amalgam.—Platinum and mercury will form an amalgam slowly; per-
haps a piece of platinum foil, with a thin layer of mercury, would answer your purpose, getting, of course, better as the amalgam was more complete. However, make the amalgam if you like. I say: "An amalgam of platinum formed by acting upon an amalgam of sodium and mercury with a solution of the sodio-platina-

chloride (2NaCl, PtCl₄). Probably, this method will enable you to make the amalgam, and I should be glad to hear of the result. I have never been partial to a mercury break. Mr. Brown seems to succeed well with his, but I fancy something was wrong with his platinum break.—W. J. LANCASTER.

[45748].—Mounting Engravings.—Thanks to Messrs. Kendall and Fryer for their replies. The engravings I have to mount are for mounts with a hole cut in the centre, so they will see their replies are hardly applicable.—J. W.

[45761].—Medical Coil.—To MR. LANCASTER.—If you will for a moment imagine a row of boys, holding hands, and gradually sloping from a big boy to a little one, and then from the little finger opposite big boy of each lad, a string is tied and carried to a table, then you will find that, supposing another cord is attached to the big boy's free hand, you can go to the table and pull two strings that will pull only the big boy; this will be the primary current only. Now keep hold of the outside cord of big boy, and hold cord from second boy; this will include the two boys. Then you can release the cord from second boy, and take cord from third boy, and so on, every fresh cord taking in another boy into the circuit. This is exactly the case in the separate coils of wire, and you will at once see that although the whole of the wires are connected, yet the end of each is carried to a binding-post. If you cannot understand, I will send a drawing.—W. J. LANCASTER.

[45772].—G.E. Engine.—Descriptions of engine 240 will be found in Vol. XXXI., No. 783, and Vol. XXXII., No. 828. In case "H. O." has not these numbers, I append the following dimensions:—Cylinders, outside, 18in. by 24in.; driving-wheels, 7ft. 6in.; bogie and trailing ditto, 4ft. There are 203 tubes, 1½in. diam.; total heating-surface, 1,208 square feet. Weight on bogie is 17 tons 15 cwt.; on driving-wheel, 15 tons; and on trailing-wheels, 10 tons 10 cwt. There are 10 engines of this class on the G.E.R. They are used for the heaviest and fastest passenger traffic on the line; but I cannot say how they perform their work. I may just add that they are noble-looking engines, and are beautifully finished as regards painting, &c. A very fair tracing of one is in Vol. XXX.—GEORGE T. FLEMING.

[45786].—Mitscherlich's Experiment.—I overlooked the query of "L. V." on Jan. 13, till shown it by a friend, owing to its being headed with my name. The rings in selenite can only be seen in highly convergent lenses, the angle being over 50°. The only difficulty is in getting plates of the crystal, as they are difficult to cut: as the plane containing both axes is that of the laminae, the crystal must be cut and polished across these, which is difficult at best, and only possible in some specimens. Talc sometimes has them, but most come by post from Steeg and Reuter, of Homburg, costing 3s. 6d. to 6s. each. They are about 1-12th of an inch thick, and about ½in. by ½in. If "L. V." studies the phenomena on a flat stage with a microscope, I should cut a metal-plate like diagram, thickness of the crystal, with a hole large



enough for the crystal to lie loosely in. Lay this, with crystal in it, on a thin glass plate, and apply a small lamp to the two ends, watching effect. On the perpendicular stage of a projecting polariscope the arrangement must be rather different. I use now a special slide made for me by Messrs. Dicker; but I did very well with a piece of printer's "brass rule," with a hole cut as above, but not reduced at the ends. The ends of this were bent forward all but the central inch, so as to be heated clear of the stage; and a piece of black card doubled over both sides, with holes rather smaller than the crystal, kept it in place. The whole was pinched to the stage by common micro-stage springs, and heat applied to the two ends. I made this in twenty minutes with a drill, hammer, and file.—L. W.

[45800].—Jet Brooches.—Nothing better than shellac. Warm the article, lay small piece of shellac on hole, take mouth blowpipe, and direct flame on piece of shellac, put joint or catch in hole, and then direct the flame of candle or lamp gently, taking care not to get the jet too hot, or it will crack.—WOODLEIGH.

[45805].—Cal. and G. and S.W. Engines.—I am able to give "R. N. H." a few particulars about the G. and S.W. goods engines mentioned. Cylinders, 16 by 22; dia. of leading and driving-wheels (coupled), 5ft.; dia. of trailing-wheels, 3ft. 6in.; dia. of barrel of boiler, 4ft.; heating surface of boiler = 930 sq. ft.; fire-grate area = 13.3 sq. ft. The engines were built by Hawthorn

and Co. some years ago, but I am unable to give date.—MEXBOR.

[45818].—Dredging.—Memo: I would decidedly recommend the would-be dredger rather than use the system proposed by "Oilman." (Query: Is this the same homo who is going to take the wind and waves by storm by means of pouring oil upon the troubled waters?—to keep out the tide with a pitchfork?) And if he won't use a Liverpool dredger, why, then, try one of our street-sweeping circular brush machines.—J. J. A., Liverpool.

[45833].—Watch Query.—"Finsbury's" watch is evidently jewelled in six holes. Jewel-holes are more durable than brass, and require no oil; consequently, a watch that is jewelled will go longer and keep better time, as there is no oil to thicken or corrode.—WOODLEIGH.

[45843].—Clock-Repair.—"H. H." must take the striking-train of his clock apart, and he will find that the pulley is loose on arbor, and also held together by three rivets. Cut off heads and drive out rivets, and then draw the worn pegs out of centre-piece or core; drive in some good wire, cut off with nippers equal length, file up to point, and rivet up together again; if any of the pegs go through to the arbor-hole, file off with round file. "H. H." must see that the detent drops into locking-plate just as the hammer strikes the bell.—WOODLEIGH.

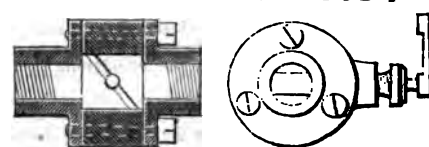
[45859].—Butter-Making.—I believe that there was nothing whatever the matter with your cream. We make a small quantity of butter occasionally. In the summer time, as we have a churn, the cook makes it by simply stirring the cream about with her hand until the butter comes. In the winter she uses a common egg whisk made of wire. The cream at first "whips" into froth just as you describe; but by going on with the whipping, the froth gradually goes down, and the butter begins to form. I am afraid you have not had quite sufficient patience. Some days the butter will form in about a quarter of an hour; on others it takes at least an hour. I believe the above method of stirring the cream with the hand, which, by the way, should be steeped previously for some few minutes in hot water, comes from Devonshire. And give me Devonshire butter.—MAX-CASTRIAN TED.

[45862].—Lens.—Your o.g. is not well-suited for either of the uses you mention, though it might be used for an astro-telescope of lower power. Should you wish to fit it up for that purpose, I shall be glad to give you a few hints on the subject.—J. H. DAVIES.

[45863].—Drilling and Rifling Small Arms.—Without the querist has mechanical skill, plenty of patience, time, and money at his disposal, I would not advise him to undertake the job even with a good screw-cutting lathe. The drilling and turning might be accomplished very well, but then comes the first boring, after which if examined internally by a practical eye, it would probably be found not to be a straight and true cylindrical tube, and would require "setting," which operation is of itself a separate branch of the trade, requiring an expert for its accomplishment; not even the royal manufactory, with the best of machinery, being able to dispense with it; after which there is the second or fine boring before the rifling is attempted, which process would require exact tools to be made of a peculiar character, and the lathe would have to be adapted for the work, for the purpose of controlling the pitch of rifling, number and depth of grooves, either of a uniform or progressive cut, for a rifling-machine is rather a complicated piece of mechanism costing at least £100. But is there not some mistake about the size? .210 would be a very small bore indeed; .380 is about the usual for a pea-rifle for rook and rabbit shooting. If "Rife" is fully bent on accomplishing it, the best way would be to visit a manufactory where he would see how it was done, for few correspondents would have sufficient leisure to draw sketches.—ARMOURER.

[45867].—Throttle-Valve.—Anything to help. I therefore send a sketch as desired. It is best made of three small castings. The two outer ones, as shown at Fig. 1, are simply boxes cast on to

FIG. 1. FIG. 2.



circular collars, and between these is a thick ring with a large aperture, and in this works the valve itself. These three parts are held together by three screws, as shown. I have shown the valve

Not only so, but the leakage of the tube diam. only, as you state, I should carefully develop into something worse. It is more than any other part, and the very best iron only its construction.—SUNLIGHT.

Electro-Plating.—I have never seen electricity, nor have I ever seen it is so easy a matter to tin ordies, that it is not worth while to go to electro-deposition. If you boil tinned boiler full of water, with tartar and granulated tin, until tinned, and then take them out and sawdust, they will look quite as electro-plating could make them. re tinned in a hot bath of tin, sal- been first applied to them.—W.

Electro-Depositing Tin.—"N. W. said what the articles are made of to tin, as different metals require ent. Many methods have been ut few are of value. Among the e to Fearn and Roseleur. Fearn's worked by the "Electro-Stannous Birmingham, who use, among made as follows:—An ounce of asium is dissolved in a pint of of solid caustic potash in another of solution of tartrate is then added, rring, 1½oz. of solution of stannous d by dissolving 2oz. of commercial ochloride of tin in a pint of water, 1, if necessary, of a little hydro- carefully avoiding excess of the olution of caustic potash is then e mixture with continuous and on, so as to dissolve the precipitate This solution is used cold, and its of metal. It has the advan- ing the articles to be occasionally ch-brushing, as is necessary with but has the disadvantage of not do so readily as it yields metal ler treatment. It becomes neces- in order to keep the solution of h, to add from time to time during the operation a supply of the tin ree ounces of sal-ammoniac (am-) are dissolved in a pint of water a fluid ounce of solution of stannous ed as above) poured into it, the ll stirred all the time. This solu- d at about 70° Fahr., but acting he anode does not need the addi- ous chloride whilst working. 3, sal-ammoniac are dissolved in a f water, and an ounce of sodium a pint of water; into the latter is ore than a quarter of a fluid ounce tin solution (prepared as before he mixture stirred until the preci- is redissolved. The sal-am- is then added to the mixture, and d. This mixture is worked at a between 100° and 110° Fahr. Tin added at intervals as with No. 1. mends a solution made thus:— crystallised stannous chloride are tion of a pint of water, and about ounce of pyrophosphate of sodium r of the water. The former is latter and the liquid stirred until ong current must be used, and a anode. The strength of the solu- intained by the occasional addition of the pyrophosphate and chloride. splate is expensive to buy, but may by igniting in a crucible or any d the common phosphate of soda of ere it is deemed sufficient to de- of tin, it is not usual to employ a ource is had to what is called a immersion—that is, the article is quid which has the power of dis- a of its substance, throwing down same time a portion of its own re many such solutions. I do not preparation here as "N. W. E." res for battery uses; but, if he o so on another occasion.—ALFRED

am-Engine.—The length of the three times the stroke of piston, (or height) at beam centres, one- ds the length of stroke of piston.—NCIT.

am-Engines.—Buy "Templeton's Engineer's Pocket Companion," and you will get all these sort of red in a simple manner.—J. J. A.,

tracting Silver from Lead Ore. stamps similar to those used in Cornish tin ores be suitable, after-

wards passing the crushed ore through a pair of rollers, if wanted very fine. The amount of silver per ton is not stated; but, supposing it to be about 20oz. per ton, as it is stated to be rich, Parkes' method would, perhaps, be the best. It is based upon the superior affinity of silver to zinc than lead, and that lead and zinc do not alloy together. If argentiferous lead be fused with about ½ to 2 per cent. of zinc, according to the amount of silver present, and the fused mass allowed to cool slowly, the zinc will rise to the surface and form a crust containing nearly all the silver, the zinc being afterwards separated from the silver by distillation. With a less percentage of silver, Pattinson's process is the best, as, by it, ores which contain 2 or 3oz. per ton can be profitably worked. The method is founded on the principle that, if argentiferous lead is melted, and afterwards slowly and uniformly cooled, being carefully stirred at the same time, a mass of small crystals separate. These crystals do not contain any silver, and, by continually removing them as they are formed, the residue which is left is found to be rich in silver—about 2 or 2½ per cent. The rich argentiferous lead is afterwards refined by cupellation. This method has also the advantage that the desilverised lead is purer, and of better quality. It would take up more space than the editor could allow to enter fully into details; you had better obtain a good manual on metallurgy, and work up exactly what you require.—ARTHUR E. MORRIS ("MOMUS").

[45943.]—**Pressure of Water.**—I suppose you want to know the pres. in lbs. per sq. in. at the lowest point in the main. The pres. would be 43·35lb. A Bourdon gauge will answer very well to show the pressure.—LABOR OMNIA VINCIT.

[45943.]—**Pressure of Water.**—Each column of water 1 square inch in area and 12in. high would equal 43·35lb., so that by multiplying by the height (100ft.) the pressure would be stated as the product. Or, if the water flows through a lin. round pipe, the weight of each foot would equal 341lb.—SUNLIGHT.

[45944.]—**Central-Drive Tricycle.**—If "G. D." will send me his address, I shall be glad to forward him a photograph of my machine, which is similar to the one recently alluded to by Mr. Blood.—W. H. STACPOOLE WESTROFF, Lisdoonvarna, Ennis, Ireland.

[45945.]—**Expansion-Link.**—I do not fully understand your query. Do you mean the length of the slot-link in the ordinary link-motion, or do you refer to the separate expansion-link worked by a separate eccentric? Let me hear as to this, and I will reply.—SUNLIGHT.

[45946.]—**Pumping Gas.**—I should certainly consider the supply-pipe (lin. diam.) as too small for the great length.—SUNLIGHT.

[45947.]—**Condenser.**—To "SUNLIGHT" OR OTHERS.—With no vacuum gauge the difficulty of stating what is the matter is largely increased. Have you thoroughly satisfied yourself that the bucket or ram of the air-pump is all right in every respect? Are you also certain that the slide-valve or piston of the engine is not blowing steam past? If these points are right, how do you know that the injection is not from some cause throttled, or perhaps nearly stopped up? Any of these points might and would give a very hot delivery in the hot-well, and would not show air-bubbles, as would an air-leak. If I were in your place, I would certainly rig up a vacuum gauge, if only a home-made one. There is nothing difficult in it to make, and it is a most useful adjunct to a condensing engine. For all you know, you may be working with a few inches of vacuum only. If you would like to make a gauge, I should be pleased to help you, and to give instructions. But if you carefully examine the engine, and ascertain if any of the defects I have enumerated are present, you will be doing much to discover the fault.—SUNLIGHT.

[45947.]—**Condenser.**—Possibly the new rubber on foot valve does not cover the grating properly; the slide-valve is not quite tight, or perhaps the piston is not steam-tight. Is the injection cock and pipe quite clear, and also the rose at end of injection-pipe? Attention should also be given to the piston-rod gland, also air-pump gland; see that they are all right. If these parts are right, then get some one to take an indicator diagram from the cylinder, and it will show whether the valve or piston is leaky.—LABOR OMNIA VINCIT.

[45948.]—**Nut-Making.**—Half-inch nuts can be made with an ordinary bolt maker's oliver.—LABOR OMNIA VINCIT.

[45949.]—**Copper Bits.**—I should say this is caused by using the bit for zinc, and using soldering fluid. If kept quite clean, and used only with rosin, I find the tin increases instead of coming off the bit. The only cure is to tin them again.—E. F. C.

[45949.]—**Copper Bits.**—If the iron is thoroughly tinned at starting, and is not over-heated, not the least trouble would be found if,

every time you take it from the fire, you just dip the tinned part in the soldering fluid for a second. This is not sufficient to cool it, but keep the surface good. Perhaps you use rosin: if so, discard it for solution if practicable.—SUNLIGHT.

[45949.]—**Copper Bits.**—Keep them clean; when finished with for soldering, dip the end into the sal-ammoniac or into the spirits, then leave the bit to get cool. I fancy it is rather due to over-heating. A good bit will keep tinned for a long time if kept clean and never overheated. We never have any difficulty with the bits; they are always ready, but sometimes they do get burned. It is not much trouble, though, to file up and re-tin.—W. J. LANCASTER.

[45949.]—**Copper Bits.**—You do not say of what is the fire made in which you heat them. I am doing a deal of soldering lately in experimenting with tin boat-models, and keep constantly upon the bench a small jam-jar half full of "killed spirits of salts." A few rubs of an old file, and then a dip in this will instantly cure this defect. Memo.: Always rub off all superfluous solder from the bit before placing it in the fire, or you will cause an alloy and a partial melting of the copper, producing a worn-eaten surface. Further memo.: Don't allow any petroleum-oil near your soldering performances.—J. J. A., Liverpool.

[45950.]—**Parting-Tools.**—It would appear that you are really successful in making parting-tools; but, seriously, I think you will find that you are not careful to keep them cutting in a line exactly coinciding with the centres of lathe. For my part, I would be content with an old smooth, thin file, and simply grind away all traces of the teeth, cut the end to a small angle, lower the temper a little, and there you are.—J. J. A., Liverpool.

[45952.]—**Intermediate Receiver.**—I am of opinion that the best size of receiver is a pipe or vessel the same diameter as would be fitted to the low-pres. cylinder if it took steam direct from the boiler. Thus, a 24in. dia. low-pres. cyl. has a 6in. steam supply pipe, when working single; the same size pipe should be fitted to supply same cyl. when working compound. I have found these proportions work well in practice. I have never seen Cowper's "hot-pot," but understand it to be a good thing.—LABOR OMNIA VINCIT.

[45953.]—**Innkeeper's License.**—Upon making a proper application to the Justices, supported by proof of the facts, I believe a temporary license would be granted for the remainder of the year, in the same way as if the outgoing tenant had died, or become bankrupt.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[45954.]—**Melting Zinc.**—At one time I melted up a lot of this metal. My plan was to melt it in a plumbago crucible. When a charge was set in and the scrap-metal just on the melting-point, I threw in some rosin, which had the effect of acting as a flux, and as soon as this had burnt off a handful or so of moulding-sand was then thrown in. As the metal melted, the sand rose to the surface and formed a protection against oxidation to a large extent. Metal melted under these conditions always gave me good, firm, and solid castings. It is a good plan to get up a good pattern with plenty of draw, and mould in clay; let the mould dry a little, and, with care, if the gates are also tapered, you may make a lot off the one mould, as the hot metal dries the surface of the clay and thoroughly hardens it. I need hardly say that I used small mould-boxes, just as would be done to cast in sand. Try this. Don't overheat the metal, and you will get sound castings.—SUNLIGHT.

[45951.]—**Melting Zinc.**—Zinc requires no flux; but the addition of a little nitre has been recommended to remove any metals more oxidisable than zinc that may chance to be present. Probably "An Amateur Mechanic" forgets to skim off the layer of oxide that forms on the surface of the melted metal. If he will remember to do this, and will melt his zinc in fairly large quantities, he will find no difficulty in casting his battery-plates. But why use cast zinc at all? Rolled metal is in every way preferable. To cut it to size, follow the directions given by "Sigma," who says: "Scratch a groove with a steel point, such as a bradawl; run first acid solution, and then mercury along this groove, and allow it to penetrate; then repeat the process on the other side, when the metal is easily broken." If required in a curved form (as for a Daniell cell), it should be heated in an oven to between 100° and 150° C., when it will become soft and easy to bend.—ALFRED W. SOWARD.

[45955.]—**Magneto-Electric Machines.**—I cannot see any necessity for brushes on commutator. Better get one spring to act as commutator. The spring wants to touch axis of electro-magnet. Twice every rotation; then you will get the current by coupling one wire to the brass frame in which the spring is screwed, and the other wire to be connected to axis of electro-magnet. This is

done by having a spring pressing lightly against the end of iron axle carrying electro-magnet. You try this, and you will soon get a current.—W. J. LANCASTER.

[45957.]—Street-Coils.—Do you wish to make up one of the large street-coils, with bells to ring and wheel to rotate, &c., &c.? If so, it will cost you in material from £10 to £12. However, if you will send another query, saying you are prepared to spend this amount, I will tell you how to make the whole thing.—W. J. LANCASTER.

[45961.]—House-Front.—You will probably do very wisely in "casing" your house-front with half-brick, particularly if the extra thickness will cause no difficulties with the various reveals, dressings, and cornices. But you must cut in to get "headers" to bond in your old and new work—two or three to every yard super., say. Repair your parapet—tar, silicate, or waterproof it; see to your gutters, and that no leaks in roof run water unsuspectedly down slope on to walls—a common thing. If in the country, can you not weatherile or weatherplate your front? It would come cheaper than the casing. Anyway, don't attempt mending your rotten cement. The least you can do is to have it all down and re-work, finishing straight off in one coat, and silicate it without painting.—A. C. G.

[45963.]—Range of Projectile.—There are three forces which act on a projectile: 1. The impulsive force of the powder; 2. Gravity; 3. The resistance of the air. The path of the projectile is a curve, the angle of descent becoming steeper and steeper, but never quite vertical. Whether the gun is fired from the top of the cliff or the base, the path of the projectile will be in the same curve (the gun being horizontal in both cases), and therefore, when it is fired from the top of the cliff, it will take longer to reach the ground, and will consequently go further. The problem is much more complicated, however, if we suppose that, instead of being horizontal, both guns are laid so as to pass through some point (such as the edge of a counterscarp wall); so that the gun at the top of the cliff has a less elevation than the one at the base. After passing through this point, which projectile will go furthest across the ditch, and why? I hope some of our friends will kindly try and solve the problem under these conditions.—DOROTHY.

[45963.]—Range of Projectile.—When a bullet is discharged horizontally the time it will take to reach the (level) ground, that is to say, the time of its flight, is the same as the time it would take to simply fall from the muzzle of the gun to the ground; moreover, the range of a bullet so discharged is proportional to the time of its flight, the height of the gun being given. Now, the time of said falling is proportional to the square root of the height of the fall, and therefore, the range is proportional to the same. When an ordinary man, standing on the ground, discharges a gun horizontally, the height is, say 5ft., and the time of falling .57sec. (as the bullet would take in our latitudes 1 sec. to fall 15-16ft.). When he stands on a cliff 100ft. high the height is 105ft., and the time of falling 2.64 sec., or 4.6 times as great as before; therefore, the range is 4.6 times as great as before. If he stands on a cliff 10,000ft. high the time of falling will be 25.74 sec., and the range 45 times as great as in the first case. In all this the resistance of the air is neglected, as is also the very slight diminution of gravity in ascending the heights mentioned. The effect of the resistance of the air might be given approximately by empirical formulae, except that the necessary data are wanting. The velocity of projection is supposed to be the same in all the above cases.—DUBLINIAN.

[45963.]—Range of Projectile.—There is not any doubt about the ranges of guns being affected by the height at which they are placed. The greater the height the greater the range, though I cannot give a short rule. The reason is very simple, namely, that the path of a projectile (as well known to all educated men) is not straight, but approaching a parabolic curve, most nearly straight at first, but gradually becoming more and more curved as it passes on, owing to the force of gravity drawing it to the earth. This subject is exhaustively treated by Sir Howard Douglas in his "Naval Gunnery," with elaborate calculations. A copy, second-hand, often to be had for a very few shillings. Also explanations in Hans Bask's "The Rifle," price 6d. to 1s., second-hand; and in many military works.—H. Y. POWELL.

[45963.]—Legal.—Marriage with a deceased husband's brother is in the same position as marriage with a deceased wife's sister, and is illegal. In the case put by "S. F. F. H." there has been no marriage in the eye of the law, and the brother cannot be made liable to maintain the children as if such had been a valid marriage. The woman is in the first place, responsible for their maintenance, and if she is unable and they become chargeable to the parish, the father

could be made to contribute towards their support.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[45968.]—Repairing Large Marble Mortar.—"Grocer" might try to stick the pieces of his mortar together with a solution of silicate of soda (sometimes called "soluble glass" or "water-glass," and costing, in small quantities, about sixpence per pound).—ALFRED W. SOWARD.

[45969.]—Boiler Power.—The nominal horsepower of a boiler is calculated from the amount of heating surface. Some allow 10 sq. ft. per h.p., others 12 sq. ft. A boiler the size given in your query, would be reckoned a 40 h.p. boiler, supposing the grate, &c., to be of the usual proportions.—LABOR OMNIA VINCIT.

[45969.]—Boiler Power.—Armstrong's rule is to find the grate-area and heating-surface in square feet, then allow one square foot of grate and nine square feet of heating-surface to the horsepower. You do not give the grate area or dimensions, but from the size of boiler I expect it is set down as a 50-horse one, perhaps.—SUNLIGHT.

[45972.]—Flywheel.—Do you mean a hand-wheel? If so, that is a plan much used by wood-turners. If you are doing metal-turning mostly, I should advise not too large a wheel—say four to five feet.—SUNLIGHT.

[45972.]—Fly Wheel.—Certainly; I once worked at a "ten-inch centre Whitworth screw-cutting lathe," with a fly-wheel of about 6cwt., about 4ft. diameter on the rim, with a 2½in. belt on the drum, which was 2½ft. diameter; two men turning this enabled good work to be executed.—J. J. A., Liverpool.

[45975.]—Boiler for Model Engine.—The simplest form would be a horizontal externally-fired boiler. If you have ample room for such, it should be 4ft. long and 1ft. 6in. diameter. It should be set in brickwork with a flash flue, so that one half of the diameter is exposed to the furnace and flues. The firegrate should be about 1ft. wide, and 12in. to 15in. long. If it should be more convenient to make the grate a little wider, it could be done; but in that case you would need to carry a thinner fire. I should not advise you to have a smaller engine by any means to drive a lathe. Small engines do not work up to their theoretical power by any means. This is due to friction, condensation, and any other causes, so that it is far best to have a margin of power. You would be perhaps told that an engine with 3in. bore is equal to 1 horse-power; but it certainly will not do what 1 horse will. I, therefore, could not advise you to use a smaller engine—that is, if you want to do any real work, beyond just turning the lathe. Years ago I started to set up a small shop for myself, and had too small an engine, and, worse still, was over-persuaded to have a boiler not equal to the engine. It was a source of annoyance to me for a long time, until I got a new boiler of more than sufficient power, and it taught me a lesson I have never forgotten.—SUNLIGHT.

[45978.]—Amateur Geologist.—A "Novice in Geology" will find Geikie's "Outlines of Field Geology" useful for information regarding outfit, &c.; but, as to naming fossils, I have always found it more satisfactory to compare them with specimens in some good museum than to trust to those figured in books, &c., and a "Novice" will find the former the better course to adopt if any museum of geology is within easy access of him.—TITTSWORTH.

[45980.]—Legal.—I believe that in Australia freehold land, in the absence of a will, descends to the heir-at-law, as in England; but it may be that the memo. amounts to a will, as to which I can say nothing without knowing more. I presume that by "probate duty" "Participant" really means legacy duty, for probate duty is the same in all cases, whoever inherits, according to a scale; while legacy duty is, for nephews and nieces, three per cent. upon the sums they respectively receive.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[45982.]—Photo. Transparencies.—You cannot do it. If you take a photo. of any picture or object, the lights and shades are reversed, and hence it is totally unfit for a transparency. What is wanted is to produce a picture that gives the lights and shadows (on the screen) as we see them naturally. You cannot by any photographic process reverse the natural order of things, and, therefore, you must first take a negative, and from this, by the reversal of the lights and shadows, produce a transparency which gives us the natural effect when projected on a screen.—SUNLIGHT.

[45982.]—Photo. Transparencies.—I have tried two plans of doing this, but they were no good, being very foggy all over. If I only want one positive I intensify with plain saturated solution of bichloride mercury, and when dry back with black varnish. The picture before intensifying

should be very clear and rather thin. I do not know whether they are permanent, as the first one I did was only six months ago. A plan of making negatives was given in the "Year Book of Photography for 1881," but I have not tried it, as it is only suited for collodion.—E. F. C.

[45983.]—Oil for Microscope-Lamp.—Paraffin oil and belmontine being composed simply of H and O, the products of combustion can be only carbonic acid and water. Hence any unpleasant odour given off by a lamp must be caused by escaping vapour, either from the reservoir being too hot, or from the wick and flame failing to bring about proper combustion. Some praise Colza oil; but it is doubtful whether you can have anything better than the best paraffin oil. It is your lamp that requires looking after.—NUR DOR.

[45985.]—Debtors in the Isle of Man.—The Isle of Man has its own peculiar laws and customs, and its own courts. The only way I know of by which a debt can be recovered there is by employing some local lawyer to sue for it in the proper tribunal. The English courts have no jurisdiction, and as the amount is certainly small, I should advise writing a strong letter before incurring any certain expense.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[45989.]—Lake Bottom.—The proper way is to lay a bottom with puddle clay, well worked and beaten down. In your case a doubt arises in my mind as to the effect of the weight of water on a yielding material, like peat. If it is sufficiently dense and thick, it would possibly be able to carry the weight of the water without, by its yielding, causing fissures in the clay. If the clay is well laid, the water would not run off, and would only be carried away by evaporation. So that the small fountain overflow would do something at least towards maintaining the level.—SUNLIGHT.

[45993.]—Railway Distant Signals.—When the semaphores were introduced on one section of the G. W. R. in place of the discs, several drivers and firemen spoke to me about it, telling me they would much rather have the old ones back again; that is, the discs.—TANK.

[45993.]—Railway Distant Signals.—A notched arm for a distant signal is the pattern of the L. and N.W. G.N., North Staffordshire, N.L., and other lines, while the Midland use a kind of oblong board for distant, and semaphores for home signals. With regard to lights, the G.N.E. seem to have entirely discarded white, except as a back-light with the arm at danger. However, white is better seen than green, and, therefore, more preferable when it cannot be confounded with station lamps, &c. The G.N.E. signals with the arm working entirely outside the post, can be seen very well, and are transplanting the older kinds in many places. This pattern is used for both home and distant signals, the "distant" having the end of the arm notched.—TITTSWORTH.

[45993.]—Railway Distant Signals.—Arms are more easily seen than discs. It is safer to have two "distant" signals. Because, if the signalman mistook which of two trains was approaching, and having only one distant, lowered it, the points, &c., having been set for the wrong line, the driver would not be aware of it until the "home signal" for that line was sighted, which he might not be able to do until he was close upon it, and too late to stop them, perhaps running into a siding instead of the main line. Whereas, if two "distant" had been used, he would have noticed which was "off," and if the wrong one for the line which he had to travel on, would be able to stop before the junction was reached. (Of course, if there are two sets of "facing points" there must also be two distant signals for up-line and two for down.) The distant signals should be "locked" with the corresponding "home signals," and these again with the points. Green lights are to be preferred to white for "all right" signals, especially at a large station, or near a town, as if not, they are likely to be confounded with other white lights, such as lamp-posts, &c. "Distant" "all right" lights are generally white, except at some junctions, where they are green instead. Back lights are generally green, but purple would be better, green sometimes being mistaken for a caution signal.—A. W. G.

[45994.]—French-polishing Fretwork.—"R. T. T." should remember that French-polishing would be of little use were it not for the very clogging he complains of, and I dare say he would quickly find fault with the process if it did not fill into a surface the open grain of the wood. It is just because "brush polish" will not do this in a satisfactory manner that the polish is put on with a rubber; but even supposing it were not so, he would surely find it quite as troublesome to follow the fine lines of the fretwork several times over with a brush as to clear the clogging away once with a penknife. The only varnish likely to dry with an even surface is copal; but I think if he tried that once he would get his fine parts in such

mess, that he would ever afterwards have a good word for French-polish.—W. H. DAVIES.

[45998].—Slide-Valve.—The way to do what you want is easy enough. All you want is the ordinary slide-valve, with such an amount of lap as will do what you want. Any properly-proportioned valve would not only cut off the steam at the required one-third of the stroke, but could also be made to close the exhaust until any required portion of the exhaust stroke has been made. I have not time at the present to go into the matter for you and ascertain the proportions; but, if you have any idea of the action of the slide-valve, by making a cardboard model you could easily find out the needed proportions, without any intricate calculations.—SUNLIGHT.

[45999].—Jewellers' Solder.—To make platinum adhere firmly to gold by soldering, it is necessary that a small quantity of fine or 18-carat gold shall be sweated into the surface of the platinum at nearly a white heat, so that the gold shall soak into the face of the platinum; ordinary solder will then adhere firmly to the face obtained in this manner. Hard solder acts by partially fusing and combining with the surfaces to be joined, and platinum alone will not fuse or combine with any solder at a temperature anything like the fusing point of ordinary gold solder.—THOS. FLETCHER, Museum-street, Warrington.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

"Since our last, 'Carstairs' has replied to 37583, 37584; 'Organ Builder,' 45271.

45415. Cement for Bicycle Tires, p. 312.
45419. To Produce Smoke and Soot, 312.
45421. Phosphorus in Iron Ores, 312.
45430. Driving Clock for Clin. Cooke Equatorial, 313.
45432. To "Clerkenwell Clockmaker," 313.
45445. Double Stars, 313.

45526. Micro. Objects, p. 411.
45531. Guardianship of Children by Marriage Settlement, 411.
45539. Eyepieces, 411.
45543. Stop Watches, 412.
45549. Wate, 412.

QUERIES.

[46000].—Pianista.—In No. 876, "W. H. H.," Brixton, contributed a very interesting reply on this instrument. Will he kindly favour several of your readers with information on the following points?—1. Is the air reservoir constructed with two cuckoo feeders, and a receiver above, like barrel-organs generally? 2. What is the diameter of the wheels, and how many teeth in each? 3. What is the diameter of vulcanized rollers, and their length? 4. Is the second wheel placed on the under or upper roller? 5. Are not the three shelves hollow, so as to serve for channels to convey wind to the small bellows? 6. What is the space between the bellows and each shelf? What is height of bellows when fully inflated? 7. The upright rods are, I imagine, simply trackers to pull down one end of lever when inflated. Which end? 8. The wires and cranks attached to end of levers are mysteries to me. Will "W. H. H." explain their construction, arrangement, and action a little more fully, so that a dull fellow like myself may comprehend what is meant? 9. The valves are a stumbling-block. Please explain their construction and action. 10. Is not the use of the ribbed cylinder to keep the cards on the table by resisting the pressure of the levers? 11. Are the tails of the levers, under the table, all of one length? And how is the action conveyed to the valves, which are situated at different distances under their respective bellows? 12. Will "W. H. H." please explain if I am wrong in the following idea of the action of the instrument?—When an open space on the card comes over the point of a lever, the lever is forced upwards by means of a spring, and in rising drops its tail end, which movement, by means of wires and cranks, opens one valve of the bellows and closes another. The valve of the bellows being opened, the wind is forced in, driving the bellows-board down, and this board carries with it the stick, which drags down the lever, which exerts a pressure on the key of the piano. As the card is carried onwards by the action of the rollers, a solid piece of card comes over the point of lever and presses it down. The tail of lever then rises, and in rising stops the communication of wind with the bellows, and by means of a second valve, which it opens, allows the bellows to empty themselves, and thus the key of piano is restored to its normal place. 13. What is the thickness of cards, and their width? 14. What is the interval of space between the first and last lever-point? I hope "W. H. H." will not feel frightened at this long list of queries, but generously come forward to help one who is desirous of trying his hand at making this piece of apparatus.—W. R. H.

[46001].—Thermometer Screens.—Would some of our meteorological friends kindly give the measurements of the Stevenson screen, with I believe is the one used by observers for the Society? Many books mention it, but none give the dimensions, and I do not want to have one made larger than necessary. Are the thermometers fixed on the back of the screen, or are they suspended in the middle? I can see several objections

to this form of screen, and should like opinions on the following, which is an idea of my own:—A 4ft. 9in. upright post, having cross-pieces to support it like a letter X, near the top of the post nailed on a piece of wood 9in. from the top, and about 9in. by 8in. To fasten the thermometers to, the whole covered with a canvas top (painted outside and inside white), about 18in. diameter—exactly the shape of an umbrella. The air would be able to circulate round them freely, and they would be shaded from the sun and rain on all sides and at any angle. Of course, a wooden or zinc top, having four triangular angles would be better, having one gable to open to take observations.—F. M. S.

[46002].—Feed-water.—To "SUNLIGHT."—In the issue of the *Engineer* of December 30th, '881, is a report of experiments with two Corliss engines, one condensing, and the other non-condensing. In this report, chief engineer Jaherwood, U.S. Navy, says the temperature of the feed-water with the condensing engine may be taken as practically constant at 100° Fahr., while the feed-water of the non-condensing is 200° Fahr. A leading article in the *Engineer*, January 20th, page 47, says 120° is about the maximum temperature of feed-water for a condensing engine, and 200° for non-condensing engine. Without referring to the difference stated by these two authorities, I wish your opinion as to the possibility of increasing the temperature of feed-water in a condensing or compound engine above even 120°. Can this not be done by exhausting the steam first through a heater of large heating surface before it passes to the condenser, and by keeping the heater as much removed as is practicable from the condenser? If this idea is thoroughly carried out, I cannot see why the temperature should not approximate in the case of both types of engines. Am I right?—BIRKENHEAD.

[46003].—Legal.—To Mr. F. WETHERFIELD.—A. ordered certain goods of B., to be delivered to A.'s order at a certain station (orders in writing), and no mistake made by A. as to station, A. having kept a copy of order. B. sent the goods to wrong station, and A. had to pay demurrage and additional carriage from the wrong station to the right one, to the Railway Co., through B.'s mistake. Can A. set off the amount of demurrage and carriage paid by him to the Railway Co. in an action brought by B. for the goods? or must he bring a separate action against B. for the demurrage and carriage, or can A. recover the amount of demurrage and carriage as paid on B.'s account, or in any other way at all; or ought A. to have informed B. of his mistake before paying the Railway Co.? A. received in the usual manner a consignment note from the Railway Co., and took it, as a matter of course, that it was to the right and usual station; B. having often previously supplied goods to A.'s order, and always to the same same station. A. holds a letter from B., in which he states the goods were consigned as per A.'s order, and from that time remained exclusively at A.'s risk and expense. A. again says they were not consigned as per his order, and of which A. holds proof. P. T. O.

[46004].—Cosine.—Will someone kindly tell me the meaning of the right-hand member of the following equation:—

$$\frac{c}{c+d} = \cos \left(a \sqrt{\frac{A}{BC}} \right).$$

I want to solve the equation, d being the unknown quantity.—E.

[46005].—Barometer.—Will Mr. Lancaster, or other correspondent, kindly state the method of "correcting" and "reducing" any particular reading of a barometer to 32° Fahr., and "mean sea level," when height of the locality and temperature are known? Also simple tables for determining the height of places barometrically! Also if anyone remembers, or has any record, of the barometer readings having been ever so high before as from 17th to 21st January last, when it exceeded in some localities 31in., unreduced (mean temperature being 45°), height under 3ft. Is it possible for a standard barometer to rise beyond 31in.?—AQUARIUS.

[46006].—Comets.—"W. C. E." says (45611, quoting Guillemin's book, "Les Comètes") that there is no authenticated instance, except one, of a star being seen through the nucleus of a comet. Was not a fixed star observed through the nucleus of comet b , 1881?—AQUARIUS.

[46007].—Turning Wooden Balls.—I have several gross of wood balls, about 1in., with a 1in. hole bored through, to make. I have been trying to turn them in lengths out of be. ch. They always break off when they are about half through. I use a heading tool (home made). I should be much obliged if some of "ours" would tell me the proper way to set about it, and what tools to use!—W. X. OWEN.

[46008].—Hot-water Pipes.—I have just had heating apparatus fixed at my house, and the pipes run round the rooms close to skirting-board. They are 1 1/2in. pipes, on the low-pressure system. I wish to have them painted similar to other parts of woodwork in the rooms, and am told that ordinary paint will obstruct the radiation of heat. Is there any other liquid that would answer the purpose intended, without the obstruction?—S. T. J.

[46009].—Gutta-percha Socket.—I wish to make a kind of socket of gutta-percha. How must I prepare the gutta-percha so that the socket will keep its shape when made, if, by chance, it should be subjected to slight heat?—K. K.

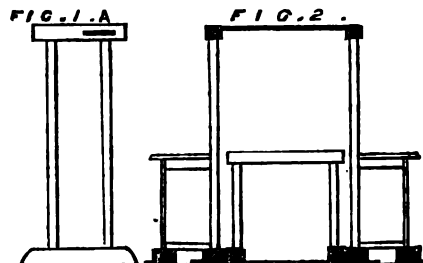
[46010].—Lead in the System.—Would Dr. Edmunds kindly advise in the following case?—I have a brother (painter by trade), who, I believe, suffers from the above. He is often attacked with pains in different parts of the alimentary canal, and of late has been subject to spasms in the muscles. If he would say how to treat the above in his medical replies, it would be thankfully received by—J. B.

[46011].—Battery.—Will Mr. Lancaster kindly explain the following?—I am thinking of a making a battery like that described on p. 67, No. 881, Vol. XXXIV.; but I should like to know (1) Whether I could dispense with the reservoir and tubing by putting the solution into the cell? (2) For what purpose is the calcined lampblack—is it necessary? (3) Is the paraffined paper necessary? (4) Does any local action take place?

(5) Does the zinc plate require amalgamating?—No NAME.

[46012].—Tile Moulds.—Is there any better article to face the top of wood moulds than leather pegged on? Would any kind of metal answer better?—CLAY.

[46013].—Overhead Apparatus to Lathe.—I have been studying with interest "J. L.'s" articles on overhead apparatus in Vol. XXII. *ENGLISH MECHANIC*. Articles I. to IV. I understand, but what follows is quite incomprehensible. Articles V. to VI., and Figs. 11, 12, 13, and 14 only confuse me. As my lathe is in a parlour, I cannot attach a pair of brackets to the wall, as recommended by "J. L.," and I cannot use the rafters for the overhead as recommended for Gilray's lathe in the *Journal of the Amateur Mechanical Society*. I am constructing a frame, as shown in sketch of beech-wood. I have chosen the size of wood used by Holtzapfel for such of his lathes as are mounted on wooden frames—viz., 6in. wide by 2 1/2in. thick. It consists of four uprights, of which two are framed together on each end, and is 7ft. high. Each frame thus forms a parallelogram, 7ft. by 2 1/2in., the cross-bars at top and bottom being a little over 2ft. (see Fig. 1). The lathe is 4ft. long, and the frames



stand away from each end 8in., and are connected by cross-bars of iron, attached at top and bottom, as shown in Fig. 2. Between them the lathe is seen to stand. Through the top side-bars at A, I shall put centres to carry a frame. These centres will have 1 1/2in., between which is the traverse of my slide-rest. To prevent any tremor in my standards, I add a small frame at each end to carry a table. On one side I shall fit a grindstone and a circular saw, and on the other a vice and drilling arrangement. This small frame on each side has the effect of a strut, and makes the whole steady. It is fastened by brackets to floor, as is shown in the drawing by black lines. I shall feel much obliged if "J. L." or "D. H. G." will describe the secondary frame, and how it is to be attached to the main frame, as I cannot understand Articles V. and VI., or the drawings, which seem to be a lot of unconnected fragments of the arrangements. Those on p. 193, Vol. XXII., simply confuse me. A perspective drawing of the apparatus would, perhaps, make much which cannot now be understood plain.—F. W. MACKENZIE.

[46014].—Rabbits.—I have a lot of rabbits which I wish to fatten for eating. Would someone advise me as to what I should feed them on, and at what age it is best to kill them?—CATCH 'EM.

[46015].—Fowls.—I have six hens (hatched early in last year), also some nine or ten older ones, and a cock. I cannot imagine why it is I only get one egg a day, although I keep them very well fed. Would someone kindly give advice?—HATCH 'EM.

[46016].—G. E. R. Locomotives.—I should be very much obliged to any of "ours" who would give me the dimensions of the coupled bogie engines on the G. E. R. I. As also of the 5ft. 8in. inside cylinder class; and, space permitting, a sketch of the former. I should also like to know whether the 7ft. 6in. singles are satisfactory! No doubt a word or two concerning the locomotives in general, employed on this line, would interest many readers besides.—TYS.

[46017].—Fan.—Could some reader inform me whether a fan made with six flyers, and each flyer 6in. square, so that the fan is about 14in. in diameter, and driven by a treadle about one 100 a minute, would give me enough wind to do ordinary smithing work at my forge, as I have no room for bellows?—BROOKS.

[46018].—Turbine for Low Fall.—Would "Sunlight," W. J. Brown, or anyone, tell me about a turbine for low fall? I have command of a stream passing about 1,000 cubic feet per minute. The fall from surface of head to surface of tail water is 4ft. I am led to believe I can get over 4 h.p. If it is not too much to ask, would you kindly give particulars, so that I might try and make one—considering myself pretty handy. I want to drive a circular saw. Have eight feet start and average beside me; but would not a turbine do better?—A. L.

[46019].—Sausage.—Can anyone inform me how to make the celebrated Cambridge pork sausages?—the quantity of meat, also the quantity of spice, say, for 30 pounds, and what it is they put in them to make them keep three or four days?—S.

[46020].—Lathe Matters.—I should be obliged if Mr. Evans will state what means are used to get the back centre to retreat, when a cylinder is being screwed between the centres, by means of a traversing mandril?—WARR HALL.

[46021].—Battery Power.—Can anyone tell me whether a half-pint bichromate battery is equal in electromotive force to four quart Leclanché batteries? If not, what size bichromate battery (bottle) will be equal to them?—BELLINGHAM.

[46022].—Railway Brakes.—Please say what has become of the hydraulic brake-train, which, for some years, has worked the 4.40 p.m. train from St. Pancras station? Also, what brake is now used on that train?—A. DRIVER.

[46023].—Westinghouse Brake.—What engines on Midland Railways has this brake been removed from?

I notice that E. B. Clark's newly-situated cars have the old axle on pipe. Are the automatic couplings unsuccessful? What other type than G.E.R. and L. and Y.R. being main brake-pipe to leading end of engine?—H. S. P.

[46024].—**Cementing Silver to Polished Marble.**—Having a valuable black marble timepiece presented to me, on which was a silver plate bearing the inscription, I cannot get the plate to adhere to the marble. I have tried all I know, and would be glad if any of "ours" would assist me. Common glue seems to have been used in the first instance—viz., a piece of wood, formed to fit a mould in the marble and glued, then the silver plate glued to the wood.—W. A. H., Manchester.

[46025].—**Midland Engines.**—Will "C. E. S." or any other Midland authority, kindly say why the new 7 ft. coupled express engine, No. 1347 (and I think 1345 too), is placed on the A list? I thought this indicated early breaking up; but these are the newest class but one, and I believe are not more than three or four years old.—Z.

[46026].—**G. W. Engines.**—How many (and which) of the 8 ft. "Great Britain" class of G. W. express engines are still running? And how many (and which) have been rebuilt or had new boilers? Are any of the 7 ft. coupled "Waverley" class still running? If so, which? What was former name of "Bulkeley"?—Z.

[46027].—**Broken Watch Chains.**—To "A FELLOW-WORKMAN."—I often have some difficulty in knocking out the pin in order to form the female. If you could kindly suggest some expeditions way of doing this, I should be very grateful.—NEGLECTED APPRENTICE.

[46028].—**Legal.**—A manufacturer brings out an article and calls it by a grand name, but does not register the name until several months after. Can he prosecute any person for using the name?—DABBLER.

[46029].—**Analysis of Silicates.**—Can anyone give me the result of their experience in using the method of fusion with lime and sal-ammoniac for the complete analysis of firebrick, or for alkalis only? I have tried it, but have not found it as accurate as some writers say they have.—DABBLER.

[46030].—**Optics.**—May I ask "Ordoric Vital" if the coefficient 0.33 which he uses in his two last papers on Optics should not be 0.92?—J. S. S.

[46031].—**Gun-Stock Chequering.**—Will any of your correspondents kindly oblige by giving some idea of the time it takes a man, well used to the work, to chequer a gun and also a pistol-stock.—ISQ.

[46032].—**Legal.**—A. agreed with B. to pay him 10s. per week to secure his services, when ready to start work, at same time leaving B. at liberty to take a situation, but to be ready to commence for A. when required. B. tried to get work, but failed. It is now 12 months since the above took place, and B. demands payment for loss of time. Is A. liable? Would this be a case to be settled in C. Court, should A. dispute B.'s claim?—CONSTANT READER.

[46033].—**Medical Coil.**—To Mr. LANCASTER.—When a medical coil is made with one ounce each of wires Nos. 32, 34, 36, 38, for secondary, as described in "E. M." of 27th ult., what advantage is there by putting on so many different sizes of secondary wires? Would not three or four layers of No. 32 for primary, and four ounces No. 36 for secondary, make a better coil? How is a coil with two wires, No. 18 and 32, "joined up" for medical use? The articles on the Induction Coil you promised a few weeks ago have not appeared yet.—J. MAIN.

[46034].—**Amplifier.**—How is an achromatic concave amplifier made?—a double concave of crown, and a plano-convex of flint, or a meniscus of flint, or what? Also, what focus is required when placed 3 in. above the front lens of 4 in. objective to double its magnifying power?—XANTHIDA.

[46035].—**Grinding Hard Minerals.**—Can any of "ours" inform me the best, cheapest, and quickest way of grinding hard minerals to a fine powder, and whether grinding by edge-runners dry, or in water, and floating off the powder, is the cheapest, and most effectual of the two, and of which some facts in proof will oblige.—AMATEUR MILLER.

[46036].—**Gasometer.**—Will "Sunlight," or some other reader, give me dimensions to supply one lantern with oxygen and common house-gas for an exhibition of two hours? I intend making them of wooden boxes, well painted inside and out, doretailed, and bound at angles with iron hoop. The larger and outside box to have four guide-rod, one in each corner, to keep the bell or inside box containing the gas in position. What weight shall I require for each gasometer, and will the gas have any injurious effect on paint? If it would not be asking too much, would you please describe the best form of mixing-chamber in the oxy-hydrogen jet?—STICK IN THE MUD.

[46037].—**Condenser.**—To "SUNLIGHT," AND OTHERS.—Will you kindly tell me the probable cause of my condensing engine (24 h.p.) heating its water to such an extent as it does—viz., 124° in the 14 days, and very frequently losing its water altogether? We have had all the rubber valves made as good as used by, and the grids scraped and cleaned; but all to no much good. Lately, we have had a vacuum gauge attached to the engine; it works at 24 in. at the early part of the day, but dwindles down to 18 in. by night, and never still, flickering at every stroke of the engine. I should be greatly obliged if someone will direct me to the remedy of the above.—R. T. B.

[46038].—**Solvent for Coagulated Albumen.**—Can any of our chemical correspondents tell me of a solvent for albumen that has been coagulated by heat? In the circumstances I wish to apply it, the solvent must not be alkaline nor strongly corrosive. I wish to remove a varnish of coagulated albumen without disturbing a greasy ink which is below. Strong nitric acid does it, but is too corrosive. Caustic soda also removes the varnish, but removes the ink as well. Can any reader help?—YANNU.

[46039].—**Model Boiler.**—To "SUNLIGHT."—Will you advise in the following case?—I have a plain cylindrical boiler, 27 in. long, by 11 in. diameter, made of 5-16 iron plate, welded, with which I have been driving an engine with cylinder 1 1/2 in. by 3 in. Do you think it will make steam enough to drive an engine with two cylinders this size? If not, what size of cylinder should I make the engine to have two cylinders, as I wish to keep it running six or seven hours at a time? Also, what pressure will the boiler carry with safety? What pressure have I with steam blowing off with valve 11-16 bore, and the bell weighing 27 lbs., 4 in. from the valve-spindle, and 5 in. from the stake?—AAC.

[46040].—**Electro-Magnet.**—I want to make for use a tolerably-powerful electro-magnet, and have in fact made three of soft iron; dimensions as follows:—1 in. by 1 1/2 in., flat iron (horseshoe), 1 in. round (also horseshoe), and one of a piece of 2 in. steam-pipe 3 in. long, split, and all of them are covered with No. 22 cotton-covered wire, the two former to the depth of their thickness—i.e., the coil of wire tightly wrapped and projecting 1/2 in. in first case, and 1 in. in second, and wrapped from within 1/2 in. of end to about the same from bend, right to left-handed helices, of course; the flat magnet has 25 yards of wire upon its coil. Now I have made eight pint Daniell cells as follows:—Outer stoneware jar containing zinc plate, amalgamated, 5 in. by 10 in., with dilute sulphuric acid; porous pot, of 1 in. drain-pipe, unglazed, with a cement bottom, copper, 1 1/2 in. by 5 in., saturated solution of sulphate of copper, and with these eight cells, although I get a sharp shock to the tongue or lip, I fail to magnetise the soft iron to any great extent, while with a few plates of zinc and copper immersed in dilute acid, I get a powerful magnetism for a few minutes only—of course till the copper becomes covered with hydrogen. Will Mr. Lancaster, or "Sigma," or any of your correspondents, advise me how to make a constant battery to develop my magnet and yet be within my means?—PRZELLEN X.

[46041].—**Cement Testing.**—Could any of "ours" tell me where I am to seek for the best cement-making machinery, such as pug-mills, mixing-mills, and grinding mills?—MILLS.

[46042].—**Lathe Bearings.**—I have a lathe, a 5 in. foot, which will not turn smoothly. The work is "rivery," to use a workshop term, and jars and chatters while being done. The spindle and collar are both of hardened steel, and the spindle is cone-shaped, the sides making an angle with its axis of 12°. The collar seems true, but the spindle shows that it does not bear all over, being bright in patches. Could I grind it into the collar in any way, or does the defect arise from its not having a double-convex bearing, as most lathes I have seen have? Although I screw the back centre up until I can only just turn the lathe, the jarring is just as bad.—W. T.

[46043].—**Cylinder Pistons.**—I am about to replace a pair of pistons to cylinders 2 1/2 in. diameter, and the stroke 4 in. 6 in., and to rebore the cylinders, and working with single piston-rods. Would you recommend to put double piston-rods to work through a stuffing-box and guides at the back of the cylinders as in front, to keep the weight of the pistons from the bottom of the cylinders? Some engineers prefer the former plan to work with a single rod. They contend that the weight of the pistons is taken off the bottom of the cylinders when the pressure is put on the pistons. I cannot understand how this can be.—ANXIOUS TO KNOW.

[46044].—**Melting Fat.**—I melt fat contained in scraps of skin as a lime soap with the aid of sulphuric acid, but find, on blowing in free steam, only a portion of fat rises: the most sinks to the bottom with the sulphate of lime, &c. Why is this? I am told by a chemist that it is albumen. How can I separate the fat without using ether or bisulphide of carbon?—JAMES TANNER.

[46045].—**Battery for Heating.**—What Bunsen battery-power would it take to heat 4 in. of No. 35 platinum wire red-hot, using quart cells, and what to heat 5 in. same size?—DYNAMO.

[46046].—**Influence of Music on Snakes.**—I happen to possess a small Brazilian snake, about 18 in. long. It is covered with rough scales, and is dark sienna brown in colour, feeding in confinement upon cockroaches and other insects. The sailor who brought it over, handled it with impunity, believing it to be perfectly harmless. The eye is remarkably bright, colour black, with yellow skin round it. The tongue is about the thickness of a fine knitting needle, red, tipped with black, and is frequently protruded from 1/2 in. to 1 in.; from its extremity the reptile thrusts forward two thread-like appendages 1 in. long, which he shakes about for a second with a quivering motion and then withdraws. Music readily excites him, especially tunes with a full bass, the treble notes not having such a marked effect. Whilst he lay quiescent at the bottom of the large glass jar in which he is confined, a lively tune was played on a harmonium, he at once raised his head, extended his body in a perpendicular direction until the head touched the gauze cover, and appeared to desire to escape. This activity increased as long as the music continued, but as soon as it ceased he dropped down to the bottom of the jar and lay quiet as before. This experiment was tried many times, and always with the same result. How is this explained? Is the reptile attracted by the music and desires to get nearer to its source, or is it fear, and does he seek to escape from it?—WALLAST.

[46047].—**Speculum Working.**—Can Mr. Wassell or "Prismatic" explain the reason of my failure to successfully fix two 5 in. iron grinding-tools together? I find that they always take a polish when worked together more readily at the edge than in the centre, which, I suppose, indicates that both tools are too high at the edge. I have used every variety of stroke I can think of, and have worked with emery both wet and dry; but the result is always the same, though it varies a little in degree. Both tools are cut into facets 1 in. square. The concave tool gives a sharply-defined fringe of the sun, but a halo of fainter light extends for about 1/2 in. beyond the sharp edge of the disc.—E. C. A.

[46048].—**Grove's Experiment with Magnetic Oxide of Iron.**—The oxide is suspended in water in a tube, rendering the water opaque, until a current passes round it. Can any of our correspondents oblige with the

following details?—1. What length and diameter shall the tube be, and of what material? 2. Length and gauge of the surrounding wire? 3. Minimum battery power required to produce a good effect?—A. S. T. E.

[46049].—**Time by Electric Current.**—Will some of your practical readers give a few hints respecting the above, as I have thought of having some in connection with business 45 miles from Greenwich, and 150 yards from the post-office here? Any information as to the probable cost and the simplest construction will be gladly received by—SYNCHROSTER.

[46050].—**Engine Query.**—To "SUNLIGHT."—What I require is a vertical engine and horizontal boiler for a pair of double-acting oscillating cylinders 1 1/2 in. by 2 in. stroke. What form of boiler is best for a methanol spirit-lamp—that is, the one that will heat quickest and burn least fuel; and would you recommend one cylinder double the above size in preference to it? An answer to the above would oblige—SIGMA ZETA.

[46051].—**Muriate of Zinc Solution.**—Will any correspondent inform me through the "E. M." how I can make muriate of zinc solution practically, together with the strength of liquor at certain reducing quantities? For which I shall be greatly obliged.—AMATEUR DYER.

[46052].—**Old Violin.**—Will some of "ours" kindly give us information about "Ignatio Pense"—any of his fiddles of any repute? I have one of his which has the shape and good tone. I could not decipher the label, but Mr. Valve supplied the key in query 45688, p. 43.—CROMO.

[46053].—**Windmill.**—To Mr. VALLANCE.—If the correspondent is the same gentleman who wrote about a horizontal windmill which he used for ploughing in Vol. XII., would he kindly, with the Editor's permission, send a sketch and description of it? If the Editor does not think it of sufficient general interest, would it be troubling him too much to write to me if I advertise my address?—E. F. C.

[46054].—**Thermometer Screens.**—Are the Stevenson's screens in use by the observers of the Meteorological Society one standard size (if so, would someone kindly give the exact dimensions), or does each observer have them made to suit the sizes of his thermometers?—AMATEUR OBSERVER.

[46055].—**Bleaching Animal Grease.**—I should feel greatly obliged if any of your chemical readers will kindly inform me what quantity of black oxide of manganese and sulphuric acid I should use to effect perfect combination, together with the quantity of water to be added to reduce it to 66° of Twaddell for the purpose of bleaching animal grease?—AMATEUR DYER.

[46056].—**Medical Coil.**—I have a medical coil standing on a rosewood case, inside which there is an Sin. coil of solid plaster of Paris. Imbedded in the plaster there are 19 plates side by side, with a layer of plaster between each. They appear to be alternately zinc and copper, with a strip along each end, one soldered to all the copper plates, and one to all the zinc, and a wire from each. Will some subscriber tell me what battery this is, and if good for anything? It has evidently been in use for some years, and no current now passes on touching the two poles. The plates are very thin, and what portions of them appear above the plaster is very brittle. In what way is the current made to pass through the body for various complaints—indigestion, for instance?—G. GILSON.

[46057].—**Planing Machine.**—Would some of our engineering friends kindly give outline sketch of the pin, wheels, and bands used in the Whitworth machine for reversing the cutting-tool? I have searched the index back to Vol. I., but can only find the spiral, which does not suit my purpose. Knight's "Dictionary of Mechanics" calls it the "Jim-crow motion," and gives a small sketch, but it is impossible to trace the bands by it.—M.M.I.Sc.S.

[46058].—**Faure's Secondary Battery.**—How should the minimum be applied to the lead plates? Should the surface be previously prepared in any way? I made a paste of red-lead and sulphuric acid and painted the surfaces, having previously thoroughly cleaned them; but after four days they show little or no indication of drying. I endeavoured to use them with alternate felt in this condition without success. I shall be obliged for any suggestions. About what (roughly) would be the strength of current from pairs of plates 1 1/2 in. by 6 in. when fully charged as compared with pint Groves?—MENELAUS.

[46059].—**Potato, &c., Boilers.**—We have six old-fashioned boilers (bedded in brickwork, each with separate flues) for potatoes, stirabout, laundry, &c., in public Institution, at present heated by turf, the grades of which we desire to remodel for economy sake, so as to use coal instead. Ought the present grates to be removed, or could we have smaller ones adapted to slip in over them through the doors? What kind of grate would be best and most economical for heating, and not over-cold? Boilers from 2 ft. in diameter, and 2 ft. deep, down to smaller sizes.—Z. Y. X.

[46060].—**Digesters.**—Will anyone acquainted with the working of digesters for extracting fat from scraps of bacon skin, &c., kindly explain how to work them properly: pressure needed, length of time required, must vent-cock at top be kept open all the time; how is it cooled before opening lid; is cold water pumped in to create a vacuum; how long must it settle to allow fat to rise; is all the fat got out; should any water be put in?—PORKER.

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eclipses to do with the matter? In your other query you have omitted the weight of heavier metals than iron, and have forgotten that the substances you mention are probably much denser below than on the surface.]—WANTED TO LEARN. (Instructions for making in delugues have been given several times. See pp. 310, 330, 406, 457, 626, Vol. XXX. Probably the horizontal engine, described on p. 293, Vol. XXXI., would suit you.)—J. HALMS. (You should look through recent volumes. We suspect the oil. It should be what is known as double boiled. Best plan now will be to clean off as much as possible with turpentine, unless you can wait, for they will dry in time.)—J. D. (It is dissolved in bisulphide of carbon. Mineral, not wood, naphtha will also dissolve it, but if you wish to dilute the solution you must add some of the solvent used in the manufacture.)—E. A. BROOKS. (A good saw, but plenty of elbow grease is necessary. 2. No, it will do very well. 3. As close to it as you please, and as short as you like, so long as the distance is sufficient to prevent direct hearing of the ticking of a watch, say.)—CONSTANT. (You will find full directions in many back volumes; but the book named gives details. It can be had from Simpkin, Marshall, and Co., Stationers' Hall-court, E.C.)—KAPP. (It would be good policy to find out the book used at the College. We do not know one that says much about scales. In Stanley's "Drawing Instruments" there is a chapter on scale computing, and you would probably find Heather's book on "Mathematical Instruments" useful.)—H. E. R. (You will find a list of books on the subject in the catalogue published by Mr. Colver, Great Jackson-street, Hulme, Manchester.)—BOLLINGWACK. (You will find such rules in Molesworth's "Pocket-book." The last question is incompressible, unless the word is "bolts," and your signature "Improver."—DANFUSCO. (We described it on p. 25, Vol. XXX., and his latest on p. 491, Vol. XXXIII. The first acted both as transmitter and receiver; but we believe it has been entirely superseded by later inventions.)—XANTHIA. (Certainly not; one is water, the other glass. Take the word "solid," literally—i. e., the lenses close together. Other query inserted.)—J. R. C. (Same way as stone is cut, with a piece of hoop-iron and sharp sand. Make the iron into a rough kind of saw.)—E. A. (Is it a fact? If so, we cannot account for it.)—TULS HILL. (Presumably the eyes are swollen in consequence of damp, and stick on the pins; but maybe that they are not all.)—SABAR. (Mnemonic devices. Take no notice of them; they are of no importance.)—E. WHITMAN BOOTH. (Use the indices of back volumes. There is no book giving practical details, but you can gain much information from catalogues of machines.)—W. QUINN. (Your query is rather too indefinite. We have not space to give "full particulars" in the hope of answering the question, but you will find details in back volumes.)—E. S. (The composition will depend on the quality of the article to be mended. A medium gold solder is made of 10 parts fine gold, 6 parts fine silver, and 4 parts copper.)—D. (You might pump and pump; but how long would you keep the air out? and the partial vacuum would be worse, if anything, in its effects.)—LOM. PAINT. (See recent articles on the Calcium Compounds, p. 514, and back volumes. It is better to buy the material, ready prepared.)—RONN. (If you supply full dimensions of the boiler, an answer can be given; but it would be necessary to know something of the quality of the iron, whether common or "best-best.")—SUFFRER. (Try the diet recommended by Dr. Edmunds on p. 495.)—I. O. G. T. (You say you have tried "almost everything." Have you tried a medical man? No one can advise without an examination.)—E. GAMBLE. (Most of the numbers containing the articles are out of print; but you will find a great deal of information in subsequent volumes.)—TWO BROTHERS. (Boosey, Chappell, and other music publishers issue good treatises. Procure some of the catalogues.)—A BAD RISKER. (See p. 521. It is immaterial where the clock is, so long as electric wires can be taken to the alarm. We have given several devices. See, for instance, p. 564, Vol. XXVIII.)—T. E. (You want a pyrometer. Send to Bailey and Co., Salford, for a list.)—A W. OLD SCB. (You refer, we presume, to a reply on p. 224, No. 485. You can obtain all the Gregorian tones of Novello for about 3d. 2. What do you mean by "screw"? The screw is treated in any book on mechanics.)—A. (Answered in most elementary treatises on Astronomy.)—J. S. G. (Read the article "Tubes," in Ure's "Dictionary of Arts, Manufactures, and Mines." You will probably find the book at the Patent Office Library, if you cannot buy it or see it elsewhere.)—J. F. MACOMBS. (Very little at your age would be needed, if you are prepared to pay the premium.)—J. D. (Do you mean herb beer? If so, many recipes have been given. They differ according to taste; but are all simply decoctions of various herbs fermented in the usual way.)—L. S. D. (No; and nothing but the magnesium or electric light will enable you to distinguish the colours named.)—D. G. (Instructions for blacking brass were given on p. 434, No. 850, and in many previous back numbers.)—STRUBB. (You can have nothing better than the last volume of the *Building News*, just published, price 12s., through any bookseller. It contains nearly 200 pages of illustrations of all kinds of buildings—churches, cottages, houses, warehouses, &c., with plans, and is invaluable alike to the country gentleman, the architect and builder, and the student.)—KALVENKAAS. (Full instructions for the preservation of natural flowers were given on p. 423, No. 850.)—DREFF. (Don't try it. You can buy it for a hundredth part of what it would cost you.)—FRANCOIS. (Better pay some professor of the language a small fee to examine you. 2. Have you tried the Albo-Carbon light, advertised in these pages? That seems what you want.)—C. M. T. (What "practical" information is it you want beyond what has appeared? The space we have at our disposal for queries about locomotives is limited, and readers must really be explicit if they expect their queries inserted.)—X. Y. Z. (Write Mr. T. Fletcher, of Warrington, and state your requirements. We have illustrated many; but he will probably supply you cheaper than you can make; or Mr. M. Cohen, whose advertisement also appears in this paper.)—ATTENTION. (A water-motor might do. Write W. H. Bailey and Co., of Salford; but, after all, we expect you would find the gas-engine the best.)—NEMO. (Information about soap-boiling, &c., will be

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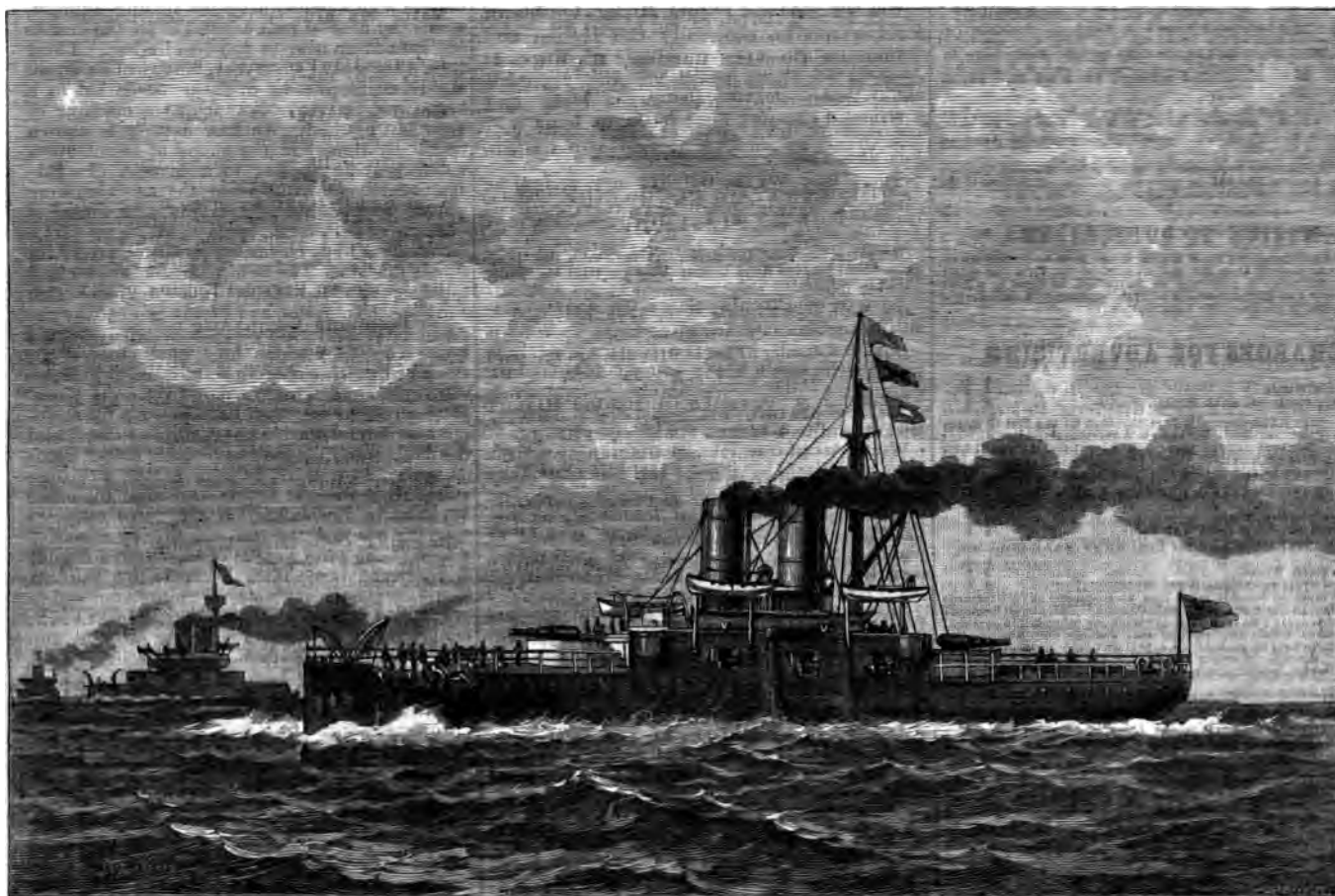
FRIDAY, FEBRUARY 17, 1882.

THE BRITISH NAVY.*

FOR some years past Sir Thomas Brassey has employed his leisure in collecting materials for what may be termed a complete history of the modern British Navy, and, judging from the volume before us, which deals with shipbuilding for the purposes of war, the work, when finished, will form in itself a library of valuable information which could be gathered only by pains-

a former work on merchant seamen. For several reasons, the first volume possesses the greatest amount of interest to the largest number of readers, and when we say that it contains upwards of 600 pages, and is full of plates, engravings, and diagrams, it will be obvious that it alone represents a considerable amount of labour. Sir Thomas Brassey calls his work a compilation, as it is in some senses; but it loses nothing from that fact, for besides translations of extracts from two important German works, King's "Warships of Europe" has been, by permission of its author, almost incorporated, while from Capt. Tromp's "Navires Cuirassés" many descriptions and admirable drawings have been borrowed. In short, Sir Thomas has freely used any matter that he considered would add to the value of his work, his main object being to supply correct information; for this reason, even the historical sketch which precedes Chapter I. is a con-

44in. thick on a backing of 18in. teak, which was calculated to be proof against the 68-pounders then in use; but with the advent of armour-clad ships came a revolution also in guns, and so rapidly did the artillerists progress, that they outstripped the naval architects, and rendered many of the vessels practically obsolete before they were completed. The race is still going on—every inch added to the armour being met by 20 tons added to the gun, the artillerists being prepared to go on until the gun becomes so large that no vessel can carry it and be managed at sea. The *Warrior* and the earlier vessels of the ironclad navy preserved in external appearance the symmetry of the splendid frigates which delighted the hearts of the old tars, but it was not long before the discovery was made that a radical change was needed, at all events in the case of vessels intended for special services. The five-masted



THE MASTLESS BARBETTE SHIP "COLLINGWOOD."

taking research and unwearied labour. The author tells us that his work had advanced far towards completion when he became a member of the Board of Admiralty, and the question arose whether it was altogether wise for him to continue his labours. That was, happily, settled in the affirmative, and, as a result, we have the first instalment of a work which, in several ways, is unique. The first volume deals, as we have said, with the ships; the second contains papers on armour, armament, torpedoes, torpedo-vessels, and cognate subjects; the third contains the "opinions" of those connected with the navy, either as constructors, administrators, or fighting officers; the fourth and fifth volumes contain speeches delivered in Parliament and elsewhere, papers in magazines, &c.; and the sixth is a reprint of

denser translation of the excellent essay on armoured ships, by Lieut. Tromp, of the Dutch artillery. So far as is known the first instance of armour protection for men-of-war was the plan of Chevalier D'Arçon, who in 1782 prepared floating batteries for the attack upon Gibraltar, by suspending iron bars over the hulls and covering the bars with a belt of cork, the interstices being filled with sand. To Napoleon III. is, however, unquestionably due the initiative of the revolution in the construction of ships of war, and after some experiments with floating batteries in 1855 the ironclad frigate, *La Gloire*, was commenced at Toulon. It was not until that vessel was nearly completed that orders were issued for the building of the *Warrior*; but having once started in the race, so much energy was thrown into the work that in 1865 this country possessed no fewer than thirty ironclads. The earlier of these vessels were constructed with armour

Agincourt and her sister-ships carried rigging to its extreme, while their great length and general unhandiness effectually condemned them as fighting cruisers. The turret principle, after a long controversy, was at length adopted, the *Monarch* and the ill-fated *Captain* were built, the former as a rival to Capt. Coles' ships, and to show the necessity of a high freeboard for the safety of the vessel as well as for the comfort of the crew. For sea-going cruisers, however, the broadside arrangement was preferred, but considerable modifications and changes were introduced. To reduce the weight of armour, and yet keep it of sufficient thickness to protect the guns, the latter were gathered into a central battery, while the vessel was protected by a narrower belt of armour at the water-line. In addition, to obtain the ability to fire at a greater number of angles, indented ports were devised, which enabled the guns to be trained in a line

* The British Navy: its Strength, Resources, and Administration. By Sir T. BRASSEY, K.C.B., M.P.; Vol. I. London: Longmans, Green, and Co.

parallel with the keel. This latter arrangement, which had disadvantages, was replaced by the projecting battery, which hung over the sides of the ship, as in the *Andurion* class, where there is a lower battery and an overhanging upper battery, allowing of all-round fire. After the battle of Lissa, attention was directed to the advisability of building vessels with stronger rams, and while providing them with a more powerful bow-fire, protecting them from the effects of raking fire by carrying the armour down much below the water-line at the stem. An early specimen of this design is found in the *Alexandra*, and a similar system is now generally adopted. The loss of the *Captain* led the Admiralty to a decision that turret-ships with full rig were not adapted to the work of cruisers, and while recognising the merits of the turret system, they decided to confine it to mastless vessels, intended for use in coast service. The *Devastation* had, however, been commenced, and a Committee on Designs having been appointed, a new departure was made; for the abandonment of sails was approved on several grounds; principally that they prevented the use of twin screws, owing to the great resistance, while the single screw was liable to be damaged by falling masts or other wreckage. It is mainly on the plans laid down by this Committee that modern war-vessels of the first class have been designed—the principle being the reduction of the armoured surface to the minimum, while increasing the thickness of the armour to the maximum. In the *Inflexible*, this principle was carried out with a return not exactly to full-rig, but to a couple of full-rigged masts—brig-rig, in fact. There is an armoured deck below the water-line, and in the middle third of the length is a citadel surrounded by armour 2ft. thick, while at two angles in a line drawn diagonal to the keel are two turrets carrying each two 80-ton guns, which may possibly be replaced by still heavier ones. There is a powerful ram, twin screws, and a submerged rudder. An unarmoured structure at each end completes the vessel, and renders her seaworthy. The design of this ship, it will be remembered, has given rise to much controversy; on one side, it is urged that the destruction of her unarmoured ends would effectually lead to her sinking, while, on the other, it is pointed out that such destruction is most unlikely to occur in any combat in which she may be engaged. At any rate, two vessels of the same type are approaching completion, and the design in its main features is accepted as the type of line-of-battle ship. Modifications are, however, introduced into the "citadel" type with each new vessel, and experiments are made with other designs. One of these, which we are, by the courtesy of Messrs. Longmans, enabled to illustrate, is the *Collingwood*, the first regular barbette ship built for the British navy. This vessel is 325ft. long, 63ft. broad, and has a depth in hold of 25ft. 5in. She was commenced at Pembroke in the middle of 1880, and has armour 16in. and 18in. on the sides and ends of the belt, with 12in. and 14in. on the sides of the barbette. In some respects she resembles the *Tim'raire*, except that the armour is confined to the middle third of the length and to the barbettes, the latter also being placed nearer the centre of the deck, to avoid the pitching in a seaway which is found to follow the placing of heavy weights near the ends of a vessel. The barbettes will accommodate four 43-ton guns, two in each, which, after firing, are run back and sunk below the level of the tower to be loaded. The six 6in. guns on the upper deck are unprotected by armour. Of the *Polyphemus*, which is a ram pure and simple, and whose only offensive weapon is the torpedo, we need say nothing, as she has been so fully described in the

newspapers; but we mention her as an indication that the author's work is complete up to date. In some respects, the title is misleading, for, though we have referred only to the British Navy, and have chosen an English vessel as a sample of the engravings, the fullest details, so far as their main features are concerned, are given of the vessels of the French, the Italian, and the German navies, with descriptions of the *Popoffkas*, and other Russian vessels, together with the most interesting ships in the Turkish, Austrian, and other navies. One of the most interesting chapters is that on the unarmoured cruisers and special vessels of the chief naval powers, while the tables giving lists and classification of the ships belonging to the navies of the world are both interesting and valuable. A coloured frontispiece, after E. W. Cooke, R.A., by Chev. E. de Martino, represents the *Devastation* firing a salute, with her bunting flying, and anchored in the middle line of the fleet. The engravings are from the pencil of the same artist, and include many of the most interesting vessels of foreign navies, especially the Italian and French, while some hundreds of diagrams serve to elucidate the text, and render a comparison of different types clear and easily understood.

THE STANLEY CLUB BICYCLE EXHIBITION.

THE exhibition of bicycles, triocycles, and their accessories, annually promoted by the Stanley Club, is this year held at the Agricultural Hall, in conjunction with an exhibition of all the appliances which go to make up what is termed "sport." The Sportsman's Exhibition occupies the whole of the ground-floor, and for variety of exhibits leaves nothing to be desired, for there are carriages, guns, fishing-tackle, cricket outfits—in fact, almost everything that pertains to the world of sport—probably the most interesting exhibit to the majority of our readers being the water velocipede of Messrs. Searle, which consists of two light boats secured together, catamaran-fashion, with a pair of paddle-wheels driven from two seats placed in a line with the centre axis. The front seat is for ladies. The same firm also show a sailing-canoe with a counter, which seems an improvement on the ordinary form. There are also several other exhibits of canoes and boats, including copies of Canadian canoes, and a very good punt by an amateur builder. The collection of bicycles and other "machines" in the galleries is, however, the best that has ever been brought together, for we have specimens of all the good makes and not a few novelties—some of them, we are afraid, rather more remarkable for novelty than intrinsic merit. Commencing with No. 1, and following the stalls in their numerical order, we find at 1 an attempt on the part of the Eagle Iron Works to meet a want in the shape of a portable triocycle lock-up, a small house or stable, which is so constructed as to take in any of the triocycles or sociables which will not pass through an ordinary doorway. Passing along we find rows of bicycles and triocycles, painted, japanned, and nickel-plated—some all bright—until we come to the exhibit of Rudge and Co., who show, amongst other machines, a Coventry convertible, which in a few seconds can be made into a single machine. A little further we find a number of machines by Singer and Co., including Mr. Charlesley's Velociman, which we illustrated last week and described on p. 130 last volume. This exhibit is one of the best in the show, though the machines vary mainly in the finish. Maynard, Harris, and Co., have the Special Devou and the Devon Safety Bicycle amongst their exhibits, and at the adjoining stall we find a four-in-hand sociable, by W. Harrison, to seat from 1 up to 4 riders. Hydes and Wigfull amongst a good collection, show an unfinished machine with their new registered ball-bearing head, which, while allowing of perfect freedom in steering, gives great rigidity, and brings the handles closer to the wheel. Instead of the ordinary cone between the backbone and the head, balls are inserted with an arrangement for taking up

wear. The Surrey Machinists' Company confine themselves to bicycles exclusively, and amongst their exhibits have two machines made for Mr. Curtis, a racer and a roadster, the former painted and made as light as possible—30lb. we understand for a machine with a wheel of 5ft., while they also show in a detached form their double section rims. This company also exhibits a new arrangement of handles, which are so framed that the rider, in the event of being pitched off, would not be hampered by his steering-gear. The improvement, however, seems to introduce a corresponding disadvantage. The Coventry Machinists' Company have the largest show of all, both in bicycles and triocycles, and the various forms of "Cheylesmore," including, especially, the new "folding" pattern, are deserving the attention of those who cannot go in for a bicycle. The Zephyr Company show a novelty in a patent "compound lever action," with rods and cranks which, ingenious as it may be, will scarcely commend itself to riders who have had actual experience of travelling on ordinary roads, and who have learnt to appreciate the fact that simplicity has a great deal to do with the success of a machine. Mr. H. Haes exhibits a bicycle with a patent attached folding support, consisting of steel rods connected to the cranks and carried up near to the handle-bar. These form a leg-guard when travelling, while a slight movement drops some of them which act as a brake, and also serve to support the machine in a vertical position. Another novelty is shown by C. R. Binney in the shape of the Dutton patent gearing applied to a bicycle. In this case, a ratchet gearing is used, the pedals working up and down behind the axle in such a manner that one or both feet may be used. The device is ingenious; but bicyclists, as a rule, prefer the simple machine. The South London Machinists' Company exhibit their well-known Nancy Lee and Nonsuch bicycles, and Flying Soud triocycles. Amongst the latter a double-driver, with patented improvement, by which the slightest turn of the steering handle either to left or right releases the right-hand wheel, which then runs loose. There are thus only two handles—one for steering and one for the brake—instead of three, and the double-driving gear comes into action automatically, as it were, as soon as the steering-wheel runs straight again. Amongst the other novelties in the exhibition are three triocycles specially adapted for hill-climbing by means of gearing—viz., the Arrow, Monarch, and Rapid; of these the last-named is made by the St. George's Foundry Co., of Birmingham, and is said to be capable of mounting inclines of 1 in 9, while it can be divided in a few seconds, and passed through a 20in. doorway. A simple motion of the right hand changes the gear from "slow" to "fast." The Monarch, which is made by W. T. Eades, of Birmingham, is also a hill-climber, but its novelty consists in the use of patented eccentric pedals, and the absence of chains and gear-wheels. Patent differential clutches are fitted to the wheels, and the cranks act as foot-rests when descending hills. The Arrow is a geared machine, which undoubtedly possesses great power for ascending hills. It was illustrated, so far as the gearing is concerned, in a letter on p. 63, present volume. Amongst lever treadle machines there are the Facile, the Devon, and the Extraordinary, and a curiosity in the shape of the Merlin, made by Bricknell and Co., of Brixton. In this machine the power is applied to the inner ends of two levers, the other ends of which are pivoted to extensions of the frame. A strap fastened to each lever is carried round a small loose pulley on each end of the axle, which carries two short radial arms and silent pawls engaging with ratchet-wheels attached to the pulleys. When the treadles are depressed the straps draw the pulleys round, and the ratchets engaging with the pawls drive the wheel round. A spring inclosed in the pulley turns it back ready for the next stroke. For this machine it is asserted that the economy effected in the rider's force is so considerable that a portion of it is available for conversion into "even higher speed than is attainable by the ordinary bicycle." It is also claimed that the friction is "reduced below that of the common bicycle." There is one notable advantage gained by the use of the loose pulley and ratchet—the stroke may be one inch or twelve, and, as the principle is applied to triocycles, they may find some favour with ladies. Altogether, it may be said that the exhibition

reflects credit on the trade, and shows that competition is spurring makers on to improve their machines in every possible way.

We must not omit to mention the stall at which Mr. Bown shows his famous *Æolus* bearings, and a large assortment of general fittings. Messrs. Lamplugh and Brown, too, show a collection of saddles and seats, bags and valises, and a new bicycle spring. Amongst makers who, without introducing any novelties, rely on the obvious excellence of their machines, we may note Messrs. Bayliss, Thomas, and Co., who show the "Excelsior" tricycle supplied to postmen; Messrs. Hillman, Herbert, and Cooper, with their celebrated "D. H. F." bicycles and the "Flying Dutchman;" Messrs. J. Devey and Co., with machines noted for low price combined with good quality; and Mr. W. Andrews, who has the lightest machine in the show, a 54in. racer, weighing under 24lb.

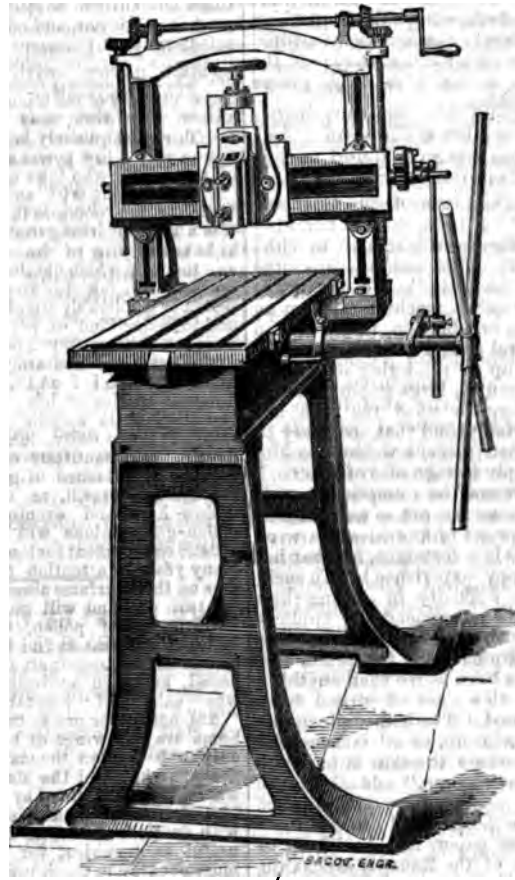
TOOLS AND MOTIVE POWER FOR AMATEURS.—XVI.

THE work of an amateur engineer may be broadly divided into four kinds of operations: forging, turning, planing, and drilling. Of the tools and appliances for the first of these I have already treated; the lathe is tolerably familiar to all readers of this journal. I therefore propose to devote the concluding part of these papers to a consideration of the tools for planing and drilling. Planing-machines in large shops are necessarily driven by power; and the details of such machines differ somewhat, although in their main features they are nearly alike; the difference consisting for the most part in the arrangement for giving a reciprocating motion to the table upon which the work is bolted. Some machines are worked by a double or treble-threaded screw, but mostly by a pinion, which engages in a rack on the under side of the table. The chief difficulty to be overcome is to reverse the motion of the pinion when the table has traversed a desired distance, when it has to be run back (for the sake of economy of time) at a quicker rate of speed than when the tool is in cut. But it is not my purpose to explain how this is done, inasmuch as I consider it wholly unnecessary to work a small machine such as an amateur requires by steam-power. It is true that very occasionally a job may require a lot of work done to it, and the perspiring workman may indulge in a fleeting wish for some motive-power more tireless than his own muscles; but the majority of the work to be done can be accomplished with as much ease by hand, and with greater pleasure, inasmuch as a power-machine is generally rather noisy in operation. Fig. 20 shows a very neat and substantial hand-planer, such as would be invaluable to any amateur who contemplates doing much mechanical work. It will be seen that the machine consists of a planed body or bed, upon which slides a table furnished with slots to receive bolts for clamping the work to be planed. This table is worked by a simple rack and pinion (or sometimes by a chain or strap wound round a drum), and the reciprocating motion is given by that most perfect mechanical arrangement, the body and muscles of the operator, directed by the operator's will; this leaves very little to be desired, the manual labour notwithstanding. It is also apparent from the engraving that the tool is held in a receptacle which is mounted upon a short vertical slide technically called the "fiddle," and this is also arranged to swivel over on either side for the production of angular cuts. The fiddle is accurately fitted upon a square plate sliding horizontally upon the long slide which extends the whole width of the machine, thus giving the necessary traverse of the tool across the table. This horizontal slide is supported by two strong uprights, and is raised or lowered by leading screws, one right-handed and one left-handed, worked simultaneously by bevel-gearing at the top. So much for the general features of a planing-machine. But it is very desirable that the tool should be automatic in its action, at least, as regards the horizontal cut—the vertical and angular cuts are not often made self-acting in small machines, nor is it necessary that they should be. The arrangement for making the cut automatic is simple: a sleeve or "tumbler" is fitted upon the shaft (between

the bed and the cross-handle), carrying two arms: the shorter of these is tilted over every time the adjustable stop on the edge of the table

available, almost any of the machines by the most amateurs do not require power drilling-machines at all. However, if the power is

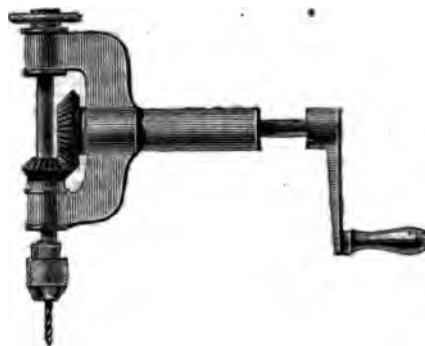
FIG. 20.



comes in contact with it, and thus throws the other arm up a certain distance. This longer arm carries a stud with a swivel-joint, through which passes a rod reaching up to a second tumbler, attached to the leading screw of the horizontal slide but not fast to it; a toothed pinion is keyed upon the screw, and the shorter arm of the tumbler carries a pawl, which falls into the teeth of the pinion, and when the longer arm is raised by the rod previously mentioned,

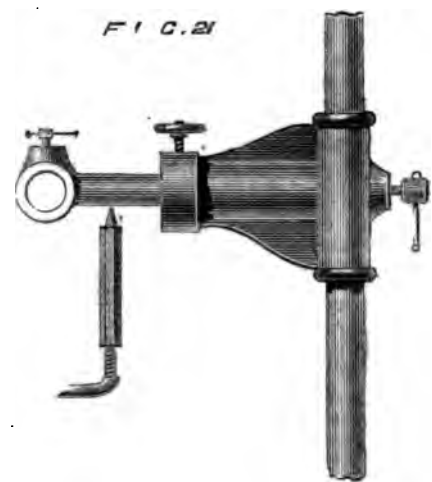
various makers may be driven thereby. But the most universally useful drilling-machine is the lathe fitted with a simple collet to hold large drills having all one size shank; and one of the American drill-chucks to take the fluted or twist-drills. But as many things are too unwieldy to be operated upon at the lathe, my recommendation is to have a drilling-post for use with the ordinary brace supplemented, as shown in Fig. 21, by a small bevel-gear

FIG. 22.



the pinion, and consequently the leading screw, is forced round a short distance, more or less, accordingly as the pawl may be adjusted to take either one, two, or three teeth each time, thus making the cut finer or coarser. The tools used for the planer resemble the ordinary tools for a slide-rest, only that they are forged as though (in a slide-rest) the cutting edge was considerably below the centre; the reason for this being that in case of the tool catching in the metal, it may tend to draw itself out of, instead of, into cut. An almost indispensable adjunct to the planing-machine, is a parallel vice to hold small work, and such as does not readily admit of being clamped in the ordinary way.

Drilling-machines vary very considerably in design; but I think I am justified in saying that



machine, carrying a self-centring drill-chuck, and carried by an eye at the end of the adjustable arm. This arrangement admits of work being placed on the bench, in the vice, or on the floor, as may be most convenient. It is also clearly obvious that the usual brace-drill, although so primitive as to be often despised by those workmen who prefer appearance to utility, is really the simplest, and, consequently, the easiest method of imparting motion to a drill. The small drill (Fig. 22) should have multiplying-gear, so as to run small drills at the necessary speed.

I have in the foregoing articles briefly described the principal machines necessary for the production of small work in metal, with the engine for conveying motion to the same. I might have amplified the list very considerably, but the lathe, the planing machine, and the drilling machine are the heads of the different families of machine tools—the milling machine being allied to the lathe; the shaping machine, own brother to the planing machine; and the slotting machine is cousin to both the planer and the drilling machine.

Had I had time at my command, I should have been glad to have written fully on the smaller tools and adjuncts of the workshop, and the methods of making, using, and abusing them; but for the present that design must rest in abeyance.

I think I can hardly conclude this series without adverting to the different ills that the amateur's flesh is "heir to." No one works long at a lathe or other machine without an occasional blow, cut, or abrasion, be he ever so careful. As a general rule, I should not advise either the binding up or plastering of a small cut or abrasion. Of course, large gaping wounds require drawing together until the flesh has healed; but I invariably find that, contrary to the generally accepted ideas, a wound heals in half time if left simply to take care of itself. I am aware that there may be exceptions to this rule, and many persons are not so fortunate as I am in getting a new set of knuckles in a week (I might say two sets in a fortnight, for that has been my recent happy experience). To such, therefore, as find a difficulty in getting their flesh to heal, I should recommend the application of lint wetted with calendula lotion for cuts and abrasions, and arnica lotion for sprains and blows. But I hate a burn worse than anything else, and find that this class of wound takes double the time to heal. The immediate application of wadding, whitening, or oil is beneficial in these cases, and where the skin is burnt off and the place looks "angry," add about two per cent. of carbolic acid to pure olive oil, and scrupulously exclude the air until healed.

Trusting that these papers may have been of use to some readers of the *ENGLISH MECHANIC*, and may tend to foster the pursuit of mechanical work in the leisure hours of those to whom a change of work may be as good as play, I bring them to a close. At some future time, if our Editor permits, I may be able to give some further directions as to the use of machine and hand-tools for amateurs.

W. S. BROWN.

DEATH OF "SECONDS' PRACTICAL WATCHMAKER."

WE deeply regret to announce the death of one of our oldest contributors, "Seconds' Practical Watchmaker."—Mr. James Coates, of Leicester,—who for many years past has contributed so much valuable information on the art of Watchmaking to our columns. We have received the following letter from his widow, and regret to learn that her husband's sudden decease at the age of 63 leaves her totally unprovided for. We feel sure that any assistance rendered to her by those of our readers who have profited by the instructions of her husband would not be bestowed unwisely.

SIR.—I regret to inform you of the death of my husband, Mr. Coates, who has for many years contributed to the *ENGLISH MECHANIC* as "Seconds' Practical Watchmaker." He went to business on Jan. 25 in his usual health, and was brought home paralysed, and died the next day, leaving me totally unprovided for, having been in ill-health the last three years.—I am, Sir,

Yours respectfully,
JANE COATES.

70, Newington-street, Belgrave, Leicester,
February 13, 1892.

THE MICROSCOPE AT HOME.*

(Concluded from page 539.)

TIME warns me I must turn to another branch of home microscopy. This time we will go to the flower-garden, which, be it large or small, I trust is an appendage to all your homes. In the flower-garden, or amongst the wild-flowers of the field, a microscope becomes the instrument of a revelation, even though the microscope be nothing more than a shilling pocket-lens.

* A lecture delivered before the Wakefield Naturalists' Society, February 1, 1892, by HENRY FOCKINGTON, F.R.M.S.

None but those who have seen them can imagine the exquisite beauty of the flower of common chickweed, pimpernel, daisy, when examined by a low magnifying power. The petals assume a new beauty, the central organs seem to be tipped with jewels of the loveliest colour, and often even the common-looking green leaves and stems are found to be studded with "hairs" of the most varied forms and colours. The petal of the pelargonium, the stamens and pollen of the mallow ("cheeses" of our childhood), the leaves of the deutzia, so commonly found as a window-plant, the leaves of many of the alpine plants grown in borders and on rock-work, may be mentioned as readily-found, and exquisitely beautiful objects for observation with a low power and reflected light. Those of the family who take a pleasure in comparing one pretty thing with another will find an ample scope for their energies in the pollen of flowers, and it is a little surprising that few microscopists appear to have any idea of the enormous variety of form and marking which obtains in the pollen of different flowers. If we take flowers of the lily family,* we find pollen as a tolerably simple oval bag with one slit, and the same kind of pollen is found in the magnolia and water lily. Some of these oval pollen grains are very elaborately sculptured—a very fine example of this is found in *Lilium auratum*, and in different species of iris. Some pollen are three-cornered, as in certain sedges, many round and spiny, as in the daisy, dandelion, mallow, passion-flower; or beautifully marked, as in *Calystegia sepium*, or attached in groups, as in the exotic *Blachemoria tonelli*, or by filaments, as in the willow herb and evening primrose. In short, pollen-grains alone will furnish interesting and artistic employment for long winter evenings during many years, if attention be confined to the markings on their surfaces alone. Those with a botanical turn of mind will go further, and study the development of pollen, its uses, the means by which it performs its functions, the parts played by insects in its dissemination, and finally, it is to be hoped, make an accurate acquaintance with the whole subject of "vegetable biology."

Amongst other pretty things within reach of the home are the wings of butterflies, which require only to be laid on the stage and examined by reflected light; and the blue mould on pots of jam, which, when examined by a moderate power, looks like a forest of curiously-interlocked branches laden with exotic fruits. The blue mould will come in useful as a subject for careful research—but I must not stay to touch upon that, but pass at once to the homely use of the microscope with an eye to pounds, shillings, and pence.

I presume that most people in Yorkshire like to be sure that they get what they pay for, and, I believe, they generally do; but the microscope, in many cases, places the possibility of certainty on the point within the reach of its owner. Suppose, for example, that the lady of the house wishes to know whether the piece of silk she has set her heart upon for a dress is all silk, or a mixture with cotton, jute, or China-grass, and, if all silk, whether it has been loaded with dye and dressing. The microscope will set her mind at rest. Take a pattern of the silk, unravel the warp and weft, and examine it under the $\frac{1}{2}$ in. objective, and you will, at any rate, see whether all the little fibres, of which the weft and warp are comprised, look alike. That, of course, will not tell you whether the material is silk; but if you procure a piece of known silk, good raw silk, and study its appearance, and compare it with the suspected specimen, you will come to a sound conclusion very soon. Then take a little cotton and examine it to find that it consists of flattened tubes, curiously twisted, quite unlike the long, cylindrical tubes of silk, and different again from the long, consistent tubes of flax with their attenuated ends and marked walls. Take wool and hairs of different kinds, and examine them carefully, noting their peculiarities, and you will soon be able to tell whether your coat is all wool, or, as is much more probable, not; whether your wife's sable muff or seal-jacket is what it professes to be, and will not improbably learn a lesson in the department of trade morality. You may examine the milk, bread, butter, and tea on your breakfast-table by means of your microscope and a little preliminary study of genuine articles; and at dinner you may search for Trichinae in your pork, and question the genuineness of the mustard, pepper, and ginger. Concerning these last I may mention as a matter of interest, or at least of curiosity, that some years since, I made a number of purchases of pennyworths of them in the neighbourhood in which I then lived with the following result:—One sample of pepper was adulterated with 50 per cent. of various farinas, chiefly starch from a Brazilian yam (this sample I found in my family pepper-box); the second sample was adulterated with about 60 per cent.

* See Edgeworth's "Pollen" (Hardwicke and Bogue, 1877), for illustrations and descriptions of some hundreds of varieties.

+ *Pharmaceutical Journal*, 3. Vol. V.

of pea-meal, locust-beans, wheat and rice-starch, and was sold as a warranted genuine article. No. 3 was largely adulterated with farinas amongst which were small quantities of wheat-starch, oatmeal, and a compound starch new to me; there was also a considerable quantity of mineral matter. That sample was unique; I have never seen one like it, and don't want to. The ground ginger was nearly as bad, and was adulterated with a variety of starches. The following method of detecting these adulterations may be useful to some of you. I apply it to pepper, but with modification it is very generally applicable.

* "Take a small quantity of the suspected pepper on the point of a clean spatula, place it on a glass slip, add a drop of clean water, and mix the pepper with the water. Place on it the usual thin cover (cleaned with something that does not contain starch-dressing). The presence of starch will at once be detected, and the nature determined by its features. Those not familiar with the microscopical appearance of starch granules will derive great assistance from the use of iodine solution (1 gr. iodine, 3 gr. iodide of potassium, 100 water), which will at once stain the granules with the characteristic blue-violet coloration." Care must be taken not to mistake the true pepper starch for foreign starches, or the reverse; but comparison with home-ground (or crushed) pepper will settle that question. The approximate percentage of admixture may be determined by a process of separation. The mixture is well agitated in a test-tube, with plenty of water, and allowed to rest for a short time. The heaviest portions, with almost all the pepper, will speedily subside. The water has now to be poured off into another tube, and allowed to subside. Comparison of the two precipitates will give fairly accurate results, but each precipitate should be separately and carefully examined with the microscope. It is, of course, more easy to determine the nature of the starches when thus separated.

One more line of thought and I have done. Probably nothing surprises the young microscopist more than the enormous profusion of living organisms which are revealed to him in almost every drop of water, the dust of the air, every tuft of moss he gathers, and, in short, all around him; at his next step, perhaps, he finds himself confronted with the, as it appears, excessive precaution Nature takes to secure the perpetuation of species of beings, seeds provided a hundred or a thousand fold more than can possibly find room to grow in, pollen vastly more than there are ovules to be fertilised, spores of ferns, lycopods and fungi all produced with the same prodigality, and the question will arise why this waste.

The microscope will go a long way in helping the solution of that problem. If you take a piece of chalk, rub it down in water with a hard nail-brush, allow the turbid water to settle until it has only a milky appearance, pour off the water, and diffuse the precipitate in fresh, allow to settle, decant, and repeat the process until the water no longer becomes milky; you will procure a precipitate which, when examined under the microscope, will be found to consist almost entirely of little shells of curious pattern, and quite unlike any of the shells you commonly meet with. If you now get a little sand from the drawer in which your chemist keeps his sponges, and examine it, you will find there a profusion of similar shells, all apparently wasted. To the saurians of the cretaceous epoch, the now-utilised chalk foraminifera would have appeared to be wasted. If you take a piece of limestone and examine it in thin section, you will find that it, too, almost entirely consists of dead organisms, and that there, at least, Nature has made of her dead self stepping-stones to higher things.

Take a piece of Bradford better bed coal, and examine it. You will find that it is almost entirely composed of the spores of extinct lycopods, other coals of such spores and various portions of extinct plants, ferns, and trees, finding there, as the geologist finds elsewhere, that death in the present is life in the future; that out of the decay and disintegration carried on in the long past, the present world, with all its beauty, has arisen, as the result of simultaneous and successive displacement and replacement. Much that is hard to understand in the economy of things as we see them becomes more plain when thus looked at, and here lies much of the educational value of the microscope. Professor Huxley put this questioning as to nature's apparent thriftlessness so well in his Bradford lecture on coal, that I may perhaps be excused if I quote them.

"Let us suppose that one of the stupid salamander-like Labyrinthodonts, which potted, like Falstaff in his old age, with much belly and little leg, amongst the coal-forests, could have had thinking power enough in his small brain to reflect upon the showers of spores which kept on falling through years and centuries, while perhaps not one in ten millions fulfilled its apparent purpose, and repro-

* *Phar. Jour.* (3) V. 681. "On Some Adulterated Pepper," by the Author.

duced the organism which gave it birth; surely he might have been excused for moralising upon the thoughtless and wanton extravagance which Nature displayed in her operations.

"But we have the advantage over our shovel-headed predecessor—or, possibly, ancestor—and can perceive that a certain vein of thrift runs through the apparent prodigality. Nature is never in a hurry, and seems to have had always before her eyes the adage, 'Keep a thing long enough, and you will find a use for it.' She has kept her beds of coal many millions of years without being able to find much use for them. She has sent them down beneath the sea, and the sea-beasts could make nothing of them. She has raised them up into dry land, and laid the black veins bare, and still, for ages and ages, there was no living thing on the face of the earth that could see any sort of value in them. And it was only the other day, so to speak, that she turned a new creature out of her workshop who, by degrees, acquired sufficient wits to make a fire, and then to discover that the black rocks would burn." Carrying the subject further, and noting that the vast commercial success and wealth of this country arises from its coal consumption in our steam-engines and our iron smelting, he adds: "Thus all this abundant wealth of money and of vivid life is Nature's interest upon her investment in club-mosses and the like so long ago. But what becomes of the coal which is burnt in yielding the interest. Heat comes out of it, light comes out of it, and if we could gather together all that goes up the chimney and all that remains in the grate of a thoroughly burnt out fire, we should find ourselves in possession of a quantity of carbonic acid, water, ammonia, and mineral matters exactly equal in weight to the coal. But these are the very matters with which Nature supplied the club-mosses which made the coal. She is paid back principal and interest, and she straightway invests the carbonic acid, the water, and the ammonia in new forms of life, feeding with them new animals and new plants." Closer thrift than this cannot well be.

This discursive and, I fear, unsatisfactory address is now at an end. I have attempted to show that the microscope brings before us new forms of beauty to gratify our artistic tastes; it reveals to us somewhat of the nature of things, and leads us on to questioning after questioning, observation after observation, till it faces us with a mystery we cannot solve—that it is a thing for everyday use, and of practical money value; but I have done this very imperfectly. I should like to have shown more of what it has done in the advancement of science, and have indicated some fields of research in which it could do more in the hands of any of us, but the time at my disposal here, and before, has not admitted of this. If I have said anything which shall induce those who have not a microscope to buy one, or lead those who have not worked with, as well as played with, their instruments to enter upon some branch of research, I shall be satisfied. But I think I shall be still more grateful if I have said anything to make the microscope a family instrument—a thing of the home.

I have been called an enthusiastic microscopist, whose admiration of the instrument has passed into a passion, and I do not care to rebut the impeachment. The microscope has taken me, as it has taken many more, from the worries and cares of a busy life into a region where, when we get beneath the surface, all is calm and restful. We see nature working out with patience and care through long ages, and calmly waiting the result. We see apparent waste of beauty on forms which for ages no eye has seen, and are seen now only by the few; hinting, it may be, to us, that the little things of our daily life are not the things to be neglected and left un beautified; and, above all, we see that through all beings, all things, and along all ages, "one increasing purpose" has run, and that they and we are somehow bound together by a "golden chain about the feet of God."

MICROSCOPIC PHOTOGRAPHY IN PARIS.

THE microscope is an instrument of great utility, not only in the biological department of science, but also in those of physics and chemistry. The microscopic examination of certain substances (writes M. Tissandier, in a recent issue of *La Nature*) enables one, in some sort, to make analysis of them with a rapidity and certainty which are often not presented by the methods based on use of reagents, especially when organic matters are in question. Has the chemist—*e.g.*, to assure himself of the purity of a sample of commercial starch, he puts a pinch of the substance into a little distilled water, stirs the liquid with a glass rod, and with this rod transfers a drop to a glass slide for microscopical examination. He may then regard as grains of starch all those which have the characteristic oval form; if the adulterator have added a powder formed—*e.g.*,

of porphyric gypsum, this substance at once betrays its presence by the appearance of grains that are angular, and of crystalline aspect. Coffee, chocolate, pepper, milk, &c., thus examined in the microscope, are immediately analysed by an observer used to studying the different kinds of those substances, and the products that are commonly used for their adulteration. It is the microscope that serves to discover trichinae in pork; and it often enables one to determine the nature of a salt seen to crystallise in the drop of water placed on the slide."

This direct microscopic inspection has the disadvantage of not furnishing a durable record of the observations made. Hence the desirability of obtaining photographs of enlarged images of the objects submitted to examination.

M. Tissandier gives an interesting account of the microscopic photography practised in the Municipal Laboratory of Chemistry in Paris, under direction of M. Girard. The methods are stated to be very complete, and to present various novel features.

The most simple system of microscopic photography consists in applying directly a small ordinary photographic camera to the eyepiece of a microscope, placed vertically as for direct observation. The illumination is obtained by means of a ray of oxyhydric or electric light, thrown on the mirror.

The virtual image is first transformed into a real image by displacing the eyepiece. In the microscope, the image furnished by the object-glass is formed in the interior of the eyepiece in advance of the ocular-glass, between it and its focus. If the eyepiece be displaced so that the image formed by the object-glass is between the focus of the ocular-glass and its centre of curvature, the image is then formed on the other side of the ocular-glass; it becomes real, and it may be received on a plate of ground-glass. The camera is then adjusted.

The other method, due to M. Vogel, of Berlin, consists in seeking the virtual image situated in the microscope, by means of a camera with its short-focus object-glass; it is known that the image is formed virtually in advance of the eyepiece, at about 0.12m. to 0.18m., according to the magnifying power of the ocular-glass. The photographic object-glass is nearly in contact with the eyepiece of the microscope. These two methods apply to an ordinary microscope placed in any working-room or laboratory.

The third system we have to describe requires a special organisation in a dark room adapted for its action. It allows of taking the photograph of an object in several planes, and is notably applicable to histological sections, trichinae, crystals, &c.

The microscope is placed horizontally in the middle; to the right is a photographic camera, the object-glass of which is connected with that of the microscope by means of a long tube; to the left is fixed, on a board, the oxyhydric or electric light. The oxyhydric light serves for obtaining negatives with magnifying power of 300 diameters; beyond this, up to 800 diameters, the electric light is used.

The apparatus here described is based on the principle that luminous pencils, with a great distance of conjugate focus, become nearly parallel, and that the points situated in planes near the focal plane are reproduced by points hardly larger than those of the focal plane. It is fixedly installed in a dark room supplied with all the necessary accessories of photographic operations, and the operators obtain excellent results by the new gelatino-bromide of silver processes.

M. Tissandier was shown a remarkable photographic album, containing very good photographs of chocolate, flour, pepper, coffee, trichinae, &c. He suggests the desirability of publishing these photographs, for the benefit of amateurs.

FORGING AND TEMPERING STEEL.

IN forging cast steel, the fire should be regulated by the size of the work. (I prefer a hollow fire to be fed with coke.) To ascertain the heat of the steel, draw it out of the fire often, for it requires to be carefully watched to get the proper heat. If not hot enough, thrust it quickly in again. The proper degree of heat is to be judged of by the eye, and care should be taken not to heat higher than is absolutely necessary to effect the desired purpose, and to use as few heats as possible. Too frequent heating and over-heating steel abstracts the carbon, gradually reducing it to the state of forged iron. It is the opinion of a great many that, so long as the steel does not fly to pieces when struck with the hammer, it is not too hot; but it is an erroneous idea, as is easily proved when it comes to be hardened, and particularly when it comes to be used.

An excellent composition for welding cast steel is prepared by boiling together sixteen parts of borax and one of sal-ammoniac over a slow fire for an

hour. When cold grind it into a powder. The steel must then be made as hot as it will conveniently bear, and the composition used the same as sand. Steel punches, or other small implements, particularly engraved dies, when, by accidental exposure to too great heat they have become spoiled, or, as the blacksmith says, burned, may be restored by the following mixture: Two ounces of bichromate of potash, one ounce pure nitre, one ounce gum-aloes, one ounce gum-arabic, and two ounces of resin. The whole having been well powdered and mixed, the piece of steel is heated to a low red heat, and the powder sprinkled over it. It is then heated again to a low red heat, and cooled. This makes the piece very hard again. The amount of nitre may be doubled, and that of the resin taken ten times greater, to produce a higher temper.

In tempering a tool for boring cylinders, turning rolls, or any large pieces of cast iron, let it be as hard as water will make it, taking care not to heat it more than to a cherry red. In the second heating, after the tool is hardened, the first perceptible tint is a light straw-colour, which makes its appearance when the heat reaches 430° Fahr. This gives the metal a maximum of hardness, with a certain amount of elasticity, fitting it for lancets, razors, and surgical instruments. At 470° a full yellow is produced, which is the temper employed for penknives, scalpels, and fine cutlery. The temperature of 490° gives a brownish-orange, suitable for shears and chisels used for cutting iron. At 510° the brownish-yellow becomes flecked with purple, the tint for pocket-knives. 520° gives a bluish purple, fit for table cutlery; while the different shades of blue from 530° to 570° indicate a temper proper for watch-springs, sword-blades, saws, and instruments requiring great elasticity. Beyond this temperature the metal becomes too soft to be used for cutting instruments.

The temper greatly depends on the quantity of carbon that is in the steel. This the practical man soon finds out, and he tempers or draws down the tool accordingly.

In Switzerland, razors, pocket-knives, &c., made from English cast steel are tempered by immersing the blades at a dark cherry-red into a bath composed of four parts of finely-powdered yellow resin, two parts of fish-oil, to which is added, in a very hot state, one part of melted tallow, and allowing them to cool perfectly; after which they are heated without wiping them, and hardened in water in the ordinary way. The blades hardened by this process are found to be more uniformly tempered than by any other, making it possible to produce an exceedingly fine cutting edge.

LUBRICATION.*

IN a steam-engine, where many parts are moving, a large amount of friction is produced, which tends to stop those parts, and it would ultimately do it, were they not continually re-supplied with fresh motion obtained by the burning of fuel. Hence it is apparent to everyone, that the engine has not only to overcome the resistance of the work to be done, but also the resistance offered by its own parts. In other words, the amount of heat manifested in friction, is the amount of extra heat that will have to be generated under the boiler, and the extra cost of working will be the cost of the fuel necessary to produce that heat. From the experiments of Morin, we find that the friction of a cast-iron shaft upon a dry bell metal bearing amounts to .2 of the transmitted power, while with a wrought-iron shaft the friction is more than .25, therefore, if such shafts were dry and unlubricated one-fifth and one-fourth respectively of the total fuel cost would be wasted in overcoming friction. By careful lubrication of the same shafts, the loss may be reduced to .065 in the one case, and .089 in the other. Hence the importance of a good lubricant. One of the next essential points is that it shall be properly distributed over the surface on which it is required, that just sufficient shall be used and all waste avoided, otherwise, what would have to be spent in overcoming friction will have to be spent in buying oil. Putting aside the commoner characteristics of a good oil, such as the absence of acidity either natural or artificial, and the absence of gumminess, one of the most commonly believed ideas is, that an oil of high specific gravity is the best for lubricating purposes. Although this may be true in certain cases, yet from observations and experiments made over a long period I have found that they are not always the best, and that the point upon which we must rely is the viscosity. To test this, I have found a French pourette graduated into 100cc. to be most useful. The pourette is fitted on a stand and filled with the oil to be tested; after allowing all bubbles of the air to separate, it is permitted to run through, and the time it takes to do so is care-

* Abstract of a note on "Lubrication," by THOMAS FARRER, F.C.S., read before the Liverpool Association of Science and Arts.

* By T. J. BOWITCH, in *American Machinist*.

fully noted. At the close of the experiments it will be found that the viscosities are directly proportional to the time taken: thus if a mineral oil takes 15 seconds and rapeseed-oil 45 seconds, the viscosity of rapeseed-oil is three times that of the mineral. The temperature may be either 60° or 90° Fahr, but the latter is preferable, as the oil may be subjected to that temperature when in use. The question next arises, How is this viscosity basis to be applied? If an oil of very high viscosity, such as castor or rapeseed, were used to lubricate an engine of low horse-power, we should in all probability find, that instead of reducing the friction to a minimum, it would itself become a source of resistance and increase the evil. And conversely, if an oil of very low viscosity were used to lubricate an engine of high horse-power, we shall find that the friction would be but slightly, if at all, reduced. Hence when we come to look at extreme cases, we see that there exists a very marked connection between viscosity and horse-power. A high viscosity is not suitable for a low horse-power, and, conversely, a low viscosity is not suitable for a high horse-power. And just as the case holds for these extremes, so does it hold for every point between them: the viscosity must always keep parallel to the horse-power. The same rule holds with respect to machinery, and to insure perfect lubrication the viscosity must gradually increase with the ponderousness. From this it is clear that economical lubrication does not consist in procuring and using the thickest oil possible, but the oil which is best adapted to the nature of the machinery, and scientific mixing likewise consists in compounding oils most clearly adapted to the purpose for which they are to be used. It is rather difficult to say what oils are most suitable for mixing purposes, but it may be stated with a tolerable degree of accuracy, that the best method is to take a basis of American or Scotch mineral oil 885° to 903° sp. gr. and add either olive, lard, rapeseed, or castor, to "work up" the viscosity. Olive and lard when mixed with mineral in proportions 10, 20, 25, and so on up to 75 per cent., are about equal in value as lubricants of the lighter class of machinery. Rapeseed oil in like proportions is valuable where the machinery is of a heavier kind, or where the lubricant has to be used throughout a works in which the machines vary much; but in such a case it will be better to divide them into classes and use a special oil for each class. Castor-oil mixed with mineral in varying proportions may be used in the case of the most ponderous machinery. In mixing castor I noticed a remarkable and interesting phenomenon. On adding about 25 per cent. to an American neutral oil of a reddish colour, I was surprised to find, after the lapse of a few hours, that the oils had separated, and that the castor, originally quite clear, had taken down with it nearly the whole of the colouring matter, leaving the mineral oil a beautiful pale straw-coloured liquid. I further found that the successive additions of fresh castor still further removed a colouring matter until both castor and mineral were of the same tint. Continued experiments showed that if the castor were first mixed with an equal bulk of olive or rapeseed oil, and then added to the mineral, the mixture was of a permanent character. In conclusion, I have found that a properly mixed oil is in every case far preferable for general use to either mineral, olive, lard, castor, or other oil used singly, and it may be added that no oil is more suitable as a basis for mixing than mineral, and that cold mixed oils are better than these mixed at a temperature over 100°.

USEFUL AND SCIENTIFIC NOTES.

Continuous Brakes on Railways.—Earl Delawar will, during the present Session, introduce a Bill, the object of which is to make the use of continuous brakes on railways compulsory. It will be proposed that, after the 1st of February, 1885, every Company shall have in connection with each passenger train a continuous brake, which shall be efficient in stopping the train, instantaneous in action, and applicable without difficulty. It must also be immediately self-acting in case of accident, capable of being easily removed, and be of durable material. The brake in each vehicle of a train is to be susceptible of being worked as part of one system. The Board of Trade is to have power to inspect rolling-stock, specially with a view to the use of the brake.

Bankruptcy, Liquidation, and Composition.—Our legal contributor, Mr. F. N. Wetherfield, of 2, Gresham-buildings, has just published a cheap shilling handbook, entitled "Hints on Bankruptcy, Liquidation, and Composition." It is readable and accurate, and will be found useful by all who are about to prove a debt or to arrange with their creditors; we trust no reader will ever have an unfortunate occasion to consult it, except for the first-mentioned purpose.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE annual general meeting of the Society was held at Burlington House of Friday, Feb. 10th, at 3 p.m.; J. R. Hind, Esq., President, in the chair. Mr. Herbert J. Bell, of the Royal Alfred Observatory, Mauritius; Mr. A. Hilger, 192, Tottenham Court-road; and the Rev. H. J. Geo. Bonavia Hunt, of Mandeville-place, W., were balloted for and duly elected Fellows of the Society.

Mr. Glaisher read the minutes of the previous annual meeting, and also the minutes of the special meeting held at the Society's rooms, to consider the question of Endowment of Research by the Government. The minutes having been approved, parts of the annual report were read; it appeared that twenty-two new Fellows of the Society have been elected during the past year, making the total number of Fellows 594. During the year the following papers have been published in the Memoirs of the Society:—Mr. David Gill, "Account of a Determination of the Solar Parallax from Observations of Mars, made at Ascension in 1877"; Mr. Common, "Particulars of the Mounting of a 3ft. Reflector"; Mr. Seabroke, "Catalogue of Micrometrical Measurements of Double Stars"; and Mr. Ranyard, "Observations of the Total Solar Eclipse of 1878, July 29, made at Cherry Creek Camp, near Denver, Colorado." Amongst the Associates of the Society, Prof. Carl Bruhns and M. Alfred Gautier have died during the past year. From the reports of Observatories, it appeared that at Greenwich observations have been made with a half-prism spectroscopic of the spectra of sun-spots, which have been observed on twenty-four days. The displacement of the F or b line has been measured in the spectra of sixty-four stars, nine of which have not previously been observed. Photographs of the sun have been taken on 173 days; these have been measured in duplicate, and the heliographic latitudes and longitudes of the spots have been deduced. At Mr. Huggins's observatory a photograph was secured of the more refrangible portions of the spectrum of comet b; the head of the comet was brought upon the slit, and afterwards through the other half of the slit a spectrum of *Arcturus* was taken for the purpose of comparison. The continuous spectrum could be traced from about F to a little beyond H; in this continuous spectrum were distinctly present G, h, H, K, and several other of the Fraunhofer dark lines, showing that the principal part of the light of the comet was due to reflected solar light. There were also two groups of bright lines corresponding to similar groups seen in the spectra of carbon compounds. Some attempts have been made in the past year to apply photography to the spectra of some nebulae, but hitherto without success. At Mr. Common's observatory photographs of Comet b were obtained on several nights. Encke's was found on August 27th, and the satellites of Mars, *Phobos* and *Deimos*, were observed on the 27th of December, and their positions measured. At Birr Castle Observatory, Parsonstown, determinations of the radiant heat of the Moon have been made on several nights.

Only one minor planet has been discovered during the year 1881: this was discovered by Herr Palisa, at the Observatory of Vienna, on May the 19th. From an interesting research by Herr Hornstein, it appears probable that all the largest of the minor planets have now been discovered, and of those having a diameter exceeding twenty-five geographical miles the number is extremely small. It seems that the number of asteroids which have been already discovered, having a diameter less than five miles is also very small, especially in that portion of the minor planet zone nearest to Mars. In the outer zone nearest to Jupiter, there may be a more considerable number of these minute bodies, probably too faint to be observed by the telescopes ordinarily employed in the search for minor planets. Omitting the few of comparatively large magnitude, the general average diameter of the remaining members of the group appears to be between 5 and 15 miles—a much smaller diameter than has hitherto been assumed. Seven comets have been observed during the year 1881, one of which was the periodical comet of Encke. The first was discovered by Mr. Lewis Swift, on April the 30th; the second by Mr. Tebbutt, on May 22nd; this was the first of the two large comets which were everywhere observed in the northern hemisphere. The third by Schaberle (known as comet c) was discovered on the night of July the 13th at the observatory of Ann Arbor, U.S.A. The fourth was Encke's comet. The fifth a small comet discovered by Mr. Barnard, at Nashville, Tennessee. The sixth an interesting periodical comet discovered on the morning of October the 4th, by Mr. Denning; it is found to move in an elliptic orbit, with a period of 3070·7 days; the orbit of this comet passes near to the orbits of Venus, the Earth, and Mercury, and it

will, therefore, probably be affected by considerable perturbations. The seventh comet was discovered on November the 16th, by Mr. Lewis Swift.

The Report also contains paragraphs referring to the Cape Catalogue for 1880, Prof. Newcomb's "Standard Stars," The Smithsonian "Report on Astronomical Observatories," "Physical Observations of Jupiter," Prof. Hall's "Observations of Double Stars," "Universal Time and the Selection of a Prime Meridian," and the volume of "Observations of the Total Eclipse of 1878, July 29," published by the United States Naval Observatory.

The President then proceeded to deliver his address, on presenting the gold medal of the Society to Mr. David Gill, for his heliometer observations of Mars at Ascension, and the discussion of his results. The President said: I have now the pleasant duty to state to you the general grounds upon which your Council have felt justified in awarding the Society's medal this year to Mr. David Gill. The planet Mars has occupied no inconsiderable place in the successive attempts at the solution of the grand problem of the determination of the Earth's mean distance from the Sun, upon which depends all measures of absolute distance and dimensions beyond our Moon. The earliest real approximations to the value of the solar parallax were obtained, as is well known, in 1672, through the intervention of this planet, which, in the summer of that year, was at one of its close oppositions, and therefore most favourably situated for the object in view. The first of the Cassini's had perceived the advantage that might be taken of the near approach of Mars to the Earth to ascertain the amount of his parallax, and thence of the Sun's parallax, by comparing observations made simultaneously, or nearly so, at distant points upon the Earth's surface; and accordingly, when Richer was sent on the astronomical expedition to the island of Cayenne, in French Guiana, in 1672, it was arranged that observations of this planet should be specially made for comparison with others to be made at Paris. In Cassini's memoir on this subject, he refers to several methods of utilising observations of Mars for the determination of the Sun's parallax, one of which is now commonly known as the meridian method, while another corresponds in principle with that which we are accustomed to term the diurnal method. By the meridian method, or by comparisons of the meridional altitude of Mars at Cayenne at Paris, he inferred that the solar parallax was 9". It is gratifying to us as Englishmen, that this important advance in the knowledge of the solar parallax from the exceptionally favourable opposition of Mars in 1672, is not due solely to the French astronomer, but that our countryman, Flamsteed, arrived quite independently at nearly the same result. In the history of his own life he tells us that "whilst he was inquiring for the planet's appulses to the fixed stars by the help of Necker's ephemeris," he found that in September, 1672, the planet Mars then newly passed his perihelion, and opposition to the Sun, would pass amongst three contiguous stars in the water of *Aquarius*, and that by reason of his then being very near the Earth, this would be the most convenient opportunity that would be afforded for many years for determining his parallax. A notice which he sent to Oldenburg was printed in the *Philosophical Transactions* of August 19, 1672, and he further states that Oldenburg having sent his admonition into France, the gentlemen of their Academy took care to have it observed; but we have seen that there was independent action in France. Flamsteed nearly missed the opportunity of contributing to the knowledge of the Sun's distance, being called away from home on the very day when he had designed to begin his observations, but he succeeded in observing Mars with the instruments of his friend Townley, and again on his return to Derby: these observations are to be found in the "Historia Cœlestis"; he concludes therefrom that the Sun's horizontal parallax could not be more than 10". On many occasions during the last two centuries the planet Mars has been observed for the purpose of investigating the solar parallax, usually on the meridian method, without any result that could be properly considered as at all definite. Mr. Gill remarks that about a year after the last transit of Venus, when observers began to compare notes and attempts were made to select corresponding phases at the contacts, a doubt began to arise in the minds of many astronomers whether we should not again repeat the experience of the Transit of 1769, and find the observations capable of so many interpretations as to preclude the possibility of unprejudiced and final discussion, and that, in consequence, his attention had been directed to the opportunity afforded by the close opposition of Mars in Sept., 1877, as a means of arriving at an independent determination of the solar parallax. In 1874, in conjunction with the present Earl of Crawford, Mr. Gill had attempted a new method of finding the solar parallax by combining the suggestions of Sir George Airy as to employing the diurnal method with those of Prof. Galle, with respect to utilising the minor planets. The success which attended

their observations of the minor planet, *Juno*, at the Mauritius in 1874, induced him to apply to the Earl of Crawford for the loan of the heliometer, with which the *Juno* observations had been made, for an expedition either to St. Helena or Ascension. His request met with a most ready compliance, and in the Autumn of 1876 application was made to the Government Grant Committee of the Royal Society, and to the Council of this Society, each of which bodies voted a sum of £250 towards the expense of the Expedition. Mr. Gill left England on June 15th, 1877, and reached Ascension on July 13th. No time was lost in erecting the observatory, which was ready for work four days later. The value of the solar parallax Mr. Gill obtained gives the mean distance of the Earth from the Sun at 93,080,000 miles.

As a piece of admirable work carried to its conclusion with unremitting energy and great zeal, I believe you will concur in the opinion of your council that Mr. Gill has well deserved the award of the medal. In handing the medal to the Earl of Crawford, as Foreign Secretary, the President said: In transmitting this medal to Mr. Gill, I ask you to assure him of the high estimation with which the Royal Astronomical Society regards his energetic efforts in the cause of the science to which we are devoted, and to express our earnest wishes that continued health may enable him to apply them to the wide field which is open to him as Her Majesty's Astronomer at the Cape, with equal discrimination and as great success as heretofore.

The Earl of Crawford said: Mr. President, it has been my pleasing duty on several occasions to receive a medal, but it has always been on behalf of a foreigner, and to be transmitted abroad. The Society has to-day, however, awarded it to a British subject, and instead of sending it to the British Ambassador to be forwarded to the recipient, it will, I presume, be my duty to forward the medal to Mr. Gill's official superior at the Admiralty.

Mr. De La Rue proposed, and Col. Tupman seconded, a resolution directing that the report of the council and the President's speech on the presentation of the medal should be printed and circulated amongst the Fellows.

Mr. Ranyard said: Before we proceed to the election of the council and officers of the Society, I wish to say that I much regret the absence of Major Herschel's name from the council-list. I wish to draw attention to the fact, because the absence of his name is due to a mistake. Mr. Christie stated to the council that Major Herschel was expected to be absent from England during the greater part of the year, and I think I may say that in consequence of that statement he was not re-elected by the council. It turns out, however, that he is only going to be absent in America for about a month, and I wish to propose that his name should be restored to the council-list. (Cries of "Order.")

The President: I don't wish to interrupt you, Mr. Ranyard, but I am afraid that what you are proposing is not in order.

Mr. Ranyard: Is not this, Mr. President, the meeting at which we have to elect the council and officers for the coming year? I wish to speak upon the subject, and to make a suggestion which I believe I have a right as a Fellow to do. I do not intend to say anything which will be personal or unpleasant. Major Herschel's name cannot be restored to the body of the council, for the by-laws direct that there must be four new members of council elected each year. This has been accomplished on the present occasion by bringing down the names of two vice-presidents and one secretary to the body of the council, and there is only one really new member of council. This is, no doubt, quite correct according to the letter of the by-laws; but I wish to point out that we must not restore Major Herschel's name to the body of the council in place of any one of these new members, or there would not be four changes. Such lists would not comply with the conditions of the by-laws, and would not be counted. I therefore propose that we should make Major Herschel a vice-president, in place of Professor Smith, who is known to us all as an eminent mathematician and as one of the ablest members of the Endowment party; but as far as I know, he has never contributed any paper to this Society. (Cries of "Oh.") I do not wish to say anything against Prof. Smith, for I believe him to be one of the most honest and able members of his party; but I wish to state that I intend to remove his name from the list, and to replace it by the name of Major Herschel, and I shall be glad if others will do the same.

The meeting immediately broke up, and proceeded to ballot for the election of officers and council. The following gentlemen were declared to have been elected:—As President, Mr. E. J. Stone, M.A., F.R.S., Radcliffe Observer; as Vice-Presidents, Mr. J. O. Adams, M.A., LL.D., F.R.S., Lowndean Professor of Astronomy, Cambridge; Mr. W. H. M. Christie, M.A., F.R.S., Astronomer Royal; Mr. J. B. Hind, F.R.S., Superintendent of the *Nautical Almanac*;

and Mr. H. J. S. Smith, M.A., LL.D., F.R.S., Savilian Professor of Geometry, Oxford; as Treasurer, Mr. Francis Barrow, M.A.; as Secretaries, Mr. J. W. L. Glaisher, F.R.S., Mr. E. B. Knobel; as Foreign Secretary, the Earl of Crawford and Balcarres, F.R.S.; as Council, Sir G. B. Airy, K.C.B., M.A., LL.D., D.C.L., F.R.S.; Mr. James Campbell; Mr. Arthur Cayley, M.A., LL.D., D.C.L., F.R.S., Sadlerian Professor of Pure Mathematics, Cambridge; Mr. A. A. Common, Mr. G. H. Darwin, M.A., F.R.S.; Mr. A. M. W. Downing, M.A., Mr. Edwin Dunkin, F.R.S.; Mr. William Huggins, LL.D., D.O.L., F.R.S.; Mr. George Knott, LL.B.; Mr. Albert Marth, Mr. Edmund Neison, Mr. A. Cowper Ranyard, M.A.

ROYAL MICROSCOPICAL SOCIETY.

THE Annual Meeting of this Society was held at King's College, Strand, on the 8th inst., the President (Professor P. Martin Duncan, F.R.S.) in the chair.

The list of donations (exclusive of exchanges and reprints) received since the last meeting was submitted, and the thanks of the Society given to the donors. The donations included some doubly and trebly-stained slides from Dr. B. W. Richardson, of Dublin; an Iris Diaphragm for objectives from C. Collins; Prof. Reinsch's work on "Organisms from Coal," and Prof. Dodel Port's Botanical Wall Diagrams.

The president called special attention to Prof. Dodel Port's admirable diagrams: and referring to Prof. Reinsch's book, said it would be very desirable to have the mounted specimens which had been promised to the Society by him, as without these it was of course impossible to determine whether the conclusions at which he had arrived were correct.

F. Crisp said that with regard to Dr. Richardson's slides, it should be noted that the processes, which he quoted as having been devised by Dr. Stirling, were in reality due to Dr. H. Gibbs, whose descriptions had been taken by Dr. Stirling, without acknowledgment of their original source. He also called attention to the Iris diaphragm for objectives presented by C. Collins. The use of such a diaphragm had been originally suggested by Dr. Royston-Pigott, but was now revived by G. E. Davis, one of the Fellows of the Society, for the special purpose of obtaining penetration with wide-angled objectives by reducing their aperture.

The Treasurer, Dr. Beale, F.R.S., read his statement of the income and expenditure of the Society for the past year, which had been duly audited by the auditors appointed at the last meeting.

The President, in pursuance of notice given at the previous meeting, read the proposed alteration of the by-law relating to the payment of subscriptions. He thought the alteration was one which would commend itself to the Fellows.

F. Crisp then moved, "That Fellows elected after February in each year should pay a proportionate part of the subscription only." This was seconded by T. Charters White, and carried.

The report of the Council was then read by the President.

REPORT OF THE COUNCIL.

"*New Fellows*.—Having regard to the large number of new Fellows elected during the years 1879 and 1880, it might have been fairly expected that the new elections would now show some diminution. The Council are, however, gratified to find that during the past year 51 ordinary Fellows were elected, as against 47 in 1880 and 58 in 1879.

"*24 Fellows* have died or resigned (1 compounder, 23 subscribers, and 1 honorary Fellow) and the list now stands as follows:—501 ordinary, 49 honorary, and 83 ex-officio Fellows.

"The greatest number of ordinary Fellows at any previous period of the Society's existence was 452.

"*Finance*.—The income of the Society (excluding admission fees) now amounts to £724, being £636 6s. derived from subscriptions, and £87 14s. from investments. In accordance with the determination come to at the annual meeting in 1881, it is not intended in future to invest compositions except in the contingency mentioned in the Council's last report.

"*Library, &c.*—The additions to the library are now so numerous that there is a difficulty in providing space for them on the shelves, and it is feared that the only remedy will be to discontinue some of the exchanges.

"A catalogue of the library has been prepared by the Assistant-Secretary, and checked by Mr. Fox, who has also kindly undertaken to prepare a catalogue of the property of the Society generally.

"*Meetings*.—The attendance at the meetings of the Society has been well maintained, and if the Council were furnished with a greater number of papers recording the results of original work on the part of Fellows, the position of the Society would leave hardly anything to be desired.

"*The Journal*.—In accordance with the desire expressed by the Council, the last volume of the *Journal* has been somewhat reduced, and would have been brought within the limit of 1,000 pages but for the pressure caused by the revived discussion of the aperture question.

"With the completion of that Vol., Mr. Crisp's arrangement for the honorary Editorship of the *Journal* terminated. The Council passed a unanimous resolution expressing the thanks of the Council for his valuable ser-

vices in conducting and editing the *Journal*, and for the great liberality he had displayed in its production. Under the special circumstances which existed, the Council did not feel themselves able to invite Mr. Crisp to continue to act as Editor; but having appointed a committee to confer with him on the subject, they were gratified to find that he was willing to continue the existing arrangement for two years further. The Council are sure that the Society will cordially endorse both their resolution as to the past conduct of the *Journal*, and their satisfaction that it will be continued for a further period. The thanks of the Society are also due to the Associate Editors for their services in connection with the *Journal*."

T. Charters White moved that the report be received and adopted, and printed in the usual way, and the motion having been duly seconded, was put to the meeting and carried unanimously.

The list of Fellows proposed as officers and council for the ensuing year, was read as follows:—

President: Prof. P. Martin Duncan, M.B., F.R.S. Vice-Presidents: Prof. F. M. Balfour, M.A., F.R.S.; *Robert Braithwaite, M.D., M.R.C.S., F.L.S.; *Robert Hudson, F.R.S., F.L.S.; John Ware Stephenson, F.R.A.S. Treasurer: Lionel S. Beale, M.B., F.R.C.P., F.R.S. Secretaries: Charles Stewart, M.R.C.S., F.L.S.; Frank Crisp, LL.B., B.A., V.P.L.S. Twelve other Members of Council: *Ludwig Dreyfus; Charles James Fox; James Glaisher, F.R.S., F.R.A.S.; *J. William Grove; A. de Souza Guimarães; John E. Tuxen; John Mayall, Jun.; Albert D. Michael, F.L.S.; *John Millar, LL.B., F.R.S.; *William Thomas Suffolk; Frederic H. Ward, M.R.C.S.; T. Charters White, M.R.C.S., F.L.S.

J. Beck and Dr. Gibbs having been appointed scrutineers, proceeded to take the ballot, and subsequently reported that the above-mentioned Fellows were all duly elected. A vote of thanks to the scrutineers was unanimously carried.

J. Beck said it had been usual to regard a vote of thanks to the secretaries as a matter of course, but he thought that at no previous time did they so much deserve that a hearty vote of thanks should be offered to them. The Society was very greatly indebted for their services, and it was not as a mere matter of form that he made the proposition that they should be thanked for the able manner in which the business of the Society was conducted.

The President thought there could be no difference of opinion upon this matter. The secretaries were the very life and soul of the Society, and most heartily deserved their thanks. The motion being seconded, was then put from the chair, and carried by acclamation.

F. Crisp in returning thanks for the vote, on behalf of himself and his co-secretary, said that he felt there should be an amendment to the proposition, so as to make it include the President and the other officers of the Society, instead of singling out the secretaries alone. The President in particular had been most indefatigable in the attention which he had given to the affairs of the Society, and had especially distinguished himself by the way in which he had added by his comments to the interest of the matters brought before their meetings. There was, he knew, a very general desire that his term of office might be an extended one.

The President then read his annual address, of which the following is an abstract:—

After an obituary notice of the Fellows who had died during the year, and a reference to the fact that the Society now included more Ordinary Fellows than at any period of its existence, the President referred to the vast amount of original work which had been done with the microscope during the past year. As it would be impossible in the compass of an address to deal with both the theoretical, and what he might term the observational, parts of microscopy, he would confine himself to the former, a course which was more to be justified from the fact that the past year had, in his view, been marked out beyond almost any previous year by the important points of microscopical optics which had for the first time been elucidated.

The President then referred to the increased interest which was being shown in Professor Abbe's theory of microscopical vision, pointing out the desirability of every microscopist making himself familiar with the leading experiments by which the images of structures, which it was known did not exist in the object, could be made to appear at pleasure, merely by varying the relative positions of the diffraction images at the back of the objective.

Turning to the aperture question, the President referred to the benefit which had accrued from the new discussion of the matter, and said that if anyone did not now comprehend how an immersion objective could have an aperture greater than that of an air or dry objective of 180° angle, it could not be charged against the Society that ample means had not been provided to enable him to do so. The numerical aperture notation was also alluded to.

The question of penetrating power and depth of vision had, the President pointed out, been placed on its proper scientific basis, it being shown that

* Have not held during the preceding year the office for which they were nominated.

the former varied inversely as the aperture of the objective, and so far from being synonymous with depth of vision, as it had so long been treated, was now known to be only one of the many factors which made up depth of vision as a whole. Some points with regard to micro-stereoscopic vision, as to which confusion had arisen, had also been advantageously explained.

Special reference was made to homogeneous-immersion objectives, and to the advance in their construction by the production of one of 1.47 N. A. (out of a possible 1.50) by Mr. Powell, and also to the communications of Mr. Stephenson, relating to the visibility of minute objects, by mounting them in phosphorus and other media.

In regard to the use of wide-angled objectives, the president stated his own opinion to be in favour of their utility, and criticised the views of Dr. Royston-Pigott, as contained in a recent paper, dwelling more particularly upon the question of the supposed "all-round vision" and the observation of "miniatured" images.

[We hope to be able to give a fuller report of this address when published.]

J. E. Ingpen said he had much pleasure in proposing a vote of thanks to the President for his very able and interesting address. He was sure that those who had followed the revival of the discussion of the Aperture question would thoroughly agree that the last year had, as the President had observed, marked an important epoch, in that it had placed the matter on its true scientific basis, and had exposed the strange fallacies by which the previous consideration of the subject had been confused. The address was one which he felt sure they would all be pleased to read when printed, and to remember. For his own part, he would venture to express the hope that the President would carry out his intention of continuing his record of progress in a similar manner at a future time.

Dr. Braithwaite having seconded the motion, J. E. Ingpen put it to the meeting, and declared it carried by acclamation.

The President thanked the Fellows for this vote of thanks, and also for the honour which they had done him in again electing him President. He had at first been doubtful as to how he should succeed in that office, for although he had occupied the chair in other societies, he had been prevented from attending the meetings of this society. He could only say that he would do his best during the term of office for which they had re-elected him, and hoped that at its termination he should receive their approval.

The meeting was then adjourned to March 8th.

USEFUL AND SCIENTIFIC NOTES.

Marking-Ink Powder.—Mr. Albert Smith, of Essex-road, sends us a marking-ink in powder, which, when mixed with water and used with a quill-pen, appears to be a capital preparation. A peculiarity is that the ink does not turn fully black until the article is washed, and that should not be done until after the name has been written 24 hours.

Velocity of Explosive Phenomena.—MM. Berthelot and Vieille operated chiefly with an explosive mixture of hydrogen and oxygen at atmospheric pressure. A straight horizontal lead tube, about 133ft. long, and 1.5in. interior diam., was filled with the mixture, and the explosion started by means of an electric spark at one end. The flame, as it went along, ruptured two electric circuits, by acting each time on a grain of fulminate of mercury applied to a thin strip of tin. Thus a delicate chronograph was affected (the Le Boulengé, having a precision equal to 1-20,000th of a second). When the tube, instead of being placed straight, was arranged in several parallel pieces with bent joints, the velocity seemed to be the same. The general average for both cases was 2,841 metres, or about 9,470ft., per second. A doubt, on getting this high figure, whether it was really the rate of propagation of the detonation that was being measured—whether a vibratory motion of the metal might not have been the cause of rupture of the circuits (though this seemed unlikely)—was set at rest when a similar strong caoutchouc tube was found to give like figures. With a capillary glass tube the velocity was somewhat less—viz., 2,341 metres. Next, it was found that the velocity was much the same, whether one or other of the ends of the tube was open alone, or both were open, or neither. The velocity appeared to be uniform throughout the tube; and with pressure varied between 1 and 3 the velocity seemed independent of pressure. Once more, the velocity is different in different gases; thus, in a mixture of carbonic oxide and oxygen, it was found to be 1,080 metres, and dilution of the other explosive mixture, of hydrogen and oxygen, with air, reduced the velocity. For instance, in a mixture containing 45 per cent. of the explosive gas, the velocity was 1,439 metres.

SCIENTIFIC NEWS.

THE Gresham lectures on Astronomy will be continued by the Rev. E. Lodge, M.A., F.R.A.S., on Monday and Tuesday, Thursday and Friday next week, Feb. 20, 21, 23, and 24. They are free to the public, and commence at 6 p.m. in Gresham College, E.C. The subject for the course is, The Planets, and Jupiter and Saturn.

Mr. Norman Lockyer, F.R.S., delivered a lecture in Chorlton Town Hall, on Monday last, on the coming eclipse of the sun, which takes place on the 17th of May. In the course of his lecture Mr. Lockyer contended that by observing eclipses of the sun, we could increase our knowledge enormously, for to understand the construction and history of our own planet, we must observe what is going on in the sun. Mr. Lockyer said it was supposed that the earth was formed and cooled exactly as the sun is cooling now.

Selenographers will be interested in the series of drawings of the lunar surface made by Tobias Mayer in 1748, 1749, 1750, which have been photo-lithographed and published by the direction of Prof. Kunkel, director of Göttingen Observatory. Mayer's lunar tables, it may be remembered, obtained him an award of £3,000, which was voted by the British Parliament and paid to his untimely widowed wife, for he died in 1762 at the age of thirty-nine.

Prof. Stokes has accepted the first appointment of lecturer made by Burnett's Trustees conjointly with the Aberdeen University Assessors. He will hold the office for three years from October 1st, 1883, and will lecture during the first session on recent researches into physical science.

Dr. W. de la Rue, F.R.S., has been appointed manager of the Royal Institution, and Mr. W. Bowman, F.R.S., hon. sec.

A paper, by Dr. Paget Higgs, was read last week at the meeting of the Institution of Civil Engineers, the subject being photometry as connected with electric-lighting. The author suggested that the solution of the problem is to be found in a system of measuring the candle-power of the arc by the heat radiated. Dr. Higgs concludes that the light varies as the fourth power of the current, the resistance or potential being constant, or as the second power of the work in the circuit.

We understand that Mr. Webb's new compound locomotive has been tried at high speeds for some little time, and has so far given every satisfaction. A full description will no doubt be given in due time. We had something to say on the general subject on p. 102, ante.

Experiments with liquid fuel in steam-boiler furnaces have been made at the works of the Co-operative Laundry with the apparatus of Messrs. Orellin and Rolfe. The boiler is of 20h.p., and has a large call for steam besides that required for the engine. The arrangement consists of a compound jet fixed through the sight-hole of the furnace-door. Steam is sent through one jet, which draws up and forces into the furnace, in the form of fine spray, a "special paraffin oil," while at the same time the air requisite for combustion is drawn in and highly heated in transit. No cold air enters at all; and even with dampers closed, the combustion is perfect and the temperature is much intensified. The patentees apply their system to all purposes for which a great and pure heat is required.

A multiplying anemometer, of simple form, likely to prove useful in measuring the velocity of air-currents in mines, or above ground, also that of water-courses, has been described to the Paris Academy, by M. Bourdon. The instrument consists of a widish tube, narrowing a little to a minimum section, which is about a third of the length from one end. Axially in the shorter truncated cone is fixed a similar much smaller tube, the longer cone of which debouches just at the stricture of the wide tube. Round this stricture is a sleeve or casing which communicates both with the interior of the wide tube and with a water manometer. With this arrangement it is found that the manometer gives indications of a negative pressure much greater than the positive pressure at the mouth of the wide tube (measured by a similar mano-

meter). With a two-tube instrument, the mean difference of the water columns was as 1:20, giving, for velocities, the ratio 1:4.5. (With three tubes, the third placed in the second, the corresponding ratios were 1:80, and 1:8.7.) It would be easy to combine alarm-apparatus with the instrument.

Some one in New Zealand has recently written Mr. Edison on the pressing need of some means of shearing sheep evenly, rapidly, and without risk of hurting the animal; and suggesting that perhaps some electrical apparatus might be made to answer, the work being done by means of a wire highly heated by an electric current. This method of cutting has been entirely successful in surgery, but whether the incandescent wire would injure the wool, or be rendered inoperative by ash, remains to be seen. We note another desideratum, expressed by a correspondent of the *Scientific American*. The settlers on the Great Western prairies suffer great inconvenience from scarcity of fuel, and yet they have all the elements of an excellent fuel in the abundance of prairie grass about them. A simple machine that would spin prairie hay into hard solid knots or rolls of suitable size for fuel, would certainly (he says) have a great demand. Prairie hay is at present largely, but slowly, twisted by hand into knots for fuel.

Attention is called by a writer in *Curt's Repertorium* to a small dynamo-electric machine, driven by hand, and meant for laboratory or lecture use. It is supplied by Krottinger, in Vienna. The dynamo is fixed between the divergent legs of a solid table, under the top of which is a steel axle for the driving-wheel, which gives rapid motion to the Gramme inductor through an endless band. The wire-ends are brought up to binding screws near a handy rheostat at the top. Of various experiments that can be made with the machine, the following are some:—A Reynier incandescent lamp (also supplied by Krottinger) gives an intense light, sufficient for capital projections with Stöhr's Scopiticon. A thin platinum wire, about 20in. long, can be heated white hot. The inductor of a hand Gramme machine with steel magnets, from which the toothed wheel has been removed, can be set in rapid rotation by means of the Krottinger machine, illustrating the transmission of force by electricity.

An interesting experiment, illustrating the force of inertia and molecular resistance, is given in *La Nature* (it was first performed, and with a practical purpose, by a Corsican, under the second Empire). Place a sealed piece of wax on an anvil, or well supported iron plate, and over it a round ball of cast lead (not compressed), of diameter corresponding to its width. Now give the ball a sudden violent blow with a hammer. The flattened ball is found to have taken the impression of the sealed wax in its least details, and without breaking it (if the experiment is properly done). With the aid of this matrix the seal may be copied.

Vine-grafting has assumed great importance of late years, but there is a large amount of failure in it. The following incident, lately reported by M. Loubet, is, therefore, worth notice. A nurseryman at Carpentras, M. Raymond, had, in March, 1881, put provisionally in a bank of water near his greenhouse, some thousand grafted slips which he had not had time to plant. Seven or eight days after, on returning, he noticed a commencement of union in the young plants. So it occurred to him to return the slips to the water, and await the result. In 25 days he found the junctions nearly complete, and he commenced plantation, taking care to cover with earth to the top of the stem. The vegetation went on with regularity and remarkable vigour, and the proportion of failures was very small (hardly a thirtieth).

The *Journal de l'Agriculture* gives details of the new inoculation of sheep, &c., by Pasteur's method, now largely practised in France. The vaccinal liquid is sent to its destination in short stoppered tubes (like test-tubes). Some are labelled "premier vaccin," others "deuxième vaccin." The Pravaz syringe is used in inoculation: it has a hollow needle and a graduated piston-rod, with adjustable runner. The syringe is filled with first vaccine matter (air-bubbles being carefully excluded), and the runner placed at the first division. A man holds up the sheep by the fore legs, while the operator pushes the syringe-needle under the skin about the middle

of the left thigh; then the piston-rod is pressed as far as the runner, and the animal is inoculated. Next the runner is moved to the second division, and a second sheep is treated. With expertness, about 150 sheep can be thus inoculated in an hour. Twelve or fifteen days after, the operation is repeated on the right side, with the *deuxième vaccin*, which is stronger. Each fill of the syringe serves for eight sheep. Cows, oxen, and horses receive a double dose, the two former behind the shoulder, the latter in the neck. The greatest care has to be taken to avoid any kind of impurity getting among the vaccine matter. The syringe must not be used for a second inoculation after some days without thorough purification. A tube of vaccine matter, once opened, must be used up the same day, or any remainder thrown away.

A Hungarian professor, Dr. Jedlik, has been for some years developing a system of tubular receivers of electricity forming a battery, which offers considerable advantages over the ordinary battery of Leyden jars. The most recent forms he adopts for these batteries are described in *Carl's Repertorium* (XVIII. Band, 1 Heft, 1882). He makes up bundles of barometer tubes (or the like), closed by fusion at one end—filled to a certain height with iron filings, from which a copper wire is brought to the mouth—and having tinfoil outside up to the level of the filings. The bundle is inclosed in a glass tube with terminal brass balls, connected with the copper wire and the tinfoil respectively. Several such tube-bundles are fitted in parallel position in a frame; but we cannot here pursue details. The capacity for electricity is very much greater than with ordinary Leyden jars, and space is saved. If perforation takes place the injured tube can be easily replaced.

Attempts have heretofore been made to produce a hydrate of carbonic acid by strongly compressing a mixture of carbonic acid and water, but the result has merely been the superposition of a layer of the liquid acid on a layer of water. M. Wroblewski believes he has succeeded in another way. If the compression be carried nearly to the point of liquefaction, and the gas then released a little, so as to produce a trace of solid matter, either in the water or on the walls of the tube, the following phenomenon, he says, is remarked: Each time that, in increasing the pressure, a certain pressure is passed (which he calls the critical pressure of the phenomenon), the tube is covered with an opaque hoar-frost (*givre*); and each time the same point is passed in diminishing the pressure, this hoar-frost disappears. The critical point is 12 atmospheres for zero temperature, (with increased temperatures, it increases). The phenomenon may be reproduced as often as one pleases, if care be taken not to diminish the pressure too much. No similar result is obtained with air and water.

The annual ball of former students of the Paris Ecole Polytechnique, took place by electric light, on January 28th, at the rooms of the Ministry of War. The grand *Salle des Armures*, usually lit with 300 candles, had a lustre with 16 Werdermann lights instead. In the buffet were four Jablockhoff candles, along with three gas-lustres, and in a large temporary hall in the garden, besides eight Jablockhoff candles on one lustre, there were 160 Maxim incandescent lamps on six magnificent lustres. Towards the end of the ball, the light of two Jasper lamps was added through apertures in the ceiling of the last-mentioned hall. The whole was considered a great success.

Amongst the new Fellows elected at the last meeting of the Royal Microscopical Society, was Mr. W. A. Thoms, baker, of Aylth, who for the past ten years has been engaged in tracing the origin of leaven, which he concludes is identical with the fibrin of gluten and the granular contents of embryo-membranes. Mr. Thoms has also devoted a great deal of time to an investigation of the potato disease, and the salmon fungus.

GRANULAR vegetable carbon, saturated with sulphuric acid, of which it holds about seventy-times its own volume, is now being tried as a destroyer of phylloxera. Buried amongst roots, it gradually gives off sulphurous acid gas, and this heavier than air, not only permeates the soil, but hangs about on the surface, and asphyxiates the phylloxera.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made Payable to J. PASMORE EDWARDS.

* * * In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his will undertake to write the whole body of physics: a vice from whence great inconveniences derive their origin."—Montaigne's Essays.

SELENOGRAPHICAL.—PLINIUS.

[19725.]—In letter 19682, p. 517, M. Gaudibert draws attention to two craters on the floor of Plinius, asking if they have been seen before, as he finds no record of them; and Mr. Elger, in letter 19681, on the same page, mentions one large crater seen by him on the same night. I find I have a rough sketch of Plinius, dated Dec. 20, 1880, which shows one good-sized crater, evidently that seen by Mr. Elger and M. Gaudibert: but I have none of the other objects seen by Mr. Elger on that occasion. It was observed on Dec. 20, 1880, from 14h. 50m. to 16h. 10m., and the note with the sketch remarks that "there is a large white spot in Plinius which, at nearly 16h., begins to show a small black spot in its centre." M. Ashley.

JUPITER—MARS.

[19726.]—The following list, which is a continuation of that given on page 470, concludes for the present apparition of Jupiter the ephemerides of the times when the assumed First Meridian of the planet passes the middle of its illuminated disc:—

h. m.	h. m.	h. m.
Mar. 1 9 26.4	Mar. 11 7 43.9	Mar. 21 6 1.6
19 22.1	17 39.7	15 57.4
2 5 17.9	12 3 35.4	22 1 53.1
15 13.6	13 31.1	11 48.8
3 1 9.3	23 26.9	21 44.6
11 5.0	13 9 22.6	23 7 40.3
21 0.8	19 18.3	17 36.1
4 6 56.5	14 5 14.1	24 3 31.8
16 52.2	15 9.8	13 27.5
5 2 45.0	15 1 5.5	23 23.3
12 43.7	11 1.3	25 9 19.0
22 39.4	20 57.0	19 14.8
6 8 35.1	16 6 52.8	26 5 10.5
18 30.9	16 48.5	15 6.3
7 4 26.6	17 2 44.2	27 1 2.0
14 22.3	12 40.0	10 57.7
8 0 18.1	22 35.7	20 54.5
10 13.8	18 8 31.4	28 6 49.2
20 9.5	18 27.2	16 45.0
9 6 5.3	19 4 22.9	29 2 40.7
16 1.0	14 18.7	12 35.5
10 1 56.7	20 0 14.4	22 32.2
11 52.5	10 10.1	30 8 27.9
21 48.2	20 5.9	

The preceding end of the great reddish spot will be near the middle line of the disc about a quarter of an hour after these times.

In case the white equatorial spot should continue to move at the rate at which it has moved for more than a year, it may be looked for near the middle of the disc

on Feb. 18, about 8.1h. after, or 1.8h. before	
28, " 5.9h. " 4.0h. "	
on Mar. 10, " 3.7h. "	
" 20, " 1.5h. "	
" 30, " 9.1h. " 0.7h. "	

the passages of the First Meridian, the interval at which it follows decreasing daily by 0.22 hours, or about 13 minutes.

Mars.—The position-angle P of the axis of Mars, the areographical latitude of the centre of the disc, the diameter of the disc, and the amount q , and position-angle Q of the greatest defect of illumination will be:—

1882.	P.	Lat.	Diam.	q .	Q.
Mar. 5....	335.0	+ 0.7	8.8	0.8	92
" 15....	336.6	2.4	8.1	0.8	93
" 25....	338.7	4.2	7.5	0.7	94
Apr. 4....	341.0	6.1	6.9	0.7	96
" 14....	343.6	8.2	6.5	0.6	97
" 24....	346.4	+ 10.3	6.1	0.6	99

Approximate times, when some of the most marked spots of Mars will be near the central meridian. *Vide* p. 61. The spot "a" is Dawes' "Forked Bay" in Mr. Green's chart, "d" is Green's

"Terby Sea" or Schiaparelli's "Lacus Solis," "r" is Green's "Trouvelot Bay" or Schiaparelli's "Sinus Titanum," "f" is Green's "Kaiser Sea" or Schiaparelli's "Syrtis magna."

1882.	h.	h.	1882.	h.	h.
Mar. 1 a 5.9 d 12.1			Mar. 23 d 5.0 r 10.8		
2 a 6.6 d 12.7			29 d 5.6 r 11.4		
3 a 7.2 d 13.4			30 d 6.2 r 12.1		
4 a 7.8 d 14.0			31 d 6.9 r 12.7		
5 a 8.5 d 14.7			Apr. 1 d 7.5 r 13.3		
6 a 9.1 d 15.3			2 d 8.2 r 14.0		
7 a 9.7 d 15.9			3 d 8.8 r 14.6		
8 f 5.2 a 10.3			4 d 9.5 r 15.3		
9 f 5.8 a 11.0			5 d 10.1 r 15.9		
10 f 6.5 a 11.7			6 d 10.8 r 16.6		
11 f 7.1 a 12.3			7 a 5.4 d 11.4		
12 f 7.8 a 13.0			8 a 6.0 d 12.1		
13 f 8.5 a 13.7			9 a 6.6 d 12.8		
14 f 9.2 a 14.4			10 a 7.3 d 13.4		
15 f 9.8 a 15.0			11 a 7.9 d 14.1		
16 f 10.5 a 15.6			12 a 8.6 d 14.7		
17 f 11.2 a 16.2			13 a 9.2 d 15.3		
18 r 4.4 f 11.8			14 a 9.9 d 16.0		
19 r 5.0 f 12.4			15 f 5.4 a 10.5		
20 r 5.6 f 13.1			16 f 6.1 a 11.2		
21 r 6.2 f 13.8			17 f 6.7 a 11.8		
22 r 6.9 f 14.5			18 f 7.4 a 12.5		
23 r 7.5 f 15.2			19 f 8.0 a 13.1		
24 r 8.1 f 15.9			20 f 8.7 a 13.8		
25 r 8.8 f 16.6			21 f 9.3 a 14.5		
26 r 9.4 f 17.2			22 f 9.9 a 15.1		
27 r 10.1 f 17.8			23 f 10.6 a 15.8		

A. Marth.

66, Lambeth-road, S.E., Feb. 11.

COMET, METEOR, AND AEROLITE SPECTRA.

[19727.]—I AM obliged to "F. R. A. S." for his answer to my question. It was with reference, however, to the spectra of aerolites, when made artificially incandescent, that I was desirous of information; but the spectra mentioned by "F. R. A. S." of incandescent meteors in our atmosphere would seem to be quite as useful for purposes of comparison with comet spectra. A remark made in Warner's Prize Essay, given in the "E. M." has led me to a conclusion, obvious indeed, but which had not occurred to me before—namely, that such comparisons are not likely to be so useful as I had at first imagined. Because the comet spectra supposed due to meteors incandescent through collisions, would no doubt arise from the most volatile constituents of the superficial laminae of the meteors, which might be dissipated by the time their incandescence is observed in our atmosphere or that they have arrived at the earth's surface. Yet spectra artificially obtained of both aerolites and aerolites would be interesting.

W. C. E.

PAINTING ON GLASS.

[19728.]—SOME time ago there appeared in the "E. M." certain correspondence regarding the production of pictures on glass of magnified objects for the magic-lantern, and there was some discussion as to the best way to prepare the glass, so that a pencil drawing could be made on it. I have lately taken to painting on glass, which I consider far superior to coloured photographs for the lantern, and I find the following very successful:—

The ordinary photographic "hard varnish" is to be diluted with an equal volume of methylated spirits of wine. This is to be poured over a clean glass in the same way as if coating the plate with collodion. It must not be warmed, but allowed to dry in a cool place, which it will do in five minutes. When nearly dry, it should be held to the fire, and made as hot as the hand can bear. The glass will now have a beautiful fine-grained surface, like the finest ground glass, and, being semi-transparent, a tracing of any subject can be made with an H.B. pencil. Water-colours should be used, mixing them with a very small proportion of gum, to prevent cracking; and it will be easy to lay flat tints on the prepared surface. When this is done, the glass can be made transparent by simply warming it, and pouring the varnish over it as before. The details of the picture can then be put on, using a "dabber," which is simply a bit of wadding inclosed in a piece of kid-glove. After each painting or dabbing a fresh coat of varnish should be given.

M. I. C. E.

SCREW-PROPELLING.

[19729.]—I AM glad to see I have set the ball moving, and I thank "J. J. A." for his notice, and, in answer to his "Moral," I must say, whilst admitting that any man who goes in for a mode of motion which fails to keep up the push continually, is well (I suppose he means ill) wasting his time, admitting his premises, I deny the applicability in the case of the motion of the oar when used in sculling. I believe the motion of the blade of the oar is elliptical with a long major axis.

axis, and a comparatively small vertical axis. I may be right in this comparison, and were I able to get about, I would soon have it tested by making an indicator that would take a diagram of the exact motion; but having been a cripple for the last five months, can only do these things through others, in which case the real *push* is wanting. "J. J. A." mentions that Harland and Woolf patented the plan. If so (if ever I recover the use of my legs), I will go to the Patent-office and see what they really did patent, a plan, and what the patent is. But whether they patented and never tried, or whether they patented it, tried, and failed, does not appear. But unless the article appearing at page 294, of No. 871 of the "E. M.," is all imagination, and Mr. Root and his experiments are all imaginary, the writer of that article has stated facts, and the results of those facts. In a tolerably long life, I have seen the pronounced "impossible" of the savant, or, as in Hindoostanee, we say the "sub-janta wallah," result in the "possible" of some plain, earnest thinker, who, having conceived the idea, patiently plodded through, regardless of failure, and who, if he did not always realise his original idea, often discovered something during his investigation. *Moral dampers* are out of place in the columns of the "E. M.," save and except on such subjects as perpetual motion, the quadrature of the circle, and the Sun going round the Earth. I could recite fifty cases where the impossible of the wise men was made possible by the simple and supposed-to-be-foolish. Where would Bessemer, with his fourteen hundred thousand pieces of tribute with the Queen's head on each, have been, had he been disheartened by the strongly-pronounced adverse opinion of Dr. Percy? But repetition of similar cases would only be filling up your columns unnecessarily with truisms. Many a crude article have I seen in your columns—that is, crude to myself—but there is scarce one that does not contain the germ of something useful behind it; at all events, they one and all show a thinking mind, and I say it is better to think, even in a wrong direction, than not to think at all. In the one case, the mind is going to rust; in the other, it is keeping bright. Now to the subject-matter of propulsion. I take it that in all cases of propulsion in or on the water, the principle is the getting a fulcrum and exerting force against that fulcrum to procure motion. Under any circumstances, the water forms an imperfect fulcrum; were it a perfect one, motion in it would be impossible. The object, therefore, is to get as rigid a fulcrum for the propelling power as possible, and to put the matter to be propelled into such a shape as to displace the water most speedily. Now, in either the side wheel or the screw at the stern, the fulcrum is far from rigid; were it so, there would be no slip. In the side wheel, the floats, as they touch the water, set on a yielding fulcrum, and so does each fan of the screw. Now, it strikes me that the action of the screw inclined at an angle to the horizon in that portion of the force that resolves itself into an up-and-down force, affords a more rigid fulcrum than the water above the screw does, placed horizontally, resulting in the long stern-wave. Now, the question seems answered by the motion of the fish's tail. I believe I am right in saying that in most sorts of fish nine-tenths of the propulsion is caused by the tail-fin—in some, I believe, it is altogether. Now, I say the nearest approach to the action of the fish's tail is the action of the oar in sculling. Whether that is the most perfect action may be a question of doubt; but as far as I can make out, it is the most fitted for its purpose as far as the fish is concerned. I am glad to see "White Swallow" is employing his head and hands on the subject of propulsion; and as he is evidently in earnest, I have no doubt that his labour will not be altogether unfruitful. To me he seems following on the same track as my friend who built the *Daddy Long Legs*, to which I referred in my article of the 3rd of February; whether my friend took out a patent or not, I know not; but his name was Henry Wise, and the time 1843 (I think). In one respect, his motion will do more than my fish-tail motion. He can reverse: I could not. So that my ideal motion would be unsuited for sea-going steamers. As an auxiliary to sailing-vessels in calms, or in threatening to windward, I believe it could be utilised; but whether equal in effect to "White Swallow's" direct action, experiment alone can decide. The writer of the article on Root's experiment evidently knew what he was writing about. I trust he will go further in this matter, and let your readers know whether Mr. Root has gone on any further with his experiments, and with what results.

Khoda Bux.

THE ARMSTRONG LATHE.

[18730].—I HAVE not very much to say in reply to letter 19715; but I would be very sorry anyone should regard me in the light of "counsel for Major A.'s lathe." That is a party paid to defend *his* *own* *case*, which is in no degree the case. *Some* *ago* *I* *became* *possessor* *of* *a* *sadly* *ill-*

made, and worse-designed lathe, no part of which is worthy of being retained; so that I am on the look out for a good design, to make the foundation of a thoroughly good practical, if not ornamental, lathe. Major A.'s seemed to me to be such, and to leave more room for after-additions, than any other; which, in a many years' pretty diligent search, I had come across. This is the whole explanation of my connection with the lathe. If it seems no one else cares anything about the lathe, or thinks it possesses any advantage, why it is high time the discussion ceased, as far as I am concerned, or till Major Armstrong returns to England, and can speak from knowledge, and thus do justice to his own invention. I have as little desire to write up this lathe as "J. L." can possibly have to write it down, and I do not know why he should attribute such a thought to me; but I have heard of such a course as damning a thing by faint praise.

I will not agree to the statement that "all combinations are terribly costly—necessarily clumsy and inconvenient." I know all tools made by some houses are *terribly* costly indeed; and by other houses *terribly* clumsy. But that Major A.'s attachment need come under either of these charges I deny. Take the slide-rest—need this exceed the ordinary make so very much in cost? If it is thought clumsy to have a rack on the cross slide, and to have that somewhat longer, there is the alternative method of driving by a link, when this slide is used for the shaper. Next take the shaper. Will or should the fitting of two gear-wheels, and the rocking arm, cost such a frightful amount as to hinder any one from attempting it, unless he had a very long purse; and lastly, is it a *clumsy* arrangement? No one doubts it is better to have a separate machine for each kind of work, if you can have it; but for one who can have it there are twenty who cannot, and it is for these twenty combination tools are invented, and are a very great convenience, spite of all that has been said. If a man has to earn his living by his work, it will pay in the long run to have a separate machine for every work; but when the work is for pleasure or amusement, as it is with the amateur, the same cannot always be said. I do not certainly like to see a lot of money buried in a machine, perhaps used only two or three times in a year, and which, if I attempted to sell after using it those two or three times, I would not get half my money for; and the satisfaction of having the machine for those few occasions is not added to by the knowledge that I could have done my job just as well—only, perhaps, with the expenditure of an additional five minutes' time—by a very simple combination, which would not have cost a third of the money.

"J. L." is interested at present in a milling combination. I thought "J. K. P." had illustrated and described his arrangement long ago, in the good old times. Is it something better or less a combination than this that he desires? I know it was the opinion of "J. K. P." that a great deal of amateur planing and shaping could be done with circular cutters in the lathe. I would not dare to question such an authority—but would it be much saving in expense? Cutters are, I think, very expensive to buy, they are troublesome to sharpen, and if wide planing is to be done, either very light cuts must be taken, or else a stout spindle must be used, which adds to the diameter of the cutters required.

Friedk. Carre.

LATHES AND LATHE-MAKING.

[19731].—I HAVE to thank you for the too-flattering note you have been good enough to append to my letter appearing in your last issue, and I must ask you to allow me to express my regret that I fear my general affairs will not leave me time for taking any considerable advantage of so courteously expressed an invitation.

Partially from this, but also from other reasons, I have not seen your admirably conducted paper for a rather long period; but a natural curiosity would have led me to desire to learn the precise gravamen of Dr. Edmunds' late complaint, had not that information been afforded me by several of your subscribers, coupled with the expression of a feeling that the matter required some further notice; and this, with your permission, I will undertake.

Turning to your correspondent's letter, No. 19675, in reply to Dr. Edmunds' inquiries for the meaning attached to certain letters, as applied to screwthreads, I read as follows:—"The above J, N, &c., and many others, are looked upon somewhat as private property, and, I believe, can only be had from myself or from Messrs. Holtzapffel, who use the same threads as I do in such work."

The decision as to whether the modesty or the candour of this astounding statement is the more to be admired, I leave to others; venturing only to say that the series of threads in question in the possession of the gentleman who penned the above sentence, can only be his private property in the sense that he has acquired them by purchase, or by less direct means seldom adopted. On the other hand, that they are the private property of Holt-

zapffel and Co., may probably be considered just in the sense that they are their set of original standard threads—a fact of which it is hard to believe your correspondent could have been unaware; while, in another sense, they are equally removed from the privacy under which he would shroud them, by virtue of their continuous publication for a long series of years through their constant manufacture and demand.

The reticence of the reply must, therefore, remain what Dr. Edmunds styles an enigma, unless the key is to be in the not improbable, though trifling, circumstance that Mr. Evans was in complete ignorance of the respective values and dimensions of the taps and dies upon which he was questioned. It is, at least, difficult to avoid arriving at this conclusion, if it be true, as I am informed, that your correspondent has more than once written such phrases as, "I cheerfully endeavour to write what I know, in the hope that it may help"; and I venture to think that he would have lost nothing by candidly admitting one exception to his power of imparting information.

Your very cordial invitation emboldens me to take this opportunity to fill a lacuna in my former letter, and then to offer a few words upon the article standing at the head of your last issue.

Dr. Edmunds and your readers are already in possession of the information he asked for by *him* or two in my last; but a word or two more, together with a list of the diameters of the taps in question, may not be unacceptable, and will include all that requires saying on the subject, without, I hope, unduly overburdening your pages.

The taps A, B, and C, not previously mentioned, are of Nos. 1, 2, and 3 H. and Co.'s threads respectively, and the diameters of the whole series are as follows—viz.:

A 1.0, B .875, C .75, D .56, E .50, F .45, G .41, H .36, I .33, J .29, K .25, L .24, M .21, N .20, O .19, P .18, Q .1625, R .15, S .135, T .12, U .10.

There is one other size between C and D which is .625 diameter and No. 4 thread.

The foregoing series of taps are grouped in separate diestocks: the following being those the more used for the purposes mentioned in my last, viz., 16in. diestock, D, E, F, H; 12in., G, I, K, M; 9in., J, L, O, Q; and 6in. N, P, R, T. A 4in. diestock, cutting 50, 70, and 100 H. and Co.'s threads to the inch has also been added to the above. The necessity for gradually reducing size and weight in the diestocks needs no comment to your readers, and the above particulars are only given in anticipation of a possible question, the reply to which is, that a purely consecutive grouping of the diameters assigned to every diestock was avoided, to afford every set a greater difference in and a wider range over diameter; whence it results that one sized diestock will often serve the purpose of one individual, and the taps in any two diestocks overlap.

The angles of the deep and shallow threads have been already published, and the deep threads find by far the more extensive use, see Vols. II. and IV.

Turning and Mechanical Manipulation.—I venture now on a few words in criticism of your correspondent's paper on the Rose-cutting Frame. It might have been, perhaps, more graceful had he named the original source of so comparatively late an addition to the apparatus for ornamental turning; and upon this I would only remark, that it would certainly have spared me the necessity of saying that the instrument described in your last number as made by Mr. Evans is, so far as it lies in his power, nothing more than a copy of that issued by H. and Co.

It is perfectly correct that the tool-slide of the Rose-cutting frame was at first but half its present length. I think six of these instruments were so made, but the real improvement arising from doubling the length of the slide was so immediately manifest, that most of these were converted to the new pattern, which has acquired no subsequent modification. Your correspondent is perhaps rather obscure upon this double action, and he does not appear to be aware of one important feature. When the tool is anywhere between the axis of its revolution and the micrometer head of the main-screw by which it is traversed,—when its positions may be distinguished as being on the hither side of the centre—it reproduces the undulations on the rosette, whether they be concave or convex; but so soon as the tool occupies any position upon the other half of the main-slide,—when it may be said to be past the centre—it produces the converse of any rosette employed, cutting concave undulations from convex curvatures upon the rosette, and convex from concave. This in effect doubles the results obtained from any series of rosettes—alone an important economic consideration; but it also has an incidental and scarcely less important value, which is, that in producing concave rose undulations on the work, by which is meant all those in which the points of meeting of component curvatures point outwards from the general centre of the work, these points are far more acute and otherwise perfect when they are

obtained from a convex rosette by means of the above-named reversal, than when obtained as direct copies of a concave rosette with the tool on the hither side of the centre.

The apparent advantages of the employment of a drill were by no means overlooked by the originator of the rose-cutting frame, but were considered open to question for the following reasons:—The fixed tool has the peculiar property of accumulating all elasticity against the direction in which it is cutting, with the effect of producing a higher degree of polished finish in the lines of surface patterns, or upon the mouldings and fillets of more deeply-cut ornamentation than can be approached by other means. The latter class of ornament may be cut with a fixed tool to a quarter or three-eighths of an inch in depth, usually sufficient, with no very great expenditure of time, and for increased depths by preparing the work in steps and attacking each seriatim; and, lastly, all patterns cut with a fixed tool may be continued absolutely to the centre, in which respect the rose-cutting frame has the advantage over the rose-engine. The drill, on the other hand, possesses the advantage of comparative rapidity; but, in other respects, the previously-mentioned absorption of elasticity is considerably diminished, and notwithstanding the correct advocacy of using a winch-handle upon the square head of the tangent-screw that carries the driving-pulley, the originality of which improvement is willingly conceded as claimed, this circumstance deprives the ornament of its otherwise clean continuous-cutting and brilliant finish. The pattern can no longer be carried to the centre of the work, by reason of the necessary diameter of the revolving-drill; but that is of little importance. But this question of the diameter of the drill becomes of importance from another aspect—namely, that it obliterates all re-entering angles, which, with the fixed tool, are perfectly sharp, thus robbing the work of half its beauty. These drawbacks are greatly against the employment of the drill; while, so far as I can judge, the form that has taken under Mr. Evans' invention is not calculated to reduce them, this particular improvement being apparently mechanically faulty owing to its length and the smallness of its base. The real objection to the drill, however, does not lie in any particular construction, as that could be modified without difficulty, but is found in its cutting action, and is inherent to any.

John F. Holtzapffel.

G4, Charing-cross, S.W., Feb. 13th.

ORNAMENTAL LATHE THREADS.

[19732.]—I CORDIALLY thank Mr. Holtzapffel for his kind reply to my request for explanations as to the Holtzapffel lathe threads, and which, owing to the excellence of his firm's workmanship, and the scientific manner in which his firm has preserved the original gauges, have kept their ground to the present day. This reply from Mr. Holtzapffel is, I believe, his first contribution to the ENGLISH MECHANIC, and I am sure that I speak for thousands of its readers wherever the English language is spoken when I endorse the Editor's request that Mr. Holtzapffel will continue to contribute now then to its columns. To a large number of readers who cannot obtain his classical volumes on "Turning and Mechanical Manipulation," his aid will be of vast value, as it is sure to be given in that scientific spirit which has always characterised the doings of his firm. To others also who have his volumes, either from inexperience on the part of his reader or want of detail in his text, data are needed which he cannot be expected to enter into private correspondence upon, but upon which, if of sufficient general interest to be discussed in the columns of the ENGLISH MECHANIC, we may hope to see his judgment therein recorded.

The information contained in Mr. Holtzapffel's letter will enable his clients to make their screws with more pleasure now that they know the exact rate of their screw-tools; and the data by which his taps and dies are now for the first time publicly identified with his celebrated comb-screw tools, will remove many difficulties which his clients have felt. If Mr. Holtzapffel would now favour us with his practice as to the best sizes of the bolts to be screwed with each of these tools, the sizes of the finished screws at bottom of thread, and the cases for which he prescribes one or other of their two angles (50° and 60°); these celebrated tools might be used at their best by all who possess them.

It is quite true that, in many cases, mechanically matching the tools and screw-guides together will prevent using a tool which—corresponding in number, but cutting a screw at one pitch, while the mandril is traversing at another—spoils the work. But amateurs generally are not up to this point, and they naturally assume that Holtzapffel's screw-tool numbered—say—three will go with his guide numbered three, instead of, as is the fact, with his guide numbered one. Then, again, when a fine guide is upon the back of the mandril it is by no means easy to be sure that the tool exactly matches, unless the light be right and the

sight be keen. And if additional guides be had, the numbering is again thrown out. All this, I submit to Mr. Holtzapffel, would be avoided by simply marking the guides in accord with the tools with which they work. To those, again, who adopt his new aliquot tools, all that will be needed is simply to mark each tool with the number (of threads per inch), and to mark each guide in the same way. Thus, if a thread of sixteen to the inch be wanted, the guide branded 16 will be put on the mandril, and the tool branded 16 will be put into the slide-rest. Nothing can be simpler than this; it is the plan adopted by Keenan, and, when working with the beautiful lathe of his which I have the good fortune to possess, I never need to think, or calculate, or compare. When, however, I work with the Holtzapffel lathe, my work is always interrupted by a bothersome investigation as to which tools match which guides, and as to the rate of the screw which I am about to produce. One more difficulty. I have in my own laboratory tools which I have had from Holtzapffel's, and they are not all branded with his name. Now, his screw-tools have been copied by many makers—such makers not having the original gauges and hobs by which to make their tools, and, as a matter of fact, all the tools current as Holtzapffel's gauge do not by any means perfectly match when placed together. So much in submission to Mr. Holtzapffel of his clients' standpoint, and which, I am sure, he will be anxious to consider.

I am very glad to know that Mr. Holtzapffel has already carried out the proposition to which I alluded as having been made by his father in 1846, and that aliquot "screw-tools from four to one hundred threads to the inch, are now part of his firm's ordinary stock." If only ornamental lathe purchasers, when purchasing new tools, be urged by Mr. Holtzapffel's people to adopt these aliquot threads, instead of his original incommensurable thread, they will have the same quality of tool, and the same accuracy of workmanship as before, and with the advantage of one set of tools which are equally good for casual and binding-screws, and, at the same time, will cut screws for regulating and micrometrical purposes in any philosophical apparatus that they may wish to construct. It is perfectly clear that clients go to Holtzapffel's, not because they prefer a screw of 6.58 threads per inch to one of 6 or 7 or 6.5; nor one of 9.45 to one of 9, or of 10; nor one of 13.09 to one of 13; nor one of 19.89 to one of 20; nor one of 22.12 to one of 22; nor one of 36.10 to one of 36; nor one of 39.83 to one of 40; nor one of 55.11 to one of 55. Clients go to Holtzapffel's because his tools are scientifically gauged and beautifully tempered, and, in spite of the fact that his workmanship has floated down to this day a series of gauges which were made in the dark ages of screw-cutting, and which, so far as the making of new tools is concerned, are now only an obstruction to scientific advance. Clients who have not the sense to avail themselves of Mr. Holtzapffel's new aliquot threads deserve to suffer, as, assuredly, they will suffer a few years hence, when they find their purchases unsaleable, because encumbered with obsolete screw-threads. A Committee of the British Association is now sitting upon this very question in its application to watch and instrument fine screw threads, where at present each maker uses such gauge as seems right in his own eyes. A beautiful series, going down to 250 threads to the inch, has been actually manufactured by Sir Joseph Whitworth, and submitted to this committee. I have examined these hobs, &c., with a lens, and even the finest of them are beautifully perfect. This Committee is about to make up its report, and, doubtless, we shall soon see a move in trades using these very fine screws. Such an advance will be greatly helped on if we can enlist Mr. Holtzapffel's active sympathy with scientific progress in our ornamental lathe-threads.

I regret that Mr. Evans has misinterpreted my letter, and taken offence. It may be some apology for my own stupidity if I cite the following paragraph from one of several similar letters now lying upon my table, and which runs as follows:—

"Evans has told things I have been wanting to know for some time, so I must not be ungrateful, but I must say his letters are exasperating. He seems to have quite a knack of puzzling and leaving out the important thing, but it does not seem to be at all intentional."

This letter is from an able member of the Amateur Mechanical Society, and I quote it as a tribute to Mr. Evans, though with qualifications, which I am sure he will thank me for frankly putting before him. I have not myself the mechanical enterprise to attempt to make anything in pursuance of Mr. Evans's papers, but I can sympathise with those who, after beginning a laborious task, find themselves at a stop for want of some critical data. That Mr. Evans intends to victimise such readers, or the purchasers of apparatus put together with obsolete and incommensurable screw-threads, I do not say. But none the less it is a fact, that a purchaser in the country or

the Colonies having apparatus out of order and dependent upon unmatchable screw-threads, does find himself victimised. And, in discussing scientific subjects, we must call a spade a spade.

As I have already stated, I have not advocated any particular rate of thread, nor any particular cross-section of thread, I am only urging that all new ornamental lathe apparatus should be constructed with screws whose threads are some aliquot part of an inch, and, therefore, can be originated in any part of the world where there is a screw-cutting lathe and a point tool to be ground to fit the thread of the broken screw.

James Edmunds, M.D.

Grafton-street, Bond-street.

ADJUSTMENT OF FLATS.

[19733.]—NOTICING a discussion on the adjustment of flats, I may say that I do my adjustments in the following way:—Having centred the flat as near as possible, I screw on a day eyepiece, take off the two lenses nearest the eye, look through the two remaining lenses, and there see the image of the flat, which I find not always to be in the centre of the lens. I then adjust with the screws at the back of the flat until the black spot is perfectly in the centre. Can any of "our" correspondents say whether this is a correct method or not?

H. H. Tilbrook.

Clare, South Australia, Dec. 16, 1881.

GAS FROM MINERAL OILS.

[19734.]—CONSIDERABLE interest having been at various times shown by the readers of the "E. M." in the question of lighting with benzoline, it will perhaps be profitable to state the following facts:—

I visited the house of a mechanic in Woolwich, and saw his arrangements, which were of two kinds, and the working of them seemed in every way satisfactory.

His first arrangement was an improvement in the burning of paraffin and dispensing with the chimney, and was effected by conveying from suitable apparatus placed in a small cupboard, a supply of air through pipes, with taps like ordinary gas-pipes having a small well holding a gill of oil at the extremity of a common gas-bracket. The air found its way into the well occupying the space above the oil, and passed out by a number of holes into the chamber formed round the burner, which only differed from the usual one in having no exit for the air, but by the slot through which the wick passed.

There was no smell, and the light was as good as if a chimney had been used, and the flame a little larger, and could be used to boil water as an ordinary gas-burner. The wick was $\frac{1}{8}$ inch.

The second arrangement was for making gas from benzoline, and was effected thus:—

The air from the apparatus previously referred to was brought into a zinc box containing a number of common wicks stretched over wires, which were kept moist with benzoline covering the bottom of the box. Perforated partitions were placed at intervals in the box, in such a manner as to subdivide the box into a number of smaller ones, each inclosing a number of wicks. The air on being turned on, passed into the first subdivision, and taking up a quantity of the benzoline gas from the wick-passed on to the next subdivision and so on through the box. The box was 14 by 5 by 4 in., and the gas burned from suitable burners. A small tap stopping the current of air entering the box arrested the manufacture, and thereby, reduced the risk. My friend preferred gasoline to benzoline, but is unable to get it in Woolwich. J. S.

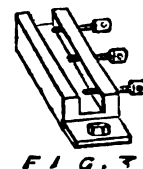
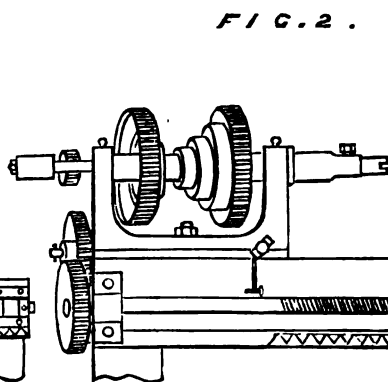
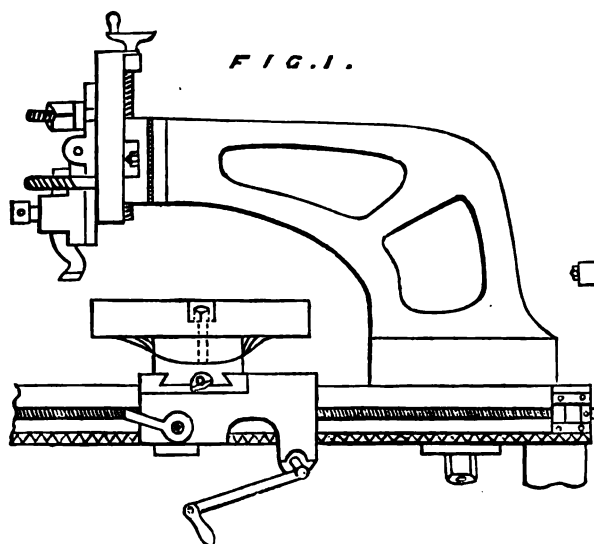
PLANING AND MILLING ATTACHMENT TO LATHE.

[19735.]—SEEING that there is some correspondence going on at present in your columns about combination attachments to lathes, I send you a couple of rude drawings (I am no draughtsman) of some apparatus that I have had in use for a good many years on my 5 in. screw-cutting lathe, and I find they do excellent work. Fig. 1 shows the planer. The top slide of my rest is taken off and mounted vertically on a casting as shown, bolted on to right-hand end of lathe-bed. It can swivel round to any angle for the purpose of planing up V slide-bars, and is graduated to show the angle it is set for. There is a special tool-holder to allow of the toolpoint rising on the back stroke. The plane-bed is a casting which takes the place of the top slide on the rest. The traversing motion is given by moving the surfacing-screw of slide-rest by hand between each stroke of the long lever, which works a pinion engaging with the rack on front of lathe-bed, about $\frac{1}{4}$ -turn of which pinion gives a stroke 10 in. long on planer-bed. I can, with this, plane 10 in. square perfectly true, which is sufficient for the wants of most amateur engineers. Fig. 2 shows the milling arrangement. It consists of an angle-chuck, which is mounted in place of the top slide of rest, facing the mandril, and the work to be milled is fastened to its face with forked drills of different sizes.

running in a socket-chuck on mandril. Slotting and shaping can be done with great ease. The traversing being done by turning traversing-screw of rest, and the feed by moving gently the long leading screw of lathe by hand, by means of the change-wheel at the end. Fig. 3 is a simple planing-machine vice, which is very

is well rounded and smoothed. This finished, a brass nut (square body and round top), perforated by an 8-32 thread, is sunk in the resonator. The centre of this nut is about 2 1/2 in. from the neck, and passes through the resonator in a right angle to the centre line of the violin, taken lengthwise. The end nearest the neck is cut out swallow-tail

rib having been fitted and glued, the screw-hole is drilled through it; this hole is tapering so as to be a little wider at the top side. This finished, one or two strips (I have used either of spruce 1/4 in. thick and 7-32 in. deep, are glued between the blocks alongside of the ribs. These strips are let into the blocks to be on the same level, and they must be



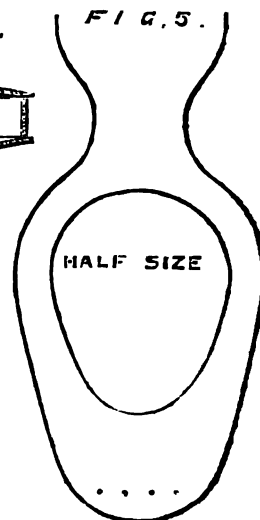
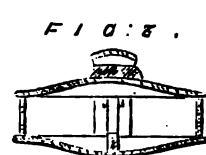
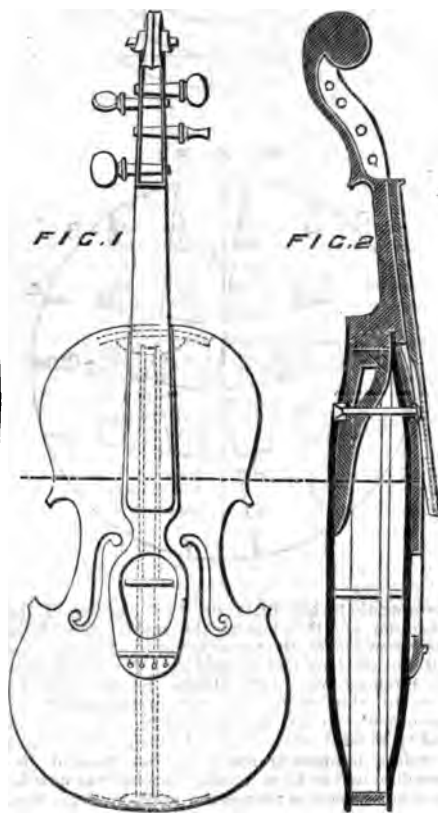
handy for holding work on both planer and milling apparatus, to which it is secured by a couple of bolts working in slots, as shown on the angle-chuck. With this lathe and its combinations, which include an excellent overhead motion, I have made for myself almost every conceivable chuck and apparatus which are described in the books on turning, including ornamental slide-rest, ellipse, eccentric, and dome-chucks; rose-cutting, eccentric, universal, and wheel-cutting frames, drilling instruments, &c., together with all the different jawed grip and die-chucks used in mechanical engineering. I also make and temper all my own tools. With respect to what "O. J. L." says about requiring a special light lathe for ornamental work, I may say that mine, though being a thorough engineer's tool, is yet capable of, and has executed, the finest ornamental work, which would bear comparison with Mr. Evans'. The truth being, that most of such work is done by revolving cutters fixed in an ornamental slide-rest, and, with the exception of oval-chuck work, all that the lathe-head has to do is to hold the work and divide it by means of its division-plate. In conclusion, I beg to say that I have been hitherto deterred from writing to the MECHANIC through my utter ignorance of mechanical drawing. F. W. G.

THE BERLINER VIOLIN.

[19736].—As mentioned in a previous letter, I now beg to submit to your readers drawings and description giving the particulars of my violin resonator. In doing so, I would like to give persons, having worthless violins to experiment with, an opportunity to test the merit of my device; and although I have obtained patents for the same, I do not mean at the present time to interfere with persons who, for their own use in private, make a resonator and provide their violin with it. At the same time, I should be thankful if they would furnish me, either direct or through the paper, with the results they obtain. I do not mean to say that every 8s. violin provided with a resonator will be as valuable as a Guarnerius; but instruments, and those of others, have shown that with a proper bridge and post, and a fair set of strings, a cheap factory-made instrument, with a resonator, will emit a perfect and full tone, and be a source of pleasure to the player. A valuable instrument will be impossible to question is simply an open question; the wood being an important factor, I cannot undertake to assert that I would be able to make the tone of an old master. This language to many a connoisseur, should not be doubted. The experimenter is to strip his violin of all places, button, &c., and to have thus far used only mahogany or other well-known woods to answer. I have made the free end (Fig. 6), and how it is shaped. It is on a

shaped, and a strip of wood, 1/4 in. wide and 1-32 to 1-16 thick, is glued under it (Fig. 4), which raises that part a little above the violin body, and nearly flush with the neck. Hereupon a hole is drilled through the top and back, through which the screw is to pass. These holes must stand

perfectly straight. I generally, while the glue is soft, correct any bent portion by holding it straight with sticks clamped lightly between strip and side lining. The glue having dried, the sticks are removed; and now glue on the belly. An iron screw with an 8-32 thread is next fitted, so that, after passing through the body, it will stick out about 1/4 in. above the belly. In order to give the screw-head a good hold, various methods are open. In the drawing, an ivory or ebony block is set into the back and countersunk. Of late, I countersink the back itself sufficiently deep to bring the screw-head below the surface, and then cover up the cavity with a button. At this stage, the resonator



perpendicular to the centre line. The upper hole is then sufficiently enlarged (1/4 in.) to clear the wood from touching the screw, leaving the belly free from contact. The violin is then opened by taking off the top, and the two blocks may then be reduced in size, and the wood of the back thus cleared, be levelled with the rest of the surface. A rib of well-seasoned spruce is now cut (lengthwise the grain) and fitted to the back, reaching from the block of the neck to the inside of the C's. (Figs. 1, 2.) It is shaped as shown in drawing, is sunk into the block a short distance, and a triangular piece cut out for the purpose of lessening weight. This rib is 11-32 in. thick, and at the place where the screw passes is 1/4 in. high. The

is fixed to the violin by the screw, and now the finger-board is carved out a little so as to leave a space between it and the resonator from screw to end. I leave the free end of the finger-board about 3-16 thick, and round off the corners. After it is glued on, its free end stands about 5-16 in. above the resonator, the object being to have the latter as strong as possible. It is generally of about 1/4 in. thickness throughout, except between screw and neck, and towards the free end where it slopes down. About the string-holes it ought to be nicely finished and brought to a thickness of 1/4 in. in the middle at the extreme end.

Before stringing up, a thickly-folded piece of paper or cloth is forced under the end of the resonator to facilitate the stringing. A slight tension after the bridge stands will sufficiently raise the end, and, when tuned to pitch, it will be raised to about 1/4 in. or less above the violin. It will be found that violins of a light build will give better results than heavily built ones. Figs. 1, 2, 3, are elevations and sections on line indicated. It appears to me that "Glow-worm," in his first en-

periment, permitted his bridge to touch the elongated finger-board, which, of course, always causes muting.
E. Berliner.

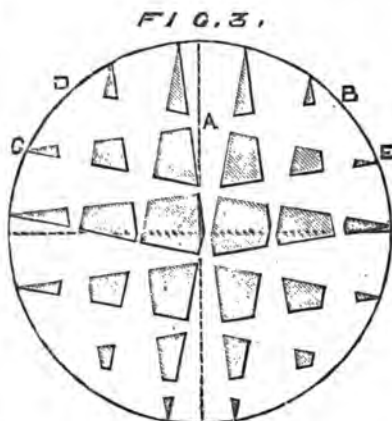
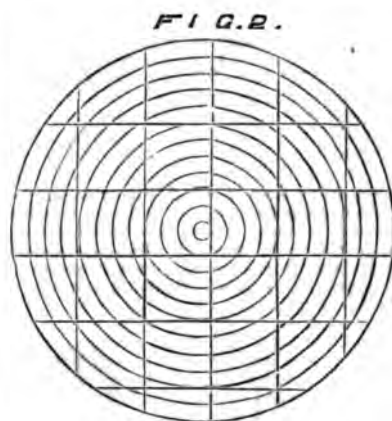
109, Court-street, Boston, Mass., Jan. 11.

GRINDING AND POLISHING GLASS SPECULA.

[19737.]—OUR readers will be glad to learn that I have received from Chance Bros. and Co. two specula of different patterns, each saving about one-third of the weight of a solid speculum of equal diameter and thickness. I am now working them with the object of testing them to ascertain the power of each form to resist flexure, as compared with a solid speculum of the same diameter and thickness. We all owe our best thanks to the above firm, for the interest they take, and have taken for many years, in any improvement in glass, both as to its quality and shape, that will further our scientific knowledge. This has been shown in the trouble they have been to with these two specula, and which partakes even of the nature of public spiritedness above mere business interest.

And now to the special object of this letter—viz., some of the causes of the formation of rings, and how to avoid them. The amateur will remember that in my last letter I showed how a zone of no cut will impress itself on the face of the speculum. Now, it is evident that half a zone of no cut will impress itself on the face of the speculum with half the effect of a whole one, and so on to any fraction of a zone of no cut, or even partial cut, which will evidently upon the same principle produce a zonal effect equal to its size and amount of cut; from this we can see that the omission of a single facet will act in the way of making a ring—of course very small, perhaps not perceptible to the most delicate testings; but nevertheless, there the effect must be. This shows us the importance of equally distributing the cutting and polishing surfaces of the facets over the face of the tool from centre to edge. Now, to practically consider this matter, let us suppose the amateur is about to make his tool for grinding, trueing and smoothing his speculum previous to polishing. I shall consider the causes of rings in the polishing when I come to that process; the shape, size, thickness, &c., of the tool I shall treat of when I give my mode of working the various processes. What I now want to teach are the laws that equally apply to all modes of working, and will, therefore, be immediately useful to all amateurs, whatever form of machine they may now use or mode of working they may adopt—only let it be remembered that the proportions I give apply to the tool used above the polisher: these proportions will be slightly different with the tool under the speculum. We must, therefore, now suppose the amateur has his tool the same diameter as his speculum, and turned to the required curve of the speculum, and that the speculum is rough-ground out to this curve. Now, the first thing to be done is to put the grooves on the face of the tool. These, we will suppose, he puts in from centre to centre of groove. This is the size I have now adopted. It will be most natural for him to begin by putting the first groove across the centre, and the others each side to the edge; then he will begin to put the other set at right angles; these beginning likewise at the centre of the tool for the first groove, and then each side to the edge. Now, with such a tool and a straight stroke only, so as to more easily study its effects, we will suppose he grinds, trues, and smooths the face of his speculum; then he makes his tool into a polisher, by putting pitch on its facets, and he polishes twenty minutes or half an hour, so as just to polish the tops of the emery marks, and thus enable him to test the shape given by the grinding-tool. It will be observed he does not polish long enough to allow the polisher perceptibly to alter the shape given by the emery-tool. Now let him test by Foucault's test, and, lo! he has shaped his speculum so as to appear as shown in section in Fig. 1; not, of course, that the centre is actually raised, but being of a longer focus than the outside, it appears, under testing, to be raised, as compared with the shorter-focused outer part; the little crosses mark where the edge of the tool reaches to at the end of each stroke. In taking a section of a working I always put a cross where the edge of the tool ends at each stroke; this I find a great help to me in studying and comparing the effects of various workings, and I have tried these experiments hundreds of times with various lengths of stroke, with and without side motion, various polishers, both as to size and arrangement of grooves, &c., and have never rested satisfied until I could satisfactorily explain every indication as shown by testings. Well, our amateur is sorely puzzled to explain the rings (indicated in Fig. 1 by the little mounds) and the depression at the crosses; he sees several rings, but those most marked, of course, attract his attention; these are shown in the section. He observes that the dull rings are not caused by the shadings of the Foucault's test, but by their not being so much polished as the bright rings: he thinks upon this fact, and at once sees that the grinding-tool has

ground rings a little lower than the general level, and that, therefore, the polisher could only lightly touch these rings; therefore, they are not so much polished as the bright rings, which evidently are the tops of ring mounds that have received most of the twenty minutes' or half-hour's polishing. He will therefore rightly trace these rings to his grinding-tool, for had they been polished rings, the shading would have been different; but as they are, they are only dull and bright rings, however the general shading alters. He at once sees the first thing to be done is to trace them to their source; so he measures their diameter, and notices a decided hill right on the centre of the speculum; he proceeds to strike on his tool with a pair of compasses with blacklead, circles the same diameter as the bright rings. The amateur now begins to study this face of his tool thus marked in earnest: he first observes the bright hill in the centre—that it has the two centre grooves crossing it, and, therefore, for a considerable portion of the revolution of the tool



there would be but little cut to the centre of the speculum, and thus leaving the surface here above the general level, the consequence is, of course, the hill the amateur has to explain. He now begins to brighten up, and thinks he has got the clue to the rings, in the arrangement of the grooves causing the face of the tool to be in reality divided into zones of unequal cut, and therefore impressing itself on the face of the speculum in the form of the rings he has now to explain; he now examines the position of the first ring, and finds it to be about the same distance from the centre as the first four grooves are; here he sees there must be a zone of less cut, because more length of groove in it; this leaving the surface above the general level would cause the ring-mound, which getting polished on the top would show as a bright ring; thus the first ring is explained. He now examines the second ring, and sees it to be caused by the second set of four grooves occurring at the same distance from the centre of the tool. There are other minor rings which the amateur can readily understand to be caused by the arrangement of the grooves not equally distributing these grooves over the face of the tool, and thus causing smaller zones of less cut. The remedy at once suggests itself to his mind—viz., he must alter the arrangement of his grooves so that no two grooves shall be at the same distance

from the centre of the tool, and thus their influence will be distributed equally over the face of the tool. To do this cost me a deal of thought, and I tried various arrangements till I finally came to the one represented in Fig. 2, which is one-third the natural size; now, to commence to make this arrangement of the grooves, the amateur must first put the centre of the middle groove in from the centre of the tool, and the centre of the other grooves of this set at distances of in. apart; then he must put the centre of the first groove of the other set of grooves in from the centre of the tool, and the groove at right angles to the first set, the remaining grooves in from centre to centre. Now, if he will draw circles so as to touch these grooves tangentially, he will find that they occur at regular distances, and that each circle has only one groove as its tangent; thus, the groove-surface, which is the surface of no cut, is distributed equally over all the zones, and by this means this evil of rings is effectually cured by removing its cause; and this is equally necessary in the polisher as in the grinding-tool, so that the amateur has only to cover his facets with pitch, and he has his polisher correctly made, so far as the arrangement of the grooves is concerned. I have proved the correctness of this arrangement many times by altering the centre of the tool so that it shall be at the intersection of the middle grooves, when rings invariably show themselves, and then by altering the centre of the tool so that it shall be as in the arrangement above described, and shown in Fig. 2, when all the rings vanished, and never once appeared in any experiment; and until I adopted this arrangement, I was continually troubled with rings, varying with the distance apart of the grooves and their arrangement on the face of the tool, and no amount of side motion would correct them all; but now, without the side motion, there is not a trace of rings formed by the grooves, and one half of my trouble as to rings has been done away with ever since I have adopted this arrangement of the grooves. I now groove all my tools in this way, and it will answer for any size, for the same law applies irrespective of size, and to the polisher as much as the grinding-tool. I may observe that the rings on Figs. 4, 5, and 6 on page 448 were caused by a defective arrangement of the grooves. I should like to have given (I did commence, but found it would occupy too much space; I may, some other time give it) a drawing of the actual zones produced in one of my experiments by a tool with grooves half an inch apart, the middle grooves crossing the centre of the tool, this distance of grooves producing more rings than when one inch apart, and thus making the effect more marked. Now, by calculating the area of each ring and measuring the length of groove in each ring, it appears most clearly that in a depressed zone seen as a dull ring there is less proportionate length of groove (i.e., less proportionate area of no cut than in the adjacent elevated zones), thus causing more wear, and, therefore, more depression, in this zone; and that in an elevated zone seen as a bright ring there is more proportionate length of groove—i.e., more proportionate area of no cut, thus leaving the surface in this zone above the general level, and thus every ring can be accounted for by actual calculation and measurement. It is a most interesting and instructive study to thus trace our troubles to their source, and feel we are getting master of them; but it takes a long time, and a great deal of patience, for in complicated process like the working of specula, one has to thoroughly investigate each step, and repeat experiments with modifications to corroborate each deduction.

The amateur is now free to turn his attention to the depression at the crosses in Fig. 1, the cause of which I discovered some sixteen years ago; but to lead the amateur to discover it for himself, and thus have it impressed on his mind more firmly, let him wipe the tool and speculum clean and dry, and then place the one on the other, and gently rub them together with small circular strokes. Now examine the face of the tool, and its circumference will be seen to be rubbed, and so it will be found to be with the speculum, thus proving that they do not fit, but are hollow to each other at their centres. The amateur will easily see the cause of this when I remind him of the fact that when two surfaces are rubbed together, of necessity the circumferences can only have one-half the wear as the centres, and that the wear increases towards the centre, to that point where the one surface is always covered by the other surface; from this point to the centre the wear is always the same, the consequence of which is that the circumference of the tool is not worn away as much as its centre; therefore it is always higher, if I may so put it, than the centre, and consequently, when it leaves the edge of the speculum to move towards the centre of the speculum it is pecking in, as I call it, in its action on the surface of the speculum, while it is keeping the centre of the tool from the centre of the speculum, and thus allowing the centre of the speculum to remain above the general level. Thus, a depression is caused

from the edge of the speculum to where the edge of the tool ends its movement, while a mound is left from this point to the centre of the speculum. This I have attempted to show in Fig. 1, by showing the depression at the end of the stroke, marked by the crosses. Now, the remedy is evidently to so make the outside of the tool that it will wear away at a faster rate and thus be kept to the general shape of the speculum, and not always above the general level. This is easily effected by cutting away the facets in straight lines from the edge of the centre one to nothing at the circumference of the tool, as shown in Fig. 3. With the facets thus cut away, I find a very near approach to a fit with the speculum is produced, and no perceptible depression at the crosses—i.e., no pecking in, as I call it. This is sufficiently near for the smoothing, though it may not be absolutely perfect; but this does not matter, as I depend upon the polisher for the truth of the figure ultimately. Of course, I am glad to get the smoothed surface as near as I can, and that is accomplished best by cutting away the facets as above described and drawn, when the middle facets will be about $\frac{1}{2}$ square, the grooves being at first—i.e., before cutting away the facets, $\frac{1}{4}$ wide; the actual way of making the tool and its important points I must leave till I come to the description of the actual working of the speculum; the letters in Fig. 3 will then be referred to and used. There are two other causes of rings incidental to the pitch-polisher, which I must leave the consideration of till I come to the polishing, and as we cannot then proceed without a knowledge of the Foucault's test, and as I find by my private correspondence (which is now rather extensive, yet I would invite all to write to me who are in difficulty, as I want to know exactly where the amateur difficulties are, so as to be able to fully meet them in these letters) I find, I say, the Foucault's test is but little understood and badly applied. I, therefore, will give in my next letter a description of it, with some improvements of my own: thus those who have specula already polished will be able to test for themselves. This, then, I think, will be my next service to them.

Addenbrook Villa.

H. A. Wassell.

[19738].—BEFORE proceeding with the next stages in the process, I will state, for the future guidance of readers of these letters: 1st. That I have not confined myself to describing the process as carried out by any single individual or establishment. I have selected those portions of the process that to my mind are the best from every source of my experience; thus giving to the readers of "ours" an advantage even over many in the trade. 2nd. The reason why I do this is to enable amateurs to change their mode of working, and to give to "ours" the results of the various methods they may have tried. Mr. Wassell's letters are extremely valuable, showing an amount of patient research that is of the utmost use to those who are wishing to simplify the production of their optical surfaces. I have not the slightest doubt that the time is not far distant when our telescope-makers will make efforts to give us something nearer to the quality of good quality. Then with working referred to something near certainty, astronomical object-glasses and specula will be attainable by numbers of anxious and worthy astronomical students with not "over

think for those who are working 6in. and over: it will be advisable to test the surface got by the "runner" without removing the specula from the "runner." For larger sizes it is better to have the "runner" off. The smaller surfaces are better suited up to finishing, without removing the "runner," either face down or up. In the case of the mirror, the better the support of the chuck described in my former letter. It is obvious when it is understood that the process of turning polisher is as little as possible to be used on the surfaces. This little requires the proportion of the area of surfaces. The proportion of the weight or pressure little is a small-sized work. Although the three factors in the result, viz., pitch, pressure, and resistance, the three "P's" must not be neglected. resistance, regular irregularity of the surface of the mirror. I find that the word "grasp" in describing the movement of the wooden "back" for the mirror, letter 19047, p. 33). "Grasp" means to grasp, unless in the sense of grasping. It does not imply pressure in the reverse. I will suppose, then, that the mirror has been got nicely polished on the surface described in my last, and upon the centre rays are short, and the surface is deeper towards the centre, and the surface is not round. Both the errors are corrected by using the largest polisher. First, the mirror is polished accurately as possible by the use of tissue-paper covering the mirror, and then the "grasp" tool,

the tool previously warmed. By lifting the polisher occasionally, it will be seen how the "filling" is going on. When all the ridges of pitch make their impress upon the paper, the paper can be clicked-off with a sharp pull upwards, and work commenced while the surfaces of the ridges are still slightly warm. Feed slightly with plenty of water and a very little finest rouge, and work with straight strokes, gradually shortening the stroke. It must be borne in mind that any feeling of friction must be at once checked by reducing the width of ridges, or making more transverse gutters. One other matter: the room, when figuring, should not be lower than 60° Fah., and may with advantage be above 65°. The working properties of the pitch in use are only learned by practice, a little of which, added to the former three "P's" (and making a fourth, by the way), will do more than any quantity of direction possibly can. I will in my next give a few pitch-tests, &c.

Prismatique.

[19739].—As I have often received valuable information from the columns of the ENGLISH MECHANIC, I think it only right that I should give some of my experiences in the matter of speculum-grinding, for the benefit of my fellow-readers. In doing so, I shall be as brief as possible, and only give the points which I think worth bringing out. The instructions I followed were Mr. Purkiss's, which, with one or two exceptions, I found to be admirable. I first obtained a glass disc, 9in. in diameter, and $\frac{1}{4}$ in. thick, and reduced it to $\frac{1}{8}$ in. on a lathe which I made for the purpose of turning the face of the large iron tool to be used for grinding the glass. So much information has been given in these columns with regard to templates, "quarrying," rough and fine grinding, faceting the cast-iron tool, &c., that I need not touch upon these subjects. I expedited the work of getting the tool to the proper curve by tying a piece of sharp emery-cloth over the face of the speculum when the quarrying was done, and then grinding down the facets with it, keeping a heavy weight on the glass during the process; and instead of using a file for reducing the higher facets, I glued small pieces of emery-cloth to sticks shaped like a piano hammer-head, by which means I got the tool to the proper curve without much trouble. I used a fine sea-sand, found on the coast near Adelaide, for the rough-grinding, instead of emery, and it answered admirably, and cost nothing. By taking long strokes before the tool was faceted, the centre of the glass became too concave; but strokes of about two inches kept the figure the same as the grinding-tool, as I found by testing with the convex gauge. I cut the facets rather more than an eighth of an inch deep, but found, as the work proceeded, that 1-16th would have been ample. Instead of allowing 28 revolutions of flywheel to one of tool, I had to alter my machine so as to allow 118 revolutions of the former to one of the latter. The very best thing that can be used to spread the emery on the tool (and the rouge also for polishing) is one of those little vulcanised india-rubber gum-brushes. You know, after you have used them once or twice, that you will spread no grit on the tool with them. They are invaluable for the purpose named. When I had got as far as the fine-grinding, I had a suspicion that the length of stroke—one-third the diameter of speculum—was too long, and that it would give a bad figure to one-sixth of the outer edge, the glass naturally pressing harder on the edge of the tool when it hung over than when in the centre. I accordingly tested it by standing it on edge and viewing the sky with it, when I found that about $\frac{1}{4}$ in. of the edge was very bright, while the other portion was cloudy-looking, although it was polished equally all over its surface. I then altered the stroke from 3in. to 2in., and reground the glass on the same tool with the very finest emery, and again examined it. This time it gave a brilliant reflection from the centre right out to the edge. The instructions I followed misled me greatly, with regard to the length of time required for fine-grinding, and, in consequence, I had a good deal of my work to do over again. It took me fully five hours' hard work, with the very finest emery, to get the semi-polish required previous to using the pitch-tool.

Having completed the emery process, I turned my attention to the pitch-polishing. I agree with your correspondent, Jno. A. Brashar (let. 19370, p. 208), that making the pitch-tool in the usual way is a very nasty process; and from want of experience I was nearly spoiling the whole of my previous work. Had I been able to procure some thin sheets of indiarubber or gutta-percha, I would have fastened small pieces to the tool with pitch; but here, at the antipodes, we are not so fortunate as our brethren in England, and are obliged to put up with many makeshift contrivances. The plan mentioned, I think, would answer better than making the polisher wholly of pitch. My first pitch-tool was so full of air-holes, caused by the wetted speculum while moulding it into shape, that after bringing the glass to a fine polish, and testing

it, I found it had assumed a hyperbolic figure, instead of a spherical one. This abominable pitch, therefore, caused me no end of trouble, and I had to remelt it about four times before I succeeded in polishing the speculum to a tolerably good parabolic figure.

Want of experience was again apparent in the silvering process. My greatest error was in not thoroughly cleansing the face of the mirror from some very minute specks of grease. I used a large quantity of nitric acid, but do what I would, I could not get all the spots off the glass; and there also remained a little grease on the outer edges, on which the acid appeared to have no effect whatever. Perhaps I did not give it time enough. I followed Mr. Ackland's modification of Martin's process, but quite unsuccessfully at first, as the solution would not work at all, and I was going to throw it away, and try again, when I thought of making experiments with it. Accordingly I added a few grains more of potash, and a great many more grains of nitrate of silver; in fact, I believe I used twice the quantity of the latter article recommended. But it had the desired effect, and I got a first-rate coating of bright metallic silver deposited on the speculum. Here and there, however, on its surface, were small dull spots, caused by the grease not being thoroughly absorbed by the nitric acid. I used pure rain-water for silvering.

Of the tube, fittings, and adjustments it is unnecessary to speak, although I would warn amateurs not to glue two pieces of wood together with the grain crossing as a bed for the mirror. I unfortunately saw a recommendation to the contrary effect in the "E. M." some time ago, and followed the advice thus given, with the result that as soon as the dry warm weather set in (and it does get dry in this fair South Australia when it sets about it) the glued boards curled up frightfully. I then got an inch board, and screwed it on to two pieces of inch-square iron laid across the grain of the wood, and it always keeps perfectly flat. My telescope performs very well, although, of course, it is not so good as those made by skilful opticians, whose work we admire so much. On the moon it shows details excellently, and the belts and spots of Jupiter come out plainly, but not so sharply as I should like; but during the present hot weather, the atmosphere is nearly always "boiling," which does not give a large aperture a chance.

H. H. Tilbrook.

Clare, South Australia, Dec. 16, 1881.

FORECASTING STORMS—A MISSING SCIENCE.

[19740].—IN the report made by a committee appointed by the Lords of the Treasury, about six years since, to inquire into the work done by the Meteorological Office, it is said, "There is important evidence that the science of meteorology at the present moment stands in need of hypothesis and discussion at least as much as, if not more than, of observation." In his evidence before the same committee, Sir George Airy, ex-Astronomer Royal, declared that, "Meteorology is in a state in which it cannot be called a science at all. It is very low indeed. We have scarcely taken a step from causes to effects." He also declared that although it was probable the Meteorological Office was acting upon empirical rules, yet that they could not give outsiders any of the rules upon which they acted, empirical or otherwise.

I have several times, during the last few years, endeavoured in the columns of the ENGLISH MECHANIC to show that the desired hypothesis is to be found in the fact that atoms of air, inasmuch as they are portions of a fluid and possess weight, will, so far as their motion is concerned, conform to the actions of atoms of water in similar circumstances. Assuming this to be a correct theory, let us see what would happen with either fluid in certain cases; if, on a calm, level lake, an isolated hemispherical wave or hillock of water were to be raised, atoms of water would have to be brought from the fluid surrounding the spot either in straight or spiral lines, tending to the apex; on the other hand, if a similarly-shaped depression were formed, the atoms would move outwards in exactly opposite directions: the relative height and depth with the time occupied would in either case give the measure of the velocity of the atoms. If we suppose the same thing to occur on the surface of the air, we should have, in meteorological parlance, the formation of cyclones and anti-cyclones; as, of course, in either fluid, such waves or hollows can only occur when they are also moving in a definite direction, the movements of the particles then become less simple; but still it is contended they will all, and always, be subject to laws as certain, and in all probability as ascertainable, as the law of equal area in equal time of the astronomer.

That this is a correct hypothesis, what we know of the sudden shifts of wind in gales or hurricanes goes far to prove; to illustrate this, let us suppose a diver to be at the bottom of an inland lake of moderate depth: while the surface is unruffled he

will feel no motion; but if waves increasing in size be formed he will, in accordance to the known laws of fluid motion, find the water move past him first in one direction and then back in exactly the opposite direction; that is, provided the breadth of the wave is at right angles to the line of its motion, but if the wave be advancing at an angle or in military phrase, right or left shoulder forward, he will find the motion of the water shift at an angle more or less acute, but which it is obvious can never be greater than a right angle. Now, this is what we constantly find reported in great gales or hurricanes: either the wind shifts quite round from S.E. to N.W., or from similarly opposite points; or it shifts from one to eight nautical points—viz., less than a right angle.

Many problems, hitherto unsolved by meteorologists, can be explained by this theory. Atoms of air are assumed to be moving in circles, sometimes of enormous size and with extreme velocity, about the positions of rest they would occupy were there no wave to disturb them; and just as we know a tallow candle can be forced through a deal board if propelled against it with the velocity acquired through its being fired from a gun, so such a light and soft substance as air can—given the requisite momentum—be made to lift a cannon from its carriage, and whirl it from end to end of a battery.

Aéronaute have generally found a much greater movement of the air in the higher region of the atmosphere than obtains near the surface of the earth; as the circles would be larger the nearer the air-surface was approached, the discrepancy that has often been seen between the velocity of the air as given by an anemometer, and the distance actually travelled by a balloon, would cease to be a puzzle.

It is generally acknowledged the cyclonic theory of Redfield, Reid, &c., is an imperfect one, and does not explain all that has been observed by meteorologists. I believe that cannot be said of the one now advocated.

W. G. Wenley.

REPLIES TO QUERIES.

*. In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[45389].—Friction.—I beg to thank "Gabarri" for his answer to this query on page 333, but would like to see his method of working this question out. Will he kindly oblige? I have waited hoping some other correspondent would have also replied. The friction seems enormous where the power applied = 37 19lb., only 14-86lb. is required to raise the weight, the remainder being absorbed by friction on the screw.—FRICITION.

[45392].—Manufacture of Soluble Cocoa. (U.Q.).—To make soluble cocoa, or chocolate, which is the same thing, the beans being freed from all spoiled and mouldy portions, are gently heated over a fire in an iron cylinder, with holes in its ends for allowing the vapours to escape;

kept at the temperature of about 220°F. by the admission of steam to the case below. Over each mill there is a feeding hopper, 1, 2, 3, 4, in communication with the pipes, 5, 6, 7, 8, with the general reservoir, E, charged upon the floor above with the cocoa through the funnel placed over it. The vertical shafts which turn these mills are marked F G H L; they are moved by the train of bevel-wheels above, which are driven by an arm from the main shaft of the steam-engine. Each mill can, of course, be thrown in and out of gear at pleasure. At I, I, I, the discharge-spouts are shown, which pour out the semi-fluid hot chocolate into shallow cylindrical tin pans capable of containing about 9lb. of chocolate each. Fig. 2 is an end view of one of the chocolate mills, with its mitre-gearing.—F. BARKER COOKE.

[45421].—Phosphorus in Iron Ores, &c.—Sodium sulphite is generally used in solution. I employ a saturated solution of the acid sulphite, and have not found it increase the bulk of my solutions to any inconvenient extent. Of course, by using sulphur dioxide in the gaseous condition, you might avoid diluting the solution at all; or the reduction might be effected by dissolving a piece of zinc in the acid solution of ferric salts. The quantity of ammoniac acetate required to precipitate the phosphoric acid as ferric phosphate, depends upon the amount of free mineral acid in the solution. If you nearly neutralise with ammonia previous to adding the ammoniac acetate, a comparatively small quantity of the latter will suffice. In this case, a little acetic acid should also be added.—ANALYST.

[45421].—Phosphorus in Iron Ores, &c. (U.Q.).—To determine the amount of phosphoric acid in iron ores, the hydrochloric acid solution is heated to boiling, then removed from the lamp, and solution of sulphite of soda added, until carbonate of soda produces a nearly white precipitate; the mixture is then boiled until the odour of sulphurous acid has gone off; the excess of free acid which might still be present is nearly neutralised with carbonate of soda, a few drops of chlorine are added, and lastly, acetate of soda in excess. The minutest quantity of phosphoric acid shows itself at once by the formation of a white precipitate of phosphate of sesquioxide of iron. (Silicic acid and arsenic acid produce a similar precipitate, and must, therefore, if present, be previously removed.) More chlorine water is now added, drop by drop, until the fluid appears reddish; it is then boiled until the precipitate has well subsided; the latter is filtered off hot, and washed with hot water and mixed with a little acetate of ammonia. The precipitate contains the whole of the phosphoric acid, together with a small portion of the iron. Redissolve this precipitate in nitric acid, transfer to a beaker, and add a considerable quantity of molybdate of ammonia solution (you will find the method of preparing this in Fresenius' "Qual. Analysis"). About 40 parts of molybdic acid must be added for every one part phosphoric acid; therefore, 80cc. of the molybdic solution for 1grm. phosphoric acid. Agitate, and keep covered 12 hours at 40° C. Pour the fluid off through a small filter, and wash the precipitate entirely by decantation, using a mixture of 100 parts molybdate solution, 20 of nitric acid of 1.2 sp. gr., and 80 of water. Redissolve this precipitate in

with a little hydrochloric acid and water, transfer to a beaker, and proceed as above. The acetate of soda (or of ammonia, which will do just as well) is better acid, though not necessary. The stronger acids, in the free state, decompose the acetate of soda, combining with the base and setting the acetic acid free. This precipitates the phosphate of sesquioxide of iron, that substance being insoluble in acetic acid.—F. BARKER COOKE.

[45516].—Hand-Thresher.—To "SUNLIGHT."—I have now waited a long time for your promised help in reference to the above; and as ill-luck, or whatever else, would have it, a reminder I wrote a fortnight ago has evidently miscarried, as I have seen no mention of it in "ours." Your uniform kindness prevents my thinking you have intentionally passed over my query.—STRAITHEAT.

[45543].—Electrical Terms (U.Q.).—The difficulty pointed out by "Kathode" is more apparent than real. It will vanish if the difference between plate and pole be kept in view. By a convention, the electric current is said to flow from the zinc plate to the iron plate inside the battery, and, consequently, to complete the circuit from the iron plate to the zinc plate outside the battery. If the plate from which the current is supposed to flow (that is, the zinc) be called the positive, then the pole from which the current flows must also be called positive, but this is the iron. Thus the zinc plate and the iron pole are positive, because the current flows from them; whilst the iron plate and the zinc pole are negative, because the current flows to them.—ALFRED W. SOWARD.

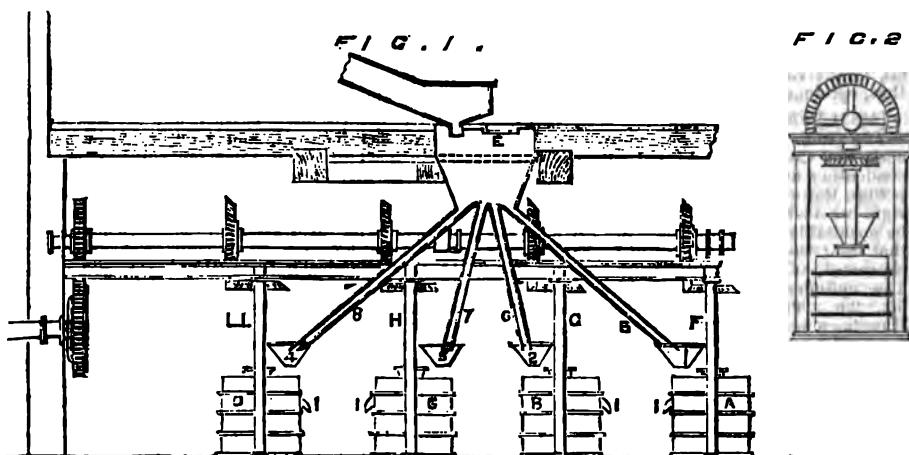
[45569].—Velocity of Water in Sewers.—
 $V = 55 \sqrt{R \times 2 H}$
 V = Velocity in feet per minute.
 R = Hydraulic mean depth.
 H = Fall in feet per mile.
 R = Area of flow divided by wetted perimeter.
 $V = 55 \sqrt{.667 \times 2 \times 32.8}$
 $V = 55 \times 7.7$
 $V = 423.5$ feet per minute.
The discharge = area of flow $\times V$.
 $= 423.5 \times 1.6$
 $= 677.6$ cubic feet per minute.—

J. C. S. B.

[45570].—Loco. Slide-Bars.—In answering this query "Nun. Dor." asks another, viz., Do loco. slide-bars out more when running tender first? Of course they do; not in one, but in scores of cases. Will "Nun. Dor." please explain the cause, and say in what way bad work will cause it? Having laid the charge of bad work, it is his duty to explain how and why, and I, for one, will thank him if he clears the point up.—LOCKSTITCH.

[45573].—Fans (U.Q.).—The size of wheels in this case is to a great extent arbitrary, from 4in. to 6in. for the large, and 3in. to 4in. for the small wheel. Some will even put multiplying gear to it; but for domestic purposes 6in. will be ample, unless you would blow the fire out of grate. Any further information with pleasure.—LOCKSTITCH.

[45579].—Metallurgical (U.Q.).—The following, extracted from a communication of Professor Stebbing's to the *British Journal of Photography*, seems to me to partly meet the wants of "D'Evlyn":—M. le Capitaine Biny made a very interesting communication to the Society on the method he employs for transforming ordinary zinc plates (on which the image has been obtained by the bitumen process, and which has the inconvenience during the printing off to change or slip off) into plates for typographic purposes, or into engraved plates, from which an unlimited number of proofs can be printed. This transformation is very simple. An ordinary zincographic plate is taken and inked with fatty ink; it is passed rapidly through a feeble solution of nitric acid, and rubbed with a brush in order to clean it thoroughly and prepare it to receive a thin coating of copper. While quite wet the plate is plunged into the copper solution, and left there from five to ten minutes. The zinc is now covered with a coating of copper upon all the parts which were not protected by the bitumen forming the design. As soon as the whole surface presents a fine red colour, the plate is taken out of the copper bath and placed in a tray containing a little benzoline. By means of a small brush the plate is washed with the benzoline, which dissolves the bitumen, and the design is seen white upon a red ground. As soon as the zinc is cleared of all the bitumen or varnish, a strong jet of water is thrown upon the plate to get rid of the benzoline. It is now washed in a bath of clear water by means of a sponge or soft towel, and then plunged once more into the nitric-acid bath. The weak acid attacks the zinc but has no action upon the copper, and thus can be formed a fine engraved plate. If a deep incision be required, it is now necessary to strengthen the copper coating by a galvanic deposit of copper. The process is very useful, as it enables the operator to employ zinc-plates instead of copper ones, which are more expensive. By the judicious employment of this process, and by using a positive, or even a double



the apparatus being similar to a coffee-roaster. When the aroma begins to be well developed, the roasting is known to be finished, and the beans are turned out, cooled, and freed, by fanning and sifting, from their husks. The kernels are then converted into a paste by trituration by a machine. Fig. 1 represents that used at the Victualling-yard Deptford. There are four double mill-stones, A, B, C, D, each 3ft. in diameter, in which the nether rests upon a bed of cast iron, like a drum-head,

ammonia, and add hydrochloric acid carefully until the precipitate produced, instead of dissolving instantly, takes a little time to disappear: finally, throw down with magnesia mixture. The sulphite of soda is used in the form of a saturated solution; with careful management you need not have much liquid. Dissolve your iron in aqua regia, in a flask, in the stem of which a funnel is placed. When all dissolved pour out of flask into an evaporation-dish, and evaporate to dryness. Take up

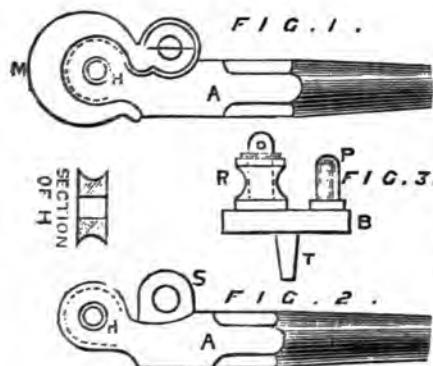
upon a semi-transparent paper, typographic *clichés* can be obtained in which the reliefs are coated with copper, and the hollows can be eaten away by the acid as deep as may be desired, by employing the well-known process of inking in order to make the reserve, and by so doing strengthen those parts forming the design.—S. R.

[45661].—Worms in Cistern.—I fancy the eggs of these little red worms escape the filters, and pass through into the cisterns. Once firmly established in a cistern, there seems no reason why they should not continue to make it their quarters if only the usual cleaning is given. But there is this to be said: that the mains, at bends and dips, often contain deposits of sand, &c., in which, I presume, these worms could breed; and I have certainly found them in water drawn direct from the main. If you swilled out the cistern with a hot solution of lime, to which a little potash is added, I should think you might safely conclude, if you found any more worms, that they came with the water. So far as I know, they are not injurious, but they are unpleasant in a glass of water.—NUN. DOB.

[45667].—Varnish for Gas-Pipes.—Do you mean lacquer?—J. K.

[45693].—Range of Projectile.—If no "elevation" be given to a gun, that is, if the barrel be strictly horizontal, the bullet will reach the ground in the same time as if it had dropped down at the muzzle. Take the case of a Martini rifle fired from the shoulder (which shooting position seems to be again coming into use), it would be about 5ft. high, and the bullet would fall this distance in a time given by the formula $S = \frac{1}{2}gt^2$. This time is .56 second, and as the bullet has an initial velocity of (about) 1,300ft. per second, it would travel 728ft. while falling to the ground. If fired at a distance of 100ft. above the earth, the bullet would take 2.5 seconds to fall, and would travel 3,250ft. These results are obtained on the supposition that the firing is in vacuo; but this is of course not the case in practice, and the resistance of the air being very great, the theory of projectiles is of but little use: in a case cited by "Todhunter" the actual range was only 1.6th of that given by the formula $R = \frac{v^2 \sin 2\theta}{g}$. If the rifle be supposed lying on the ground, so that the bullet rubs over the surface, the range then would depend merely on the friction between the bullet and the earth; air resistance being neglected. The friction would be great in practice, and the question presents no difficulty, being simply a case where an initial velocity v is gradually destroyed by a retarding force $f = \mu g$.—WM. JOHN GREY, Quayside, Newcastle-on-Tyne.

[45700].—Tools for Bending Iron.—In answer to "W. J. B.," the wings are not "shut" on to axle-guards, but *in* to them; 2nd, the guards should be bent before the wings are attached; 3rd, it is doubtful if their mode of manufacture is of sufficient interest (to general readers) to warrant the cost of wood-cuts. Should the Editor think so, I will send description of tools required; in the mean time, I will try to explain the way in which coupling-hooks are made. There are two tools required—i.e., the lever, which is about 5ft. long, and whose end is shown at A, Fig. 1 and 2; and



the fork B, Fig. 3; 4, the tang of the fork, is square and fits into the hole in the anvil; the pin *p* fits the hole *h* at the end of the lever, and acts as a fulcrum, about which it may turn; *r* is a roller, which presses against the back of the hook during process of bending; *s* is a lug, to which the eye of the hook is fastened by a pin and cotter. If that weak and ugly kink is required, it should be given whilst the eye is forming. The eye and neck of the hook must be cooled before being cottered up, and the part *m* of the hook should be flattened before it is detached from the lever.—EX-BLACK-SMITH, Gorton Brook, Manchester.

[45701].—Musical Box.—I should recommend "Watchmaker" to look through Vol. XXVII, in

which he will find several replies on the subject. The small springs are to prevent the teeth of the comb jarring against the pins.—ESSAN.

[45718].—Watch-Springs.—Presuming you mean preserving a stock of springs, I would suggest keeping them in plumbago—that is, powdered blacklead. How they are to be preserved, if you mean that they rust in the watch, I cannot say; but the mainsprings might be oiled, and the balance-spring might be of some other material than steel.—NUN. DOB.

[45742].—Grinding Model Taps.—Nothing better than finely-sifted Bath brick and water; finish with oil. Never use emery.—JACK OF ALL TRADES.

[45761].—Medical Coil.—To MR. LANCASTER.—I should be obliged if you could spare time to send me a drawing of the connections. I have no doubt I should manage it from your explanation; but I want to be certain before I commence. Am I right in the following for the first power? One end of primary to break spring—the other to battery terminal, thence to stud No. 1. Stud No. 1 to secondary terminal—break-spring to the other secondary terminal—the other battery wire to break-screw.—ENQUIRER.

[45777].—Paraffin Lamp Reservoirs.—If, after the top brasses were put on with plaster, they were painted over with gum-water, or glue and treading, or were gummed over before using when bought, this nuisance would not occur.—JACK OF ALL TRADES.

[45802].—Brazing.—There is a mistake here; I think brass filings is meant instead of brass fittings. You must be somewhat of a judge of metal to know what sort of brass-filings to use for brazing. Use fine wire or spelter in preference, and pass an iron rod through your tube, to keep from bending.—JACK OF ALL TRADES.

[45804].—Water-Gas.—May I ask "H. B." (p. 525) for a more detailed description of the method of making water-gas from the oily or tarry matter from coal, &c.—J. W. I.

[45808].—Erasing Letters from Leather Bag.—The question is, what are they put on with? If I had such a job, first I should try spirits of wine; if that did not move it, I should paint over the letters with turps, and soften with soft-soap, and after being on an hour, wash with clean water; that will remove, if paint. If that failed, I would wash it with oxalic acid. If done with spirit varnish, the first will remove it; if with oil, varnish, gold size, or oil paint, the second will remove, if with common inks, the last will remove it. But the two first applications might require the soft soap or oxalic acid to clean it off.—JACK OF ALL TRADES.

[45833].—Watch Query.—I beg "Woodleigh's" pardon for objecting, as I must, to the statement that "jewel-holes" require no oil. What would be the consequence if a watch, having no oil at the pivots, was taken for wear by a person subject to profuse perspiration, as many are? I grant that jewel-holes do not require so much as brass-holes; but that, because jewelled, a watch does not require oil, neither I nor any sensible watchmaker can allow. I have frequently found the pivots in a jewelled watch nearly destroyed by corrosion and frictional wear, which I could attribute only to the absence of oil, or through its having dried up. The only jewelled part of a watch that, in my opinion, requires no oil, is the roller-pin of a lever. Even as regards that, opinions differ.—ALFOJOE.

[45834].—Midland Engines.—To "METEOR."—The 230 to 239 class were built by Beyer, Peacock, and Co., 1868, and fitted with the necessary condensing apparatus for working over the Metropolitan Railway. These tank engines had a long rigid wheel-base of 16ft. 6in., and were found to be unsuitable for running over the sharp curves on that line; therefore, in 1869 and 1870, they were converted, at Derby, into main-line tender engines. The cylinders are 16½ by 24, coupled wheels, 6ft. 2in. The 340 to 349 class were built by Hawthorn and Co., 1853, 1854. Some of these engines have been broken up and replaced, and all the others completely "rebuilt." The cylinders vary from 16, 16½, to 17in. Dübs and Co. built the 630 to 649 class of goods engines from Mr. Kirtley's design in 1868: the cylinders are 16½ by 24. The 930 to 989 class were also built by Dübs and Co., 1871, 1872, 1873, and designed by Mr. Kirtley; the cylinders are 17 by 24.—CLEMENT E. STRETTON.

[45836].—A Tauri.—In reply to "F. R. A. S.," I may say that the position angles were arrived at by estimating the angles respectively made by lines drawn from the small stars to the principal star with the meridian. The second angle should be 250° and not 230°, and the distances from *a* are about equal. I estimate the distances at quite 2'. My object in asking for distances and magnitudes is that I think they may form guides to seeing the comes, which I am hopeful in doing as I have seen

the Deblissima in Lyra with the same telescope. The two stars I refer to seem the only ones about this distance, and are comparatively new. The reply of "F. R. A. S." has called my attention to a curious blunder on my part in looking for it comes at an angle of 108°. I imagined I saw star, *n f.* the principal star, but dismissed it at once as in the wrong position.—ZENAS.

[45852].—Varnish for Loco.—"Wearing Body" is not the best varnish for locomotive, being too tender. "Engine copal" is the proper one to employ, being made by the best manufacturers expressly for the purpose required by querist. If he will advertise, I will tell him where to obtain the right article.—DANDIE DENTIST.

[45870].—Waterwheel.—To "SUNLIGHT."—I beg to thank "Sunlight" very much for his kindness and promptitude in answering the above query, and no doubt the course indicated by him—viz., to call in the aid of an engineer, would be the best; but I find that would be rather expensive, and more than I could conveniently afford, and being an amateur mechanic, I thought, with the aid of some advice, which I felt sure I could get through the ENGLISH MECHANIC, I could manage the job myself. In accordance with "Sunlight's" wish, I send following further particulars:—Width of stream averages about 20ft., depth from bottom of tailrace to water-level of top water, about 2in. I cannot raise the head, as, being close to the highway, the effect of doing so would be to throw the water over the road.—C. W.

[45877].—Trochoidal Cutter.—In reply to "C. E. L.," I may say that I fear I could not give full dimensions of my cutter without further drawings than those already published, and possibly the Editor might object to more demands upon his space. If, however, "C. E. L." will write to me to the address at the end of my article, I shall be happy to give him all the help I can.—C. W. BOUENE.

[The Editor would not object at all, and much prefers that information should be given in the "E. M." for the benefit of all.]

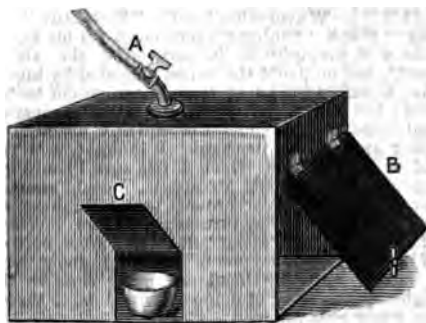
[45880].—Gravity Escapement Clock.—I should imagine that the fly of "Gimel's" clock is either too small or loose upon its arbor; it is most probable that it is too small, and that when the going springs are set up by pressing the key back, the fly does not control the train sufficiently, and the escapement trips. The remedy in this case is to increase the area of the fly. With regard to setting up the maintaining power before winding, I would remind the querist and those who have replied to the query, that a gravity clock differs from one with an impulse escapement, inasmuch as the pallets must be lifted at every beat; but with a dead or other impulse escapement, it is sufficient if the wheel simply follows the pallets during the short time occupied in winding. Now the driving weight will not set up the going spring sufficiently to lift the pallets promptly unless the weight is much heavier than necessary for driving the clock: hence the necessity for setting up the springs before winding; 36lb. on a triple line is not an excessive weight, and I do not think the draughts mentioned should affect the rate of the clock, providing it is well cased, and firmly fastened to the wall.—A CLEVERWELL CLOCK MAKER.

[45880].—Gravity Escapement Clock.—In my reply (on p. 549) for "lap," read *pass* *table* the click.—J. K. P.

[45880].—Gravity Escapement Clock.—I am much obliged for the replies to my queries; but I am as yet without a remedy, and the maker of the clock has removed, and a letter to him has been returned; so I hope some one will be able to help me. I give the further information asked for. The weight falls about 40in. in a week; the pendulum-bob is 9in. by 3in. diameter (about 25lb.). The teeth on the ratchet-wheel are about 170. In ENGLISH MECHANIC, Vol. XIII, I name one spring for such a clock, with its head towards the teeth of the wheel; whereas my clock has three springs, turned the reverse way, with their heads towards the centre of the wheel. These did seem to bind a little, but I have fixed them. A professional also suggested that I ought to bevel slightly the edge of the ratchet-wheel, so as to prevent its binding on the great wheel. This I have done also. The clock has a fly, each half being 1½in. long. It appears to work correctly, going round in eight beats. I have tried what "Pegaredstuff" suggested. By holding up the detent out of teeth, and letting the power of weight on again, the detent clicks over several teeth; then, by taking off the weight, the detent is tight. What I have done seems to have made somewhat of a change; for, in winding up, it stops now, more than trips, but still goes up at three seconds at a jump after stopping. When winding, the clock seems to go steadily and well, as far as I can tell; but, being disturbed every time it is wound up, I have not been able to regulate it properly.—GIMEL.

[45890.]—Induction Coil.—My thanks are due to Mr. Lancaster, "H. B. T. S.," and J. Brown for their replies. The latter, I think, has misunderstood my query. The coil I proposed is practically a number of small coils on the Ferguson plan, joined in series. I understand that differs from Apps's plan. My present coil is built on the Ferguson system, but has broken down owing to the decomposition of the gutta-percha paper with which it is insulated.—H. A.

[45896.]—Fumigating Oak with Ammonia to Darken its Colour.—In answering the above question, we must state that the first thing necessary is a wood or tin case similar to the sketch.



The size must be regulated according to the amount of work it has to do, and the room the owner has at his disposal. If it is made sufficiently large to hold six or eight chair-frames, it will be a nice medium size, and the cost will not be very great. Now, having got our case—whether it be tin or wood it must be perfectly air-tight, and the best way of managing this will be to paste slips of paper or American cloth over the joints and cracks (if there be any.) As illustrated in our sketch, it is essential that there be two doors, the arrangement of which is left entirely to the requirements and the genius of the operator. B is the principal aperture in which we place the pieces of wood for fumigation, and C a smaller one for the reception of the liquid. So far so good; but we come to the chemical which has to be used, and this, I believe, is somewhat special, so give the full particulars:—Liq. ammonia, S.G. 840. About a half-pound of the liquid is capable of filling 40 cubic feet of air. Our querist will no doubt be aware that tannic acid is especially present in oak, and the ammoniacal gas acts upon this; the effect of which is that the wood is permeated to a considerable depth—in many cases to such a depth that the plane may be gently applied without the removal of colour. We now come to a very important part of our reply. Previous to the articles being placed in the case, they must be absolutely finished, even to fine papering, as one of the advantages of fumigation is that the grain is not raised as in staining. As the chemical used is very dangerous, every care must be taken. It is by far the best and safest plan to have everything ready before inserting the liquid. Place every piece you wish to fumigate in the case, and then paper down the principal door B. Next, bring a basin or dish near the door C, pour out your liquid, and place it in instantly and close the door. Be exceedingly careful not to inhale any of the gas which is emitted, or stupefaction will ensue. A very small quantity of the gas which is set free, if suffered to spread in a room, is quite capable of suffocating the occupants, and one or two cases having come under my own observation only adds proof to my statement. (Of course, I do not mean absolute suffocation.) The pipe and tap A, which is at the top of the case, is for carrying off the gas when the articles are sufficiently browned. We cannot give any exact length of time that is allowed for the action of the fluid—this depends upon the degree of colour wished for. Fumigation is by no means confined to oak: it answers admirably for mahogany, chestnut, and other woods. It is a valuable and easy method of destroying that new appearance which our "aesthetics" so much object to in the furniture of the present day. Allow me, in conclusion, to inform "D." that the penning of the above in answer to his query has given me the greatest pleasure, and I sincerely hope that he will be as much benefited thereby.—A. MANOOR.

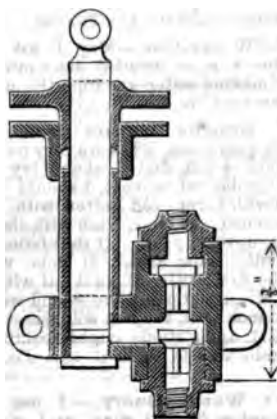
[45897.]—Artificial Indigo.—The following extract, from a letter of Professor Baeyer to Professor Roscoe, taken from the *Journal of the Society of Chemical Industry* just issued, may interest your readers:—"The series of operations necessary for passing from toluene to indigo-blue are, as is seen, rather long, but each process works so regularly and well that the preparation of propiolic acid and its conversion into indigo-blue can be carried out with perfect ease: the only serious imperfection in the process is the loss of 40 per

cent. of the cinnamic acid in the form of para-nitro-cinnamic-ether. This will, it is to be hoped, be overcome by the employment of the compound for some useful purpose. On my visit to Ludwigshafen, last November, I found the manufacture of indigo in full activity—200 kilos. of propiolic acid paste, containing 25 per cent. of the dry acid, were produced every day, and this is sold at the price of 10s. the kilo." The date of this letter, I may add, is December 31, 1881.—CHEMISTIANA.

[45900.]—Limelight.—I note Mr. W. J. Baahford mentions this matter, and describes it as Mr. "Gilmour's method." This should be attributed to Dr. John Nicoll, whose directions for the process were exactly as stated at page 549, including the mode of piercing with an "olive-ended" wire. It will be noticed that I myself tried, as stated at page 528. The object of again mentioning this is that I feel sure Mr. Baahford cannot have tried the plan himself, or he certainly would not have described it as "durable" and "effective." Durable it certainly is not, as the cylinder, unless incased, as I described, would quickly fall to pieces, except a very small jet of oxygen was used. The idea was first put forward in the *Journal of Photography* some time in 1872, I think; but was only recommended as suitable for making enlargements where a light of but a minute or two was needed.—SUNLIGHT.

[45901.]—Defective Iron Gas-Stove.—Make the upper part of the stove on Phillips's plan, two-sheet air-space cylinders, with a ring of jets between them. I have had such a one in use for years, with good results. Open-flame radiators are poor stoves.—J. W.

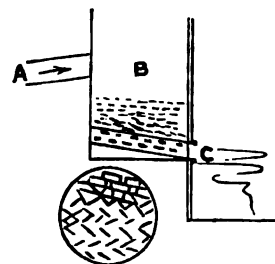
[45914.]—Feed-Pump.—As desired, I redeem my promise by forwarding the sketch of pump. If



I were about to make it I should get, if possible, a pair of fishing-rod ferrules, one of which would form the plunger (the one end being plugged up, and another plug to form the eye, where the rod from the eccentric takes, being soldered into the upper end), whilst the outer tube forms the barrel. At the top end we solder on the gland as shown, whilst the packing gland is a separate casting, as I have shown. A couple of studs of iron or brass wire and a couple of small nuts finish the gland. The bottom casting is the one most difficult to deal with. We want a T-shaped casting, which, if we make the pattern as a block of the right shape outside, will be best. Supposing we have the casting, we first drill a hole into which the barrel of the pump will fit nicely, and we then drill the upper end of the cross part to allow of a plug being screwed in as shown, and then a smaller hole may be drilled a little farther to carry the valve. Now we turn the casting and for end, and drill up with the large drill, so as to allow of fitting the plug at bottom. This latter screwed plug is again drilled to carry the bottom valve. Both top and bottom plugs are drilled again top and bottom to take the pipes which lead in the suction and delivery pipes. The small valves and the plug may be with advantage turned up out of brass rod. A cross passage from the space between the valves to the barrel is formed by drilling through the part where the barrel is secured, and plugging the hole at the one end. A screw at bottom closes the barrel. Most likely the ferrules would be a little too tight a fit, but can be readily eased with a very fine file, afterwards finishing with emery cloth. One great advantage of the plunger being a good fit in the barrel is, that for a small pump it will suck and force far better than one where there is any space round the plunger; and, in addition, it forms a guide, so that there is less bother to keep the gland tight. A very little quantity of lamp cotton, well greased, will make a good joint. For sizes, I may add that the plunger may be $\frac{1}{4}$ in. diam., and to allow a stroke of $\frac{1}{2}$ in.—the barrel and other parts being a size to suit the convenience

of the maker; the valve should be also $\frac{1}{4}$ in. diam. The height of valve-box is shown in figures; the other parts being full size. The feed-pipe may be $\frac{1}{4}$ in. brass pipe. Any details not plain to you, on inquiry, I will make clear.—SUNLIGHT.

[45919.]—Filtering Feed-Water for Boilers.—The best plan will be to sink two wells or brick tanks. Let the water into the first shallow one from the river for a filtering tank, and pump from the deep one. A, inlet from river; B, filtering



tank, consisting of three courses of bricks, 1 ft. coarse gravel, 1 ft. of fine, 1 ft. of sand; C, outlet into reserve tank. Pump from this to boilers. The bricks are to be placed as shown for bottom of filtering-bed, two rows upon edge chequered and top course flat. Next comes ballast.—JACK OF ALL TRADES.

[45919.]—Filtering Feed-Water.—I should not advise you to use an iron tank, as you suggest. The labyrinth would, of course, be horizontal, and you would lose the value of a surface-pressure. You say you use 600 gals. per hour; now, for safety, you should provide filtering capacity for 1,000 gals., or you may, when your filters get a little foul, find the supply run short, especially if the water is very dirty. I use about 1,000 gals. per hour river-water, the method of filtration being, firstly, a settling pond to receive supply from river, so as not to send all the dirt into filters. Another object also is to catch a good store when the river is at its cleanest, say, just after a flood. The filters are as follows, of which I have a pair, so that one can be in use, and the other cleaned, as required: They are built of bricks, and the inlets from settling-pond are 6 ft. above bottom of filter, the outlet 4 ft. below. Now, supposing it to be empty, place stones evenly over bottom about 1 ft. deep, about the size of coconuts; now a layer, say, one half as large; now another, say, bean size, 6 in. deep; then same depth, about pea size; then finish with 1 ft. rough sea-sand. This will give you 1 ft. for pressure below inlet-pipe; this is ample. You next require a receiving-well for filtered water to flow into, in which your pump is fixed. Should you be near the sea-shore, getting the material is quite easy; but, if not, of course, it is expensive. The sand may be lightly skimmed when dirty, and the skimmings washed and used again. If you think this would suit you, I should be pleased to render you any advice in detail, with sketch or otherwise, if you advertise your address in "Sale Column."—ON GUARD.

[45920.]—The Audiphone.—The audiphone, as invented by Mr. R. G. Rhodes, of Chicago, consists of a sheet of thin elastic vulcanized rubber, generally of square shape, with the corners rounded off. It may be of any convenient size (say from six inches to a foot in the side). At the middle of one edge is fastened a handle. At each end of the edge, opposite to the one carrying the handle, is a hole, and passing through each hole, and fastened there, is a string. The strings are led diagonally across the plate to about the centre and are there tied together; one is out off close to the knot, and the other carried down towards and past the handle, and cut off about six inches beyond the edge of the plate. A contrivance is fixed to the handle by which this loose string can be grasped at any desired point. It is evident that by holding the handle in the left hand with the plate uppermost, and pulling the string downward with the right hand, the elastic square can be pulled into a more or less curved form, and further, that it may be kept so by cleaving the string with the contrivance before referred to. In using the instrument the top of the rubber plate is lightly pressed against the upper teeth, the convex side being directed towards the speaker; the string is then tightened or slackened until the best effect is produced, when, by a touch of the finger, the string is secured in position. Professor Colladon, of Geneva, who studied the action of this instrument, found that the sheet of ebonite might be advantageously replaced by a sheet of fine elastic cardboard, the best kind being that smooth dense variety, known to the trade as "shalloon board" or "satin board" (carton d'orties), which is a fine kind of yellow mill-board, with a very smooth glazed surface. A rectangular sheet of

this material, about 18in. by 10in. broad, is selected, and varnished at the edge, where it is placed in contact with the teeth. In use, one of the short sides is pressed against the teeth, and the opposite short side grasped in the hand; pressure is then applied by raising the hand until the board has assumed the proper curvature, the convex side, as before, being directed towards the speaker. Mr. Thomas Fletcher, of Warrington, further improved the instrument. He found that birch-wood veneer was preferable to either of the materials mentioned. An oval piece, about 12in. by 8in., is taken, steamed, and bent to a curve on a suitable block; it is then fastened by string and pins, and allowed to remain until dry. After removal, the surface is varnished, first with shellac in spirit, and afterwards (to conceal the colour of the veneer) with the same, to which a small quantity of ivory black has been added. The advantages claimed for this modification of the instrument are that, being held between the teeth and needing no other support, it leaves both hands at liberty; and further, that it is more efficient in transmitting the timbre of musical notes than the forms before described. Later on, Mr. Fletcher suggested the use of a sheet of stiff brown packing-paper, without folds or creases, about 11in. by 15in. This is bent into a loop, and the ends placed between the teeth, the curved part being directed outwards. Mr. Fletcher considers it a distinct improvement in every way (except, I presume, in appearance) over his first pattern. The audiphone, whatever the model on which it is made, conveys the sonorous vibrations through the teeth to the bones of the head, whence they pass to the inner ear. The auditory nerve then acts in the usual way. It is, therefore, evident that the instrument is only of value in cases where the injury is to the external ear alone. When the inner ear, or auditory nerve, is defective, it is quite useless.—ALFRED W. SOWARD.

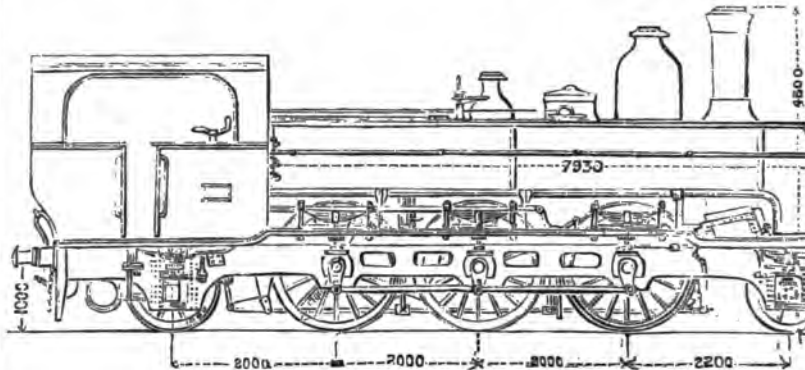
[45920.]—Audiphone.—Although a good deal has been written on this subject, it would appear from constant inquiries, that very little is known about the instrument. The original inventor, Mr. Rhodes, uses a thin sheet of hard vulcanised rubber, with a handle, this sheet being bent to a curve, which has been found necessary, by silk cords. The sheet of hard rubber used is identical with those used in the large-size manifold writing books, and in copying presses; the handle is totally unnecessary, increasing the clumsiness of the apparatus; and the silk cords to stretch to the required curve are also worse than useless, as the rubber plate can be bent on a warm block to the right curve, which it will retain when cold, forming an audiphone which, not being strained, takes up vibrations much more readily. It would appear, therefore, that the patentee obtains 42s. for what anyone can make for himself for 2s., which is the price of the hard rubber sheets used; these are to be obtained at almost any commercial stationer's shop, the only practical difficulty being bending on a block shaped to the right curve, which is not by any means needed to be precise. It is only necessary for the curve to be equal and of such a radius that one end shall be held between the teeth whilst the other end hangs down so as not to rub against the clothing, and make disagreeable scratching noises. Being myself partially deaf, I experimented with one of the original form, and found that for my special purpose (to hear myself playing on a musical instrument), the handle was an unnecessary nuisance, and that hard rubber was both heavy for its power and disagreeable to hold between the teeth. I further discovered that, given the shape, of which I have sent the Editor a sample, the material may be anything, and I have made and used satisfactory audiphones of tin-plate, wood-veneer, brown paper, pasteboard, show-cards, and hard rubber. Of all these, the best appears to be thin birchwood veneer, steamed, bent to shape, and varnished black. This can be held between the teeth without any assistance from the hands for an hour or two at once without effort, in fact, it is forgotten after a few minutes. The one I sent to the Editor is made of this material. The question of size is important, as on the size depends the power. The most manageable size is about 10in. by 12in., but this is as a rule insufficient to enable speakers to be heard in a large room. For this purpose, nothing is so good as a sheet of stiff, smooth, brown paper, held to the curve by the hands, and it will be found that curves of irregular forms in the paper destroy its power almost entirely. If paper is carried about for this purpose, it must be rolled up, not folded. It must be borne in mind that the audiphone falls totally when there is disease of the auditory nerve, and is, therefore, of use only in a small proportion of cases. At one of my scientific evening meetings two years ago, the deaf and partially deaf were invited, for the purpose of testing different forms of the audiphone, and, to my particular and special disgust, I failed totally in every case, except with myself, making me look every way foolish, as I certainly expected some, if not all, would find it a benefit. Since then, I have met

with many cases where it is perfectly successful, still with a large majority of failures. As anyone can, with a sheet of brown paper, or a pasteboard show-card, supply himself with a good audiphone, it need not any longer remain a doubtful and expensive question whether this instrument will prove of any use in any special case. If it is of any use one can be improvised almost anywhere, a concert programme often filling two uses. As the audiphone acts by conveying the vibrations in the air mechanically through the teeth to the bones of the head, it will be of course understood that direct and close contact between this and the natural upper teeth is necessary; the lower teeth have very little power to convey sounds, and artificial teeth are useless, unless the plates on which the teeth are mounted are in direct contact with firm roots of natural teeth remaining in the gum, a rigid means of communication between the audiphone and the bones of the head being necessary.—THOS. FLETCHER, Museum-street, Warrington.

[We gave an illustration of the audiphone on p. 42, No. 782. It will probably be sufficient to say that the audiphone sent by Mr. Fletcher is bent to a curve having a radius of 9in. approximately. The curve can be easily struck by taking a piece of string and tying the two ends, so that the loop is 9in. long. Put one end of the loop over a pin in a sheet of paper, and a pencil at the other end of the loop will then describe the required curve.—ED.]

[45926.]—Book-Edge.—Did you prepare first with parchment size and bole or red chalk first?—JACK OF ALL TRADES.

[45927.]—Belgian Tank-Engines.—I have much pleasure in sending to "Grosvenor" and your other readers interested in the subject, the



following particulars and drawing of the above-named locomotives. I had the opportunity of thoroughly examining one of them at the Paris Exhibition in 1878. It was a curiosity of the Belgian section. I shall not be far wrong in stating that such a design would not be favourably looked upon by the English brethren of the engineering profession. Hitherto, there had been built, both in England and on the Continent, eight-wheeled engines, either tender or tank, in which the two middle pairs of wheels are coupled. The late Paris Exhibition offered several examples of this sort of locomotives. Amongst others, I will mention the tender-engines of the Paris, Lyons, and Mediterranean, and Paris-Orleans Railways; also, the tank-engines of the Western Railway of France, and of the Grand Central Belge, that are used chiefly for suburban traffic. In the case before us, this principle is extended to three pairs of middle wheels. These, with the extreme leading and trailing pairs, make an unusually long engine, as will be perceived on inspecting the following table of dimensions:—

CYLINDERS (INSIDE).

Diam. of piston	450mm.	17-77in.
Stroke of do.	600	1ft. 11-7in.

WHEELS.

Diam. of leading	1,060mm.	3ft. 5-73in.
" of the 3 middle ..	1,700	5ft. 7in.
" of trailing	1,060	3ft. 5-73in.
Total wheel-base	8,400	27ft. 6-7in.
From leading to 2nd pair ..	2,200	7ft. 2-6in.
" 2nd pair to 3rd ..	2,000	6ft. 6-74in.
" 3rd " to 4th ..	Do.	Do.
" 4th " to trailing ..	2,200	7ft. 2-6in.
Rigid wheel-base	4,000	13ft. 1-5in.
Between tires	1,355	4ft. 5-46in.
Breadth of tires	140	5-6in.

FIREBOX.

Length	2,700mm.	8ft. 11in.
Breadth—		
Top	1,170	3ft. 10in.
Bottom	1,076	3ft. 6-3in.

TUBES.

Number	226	
Length	3,467mm.	11ft. 4
Diameter (ext.)	45	1

HEATING-SURFACE.

Firebox	10-95m. ²	1174
Tubes	58-55	1,660
Total	109-50	1,751

BOILER.

Length	2,740mm.	9ft.
Breadth	1,110	3ft. 6-8
Surface	3m. ²	32sq. ft.
Mean diameter of barrel ..	1,300mm.	4ft. 3-2
Thickness of plates	11	7-16in.
Working pressure per cm. ² ..	7-5atmos.	110lb.
Thickness of frames (ext.) ..	25mm.	1in.
Distance apart do.	1,848	6ft. 1-2
Height of centre of boiler above rail	2,100	6ft. 10
Weight empty	41,000kilo.	49-3cu
Weight in working order ..	58,000	57-0
Weight on leading axle ..	10,000	9-8
Weight on second axle ..	12,500	12-4
Weight on third axle ..	13,000	12-8
Weight on fourth axle ..	12,000	11-9
Weight on trailing axle ..	10,000	9-8
Capacity of tank	9,950litres	2-71
Capacity of coal-bunkers ..	2,000kilo.	38cw
Total length over buffers ..	11,940mm.	39ft.

The above engines were built at Brussels well-known "Société de Construction de Matériels de Chemins de Fer," under supervision of M. Ch. Evard, manager from the designs of MM. Schaar as chief engineers of the Belgian State

They were designed for the traffic hilly parts of that railway. The firebox of the Belpaire type, with a top connected to the crown-plate by the only rational, cheap, and most practical dispensing with the old form of crown-plate door is cut clean out of the lower back-plate, and is consequently level immense fire-grate upon which the fire is thinly distributed. The framing is wholly no other is used save a slab placed in symmetry of the engine, extending cylinders to the firebox. At the front embraced by the cylinders between a bolted; at the other end it is merely a kind of socket riveted on the fire-allowing free expansion of boiler without on the slab. This slab fulfils also the steadying the crank axle by means of a box and a spring which relieves the axle as part of the weight thereon. The steam as may be seen from the drawing, outside got at. This disposition did not lead to often met with in France—of outside link The sheaves, eccentric-rods, link, &c., between the wheels and the outside cranks. It may be mentioned, by the the slab above-mentioned is also greatly used four-coupled and single engines of the line of the G. W. Ry. The leading and axles are provided with Adams's radial and the mean radius of which is 2-600m. (8ft. 6 engine is fitted with the Lechatteaux's pressure brake, and also with the West's compression-pump being placed on plate against the firebox. I do not think engines will find imitators here, though engineers were the first to devise the these engines, and apply it to eight wheels, for example, we have had the St. Helier engines, by Mr. Cross, embodying Mr. suggestions. It is difficult to admit that frame of such a length as here will necessary stiffness. The oddity of these of the machinery is not compensated stability of the engine. It is not, solution of the locomotive of the future

letter of the writer in the *Engineer* 1881.)—E. GOBERT, B.Sc., 39, Nottingham.

gian Tank-Engines.—Of course, are metric. I give them reduced at.

ders..... 17-in. by 23-6in.
at pair wheels..... 3ft. 5-7in.
2nd "..... 5ft. 6-9in.
3rd "..... 5ft. 6-9in.
4th "..... 5ft. 6-9in.
5th "..... 3ft. 5-7in.
ree..... 110-52lb.

in 1st and 2nd wheels .. 7ft. 2-6in.
2nd and 3rd " .. 6ft. 6-7in.
3rd and 4th " .. 6ft. 6-7in.
4th and 5th " .. 7ft. 2-6in.

..... 27ft. 6-6in.

ifth pairs have radial axle-boxes, and, fourth are coupled.

Boiler..... 4ft. 3-2in.
oiler to rails 6ft. 10-7in.
rate..... 8ft. 11-9in.
..... 3ft. 7-7in.

gth between plates, 11ft. 4-5in.;
r, 1-77ft.; pressure of eight atmo-
s, 189 gallons; coal room, 70-6 cube
ft., 41tons 9cwt.; weight, work-

	Tons cwt.
.....	10 0
.....	12 5
.....	13 0
.....	12 5
.....	10 0

57 10

1, 39ft. 2in. Westinghouse-brake
e. "Grosvenor" will notice the
stry of these engines, in all matters,
tribution of weight, &c., although
admire their appearance. They do
and, in spite of their long wheel-
e the sharpest curve without a
in with the utmost ease. They are
gest engines extant.—THE FLYING

erical Rest.—Gear a 59 driver
our tangent screw.—JACK OF ALL

hausting Large Cylinder.—
and pump out with your Cameron
F. ALL TRADES.

arionet Tuning.—In reply to
must inform him that the little in-
rred to is used by vocalists, and is
laying the bearings of an organ.

Electro-depositing Tin.—The
us Company, of Birmingham, re-
ply answer to this query, has ap-
to exist. I presume, therefore,
ocess, like most other processes for
osition of tin, has proved commer-
ful. Can Mr. Lancaster, or some
am correspondent, say whether this
D. W. SOWARD.

am-Engines—Your beam should
1 three times the length of stroke
es. Height will depend upon other
JACK OF ALL TRADES.

tracting Silver from Lead Ore.
will find all the different kinds of
l for crushing and pulverising de-
onstrated in Dr. Ure's Dictionary,
"Dressing of Ores," and all the
racting the silver in Vol. III., under
would be impossible to answer your
orily in this paper for want of room.
COOKE.

mpressing of Gas.—Your pumps
driven by cranks. Drive them by
CK OF ALL TRADES.

essure of Water.—Calculate every
as lib. per square inch; that will
arly. A Bourdon gauge would be
ALL TRADES.

mping Gas.—You want another
le the speed of your pump. Nothing
you. Your single pump will not
ers going.—JACK OF ALL TRADES.

ut-Making.—You want a fly-press.
ses for punching out the hole and
ne heat, working with compound
ld be rather elaborate to describe
think, beyond your reach. If you
unch the blanks to be finished by
be able to help you with a lever.—
TRADES.

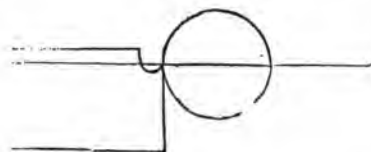
pper Bits.—Sulphur and dirty

coal will do that. Use charcoal, or keep some
killed spirits to dip your bits in, which will make
them keep a face longer.—JACK OF ALL TRADES.

[45949.]—**Copper Bits.**—Do not use pure tin
at all; simply file your bits clean, and when
heated, plunge in vessel containing acid, withdraw
quickly. Next place a piece of solder on scrap of
tin, and rub the bit well in it; it will not come off
with fair use.—ON GUARD.

[45949.]—**Copper Bits.**—Memo. for "E. F. C.,
and all whom it may interest. You cannot solder
zinc properly with any soldering fluid such as
"Baker's or anyone else's. To solder zinc, then,
take the hydrochloric acid itself, and apply it on
the spot, instead of previously killing it. I should
"admire" to see you stick two pieces of zinc, or a
crack on a housetop with rosin. I have heard of a
plumber who used to thank God that "if he was
poor he was not honest," and used to kick up a
fuss in the kitchen with the "metal pot and irons,"
but when he arrove on the heights, he used to dab
on a patch of white lead and canvas; but still he
was not "appy."—J. J. A., Liverpool.

[45950.]—**Parting-Tools.**—If "W. T." will
follow the sketch he will find no difficulty. Temper



to a brown; give as little clearance on the sides
as possible.—JACK OF ALL TRADES.

[45951.]—**Shot-Making.**—The following is
Ackerman and Martin's process: Melt a ton of soft
lead, and sprinkle round its sides in the iron pot
about two shovelfuls of wood ashes, taking care
to leave the centre clear; then put into the middle
about 40lb. of arsenic, to form a rich alloy with the
lead. Cover the pot with an iron lid, and lute the
joints quickly with loam or mortar, to confine the
arsenical vapours, keeping up a moderate fire to
maintain the mixture fluid for three or four hours.
After which, skim carefully, and run the alloy into
moulds, to form ingots or pigs. This composition
is to be put in the proportion of one pig or ingot
into 1,000lb. of melted ordinary lead. When the
whole is well combined, take a perforated skimmer,
and let a few drops of it fall from some height into
a tub of water. If they do not appear globular,
some more arsenical alloy must be added. The
surface of the lead gets covered with a crust of
oxide of a white spongy nature, which is of use to
coat over the bottom of the cullender, because,
without such a bed, the heavy melted lead
would run too rapidly through the holes for
the granulating process, and would form oblong
spheroids. The cullenders are hollow hemispheres
of cast iron, about 10in. in diameter, perforated
with holes which should be perfectly round and
free from burrs. The holes have nearly the follow-
ing diameters for the annexed numbers of shot:—
No. 0, 1-50in.; No. 1, 1-53in.; No. 2, 1-66in.;
No. 3, 1-72in.; No. 4, 1-80in. From No. 5 to No.
9 the diameter decreases by regular gradations,
the latter being only 1-360th of an inch. The
operation is always carried on with three cullen-
ders at a time, which are supported upon project-
ing grates of a kind of chafing-dish, made of
sheet-iron, somewhat like a triangle. This
chafing-dish should be placed immediately above
the fall, while at its bottom there must be a tub,
half-filled with water, for receiving the granulated
lead. The cullenders are not in contact, but must
be parted by burning charcoal, in order to keep
the lead constantly at the proper temperature, and
to prevent its solidifying in the filter. The tem-
perature of the lead-bath and the height from
which the particles should be let fall vary with the
size of the shot. With a fall of 33yds., or 100ft.,
from No. 4 to No. 9 may be made, and for larger
sizes 150ft. will be required. Everything being
arranged as above described, the filter stuff is put
into the cullender and pressed well against the sides.
Then the lead is poured into it with an iron ladle. The
centre of the cullender, being cooler than the sides,
forms larger shot; consequently the shot found in
the tub are not all equal; and also three cullenders
of different size holes are sometimes used at the
same time. The shot are therefore separated by
square sieves of different fineness, 10in. broad and
16in. long, their bottoms being of sheet-iron,
pierced with holes of the same diameters as those of
the cullenders. To polish the shot it is shaken up
with plumbago.—F. BARKER COOKE.

[45954.]—**Melting Zinc.**—When melting, pour
off from the dross and dirt; place in the ladle or
crucible again, and cover with salt. When about
to pour, poke a hole in the crust, the side you

want to pour from; it must be red-hot.—JACK OF
ALL TRADES.

[45957.]—**Street Coils.**—To Mr. LANCASTER.—
I wish to make up one of the large street coils, with
bells to ring and wheel to rotate; if you will kindly
inform me how to do it, I shall feel obliged.—F.
ROWE.

[45960.]—**Darkness.**—Your query reads more
like a joke than anything else. You will be unable
to find any substance upon which darkness will
have an effect similar to light on silver salts, &c.
Have you not made an error in your query? If
you will say exactly what you want to do, I will
try to help you.—W. J. LANCASTER.

[45968.]—**Repairing Large Marble Mortar.**
—The white of egg and finely sifted slaked lime
will do it, and have some holes drilled in it for
clamps about 1/4 brass wire, the same as china is
riveted. Some good glue with a little treacle
make a good tough cement, or some gelatine.—
JACK OF ALL TRADES.

[45971.]—**Metal Planing.**—Why not add the
old mangle motion? Nothing better. If you do
not know it I will do my best to put you in the way
of making one.—JACK OF ALL TRADES.

[45973.]—**Parrot.**—Give it a few blades of
saffron and a few slices of liquorice root in its
drinking water, and watch the effect. Put a cloth
around two-thirds of the cage to keep from
draughts.—JACK OF ALL TRADES.

[45976.]—**Hall-Marks.**—I hope the following
may prove of service to "Z. Y. X.," viz.:—
London, before 1823, leopard's head, crowned;
since then leopard's head, not crowned. York,
five lions on a cross (discontinued). Exeter, castle
with three towers. Chester, dagger and three
sheaves; but before 1779 three demi-lions and a
wheatsheaf on a shield. Newcastle, three castles.
Sheffield, a crown. Birmingham, an anchor.
Norwich, a castle and lion passant (discontinued).
Edinburgh, castle. Glasgow, tree, fish, and bell.
Dublin, Hibernia. York and Norwich have not
been used for some time.—J. CHAMBERLAIN.

[45978.]—**Amateur Geologist.**—Begin at the
beginning; don't get a lot of useless tools, but go
to work, first, with a hammer and chisel. The
chisel should be of steel, about 5in. to 6in. long
and about 1/4in. square. You will require a pocket
compass, a simple sort of clinometer, and a bag
with shoulder-straps to put specimens in. Get
Page's "Elementary Text-book of Geology,"
and commence work in the formation nearest
to your residence. Well, read up about the
formation before you start fossil-finding; take
a little food for your stomach's sake, and com-
mence by entering in note-book, bearings, dip,
and strike, kind of strata, and any other matter
worth making a note of. Having done this, go
steadily to work at one spot. Don't go here,
there, and everywhere like a dog in a fair, but
stick to one piece of rock until you have found
something worth having; then go to another piece,
and work on until you have your bag well filled
with good specimens. Spend a quarter of an hour
if required to chip off useless rock. I shall never
forget carrying home about 80lb. of Silurian rocks,
with about 5lb. weight of fossils. It was the first
time and the last I ever carried home so much
useless rock.—W. J. LANCASTER.

[45982.]—**Photo Transparencies.**—There is a
method of over-exposing a plate and developing
out a positive instead of a negative; but it is a
most unsatisfactory method, and is never adopted
except as a curiosity. The right way is to take a
negative, then print from that. I shall be pleased
to give you the necessary instructions to enable
you to take good transparencies, if you wish to do
them well.—W. J. LANCASTER.

[45982.]—**Microscope Lamp.**—Keep your
lamp clean; burner and cotton as well. Use the
best paraffin you can obtain, and put into the
paraffin a little essence of Balm of Gilead. This will
produce a pleasant odour in the place of your dis-
agreeable smell.—W. J. LANCASTER.

[45994.]—**French-Polishing Fret-Work.**—I
always use white French polish, which I get from
the oilshop. If the wood is mahogany, I rub it
over with boiled linseed oil, and then after that is
soaked in, for the plain parts I use a piece of linen
rag with some wadding inside to make a pad,
well saturated and wipe over it. Sometimes as
many as six times I go over it, and as it dries so
very quickly, it does not take up much time, espe-
cially if you have two or three articles to be done,
and for the flagee parts I use a camel's hair brush.
—J. CHAMBERLAIN.

[45994.]—**French-Polishing Fret-Work.**—
No, not polish, but varnish it with bright: 1 ounce
gum benjamin—i.e., benzoin, about 3 ounces spirits
of wine. When dissolved, apply with a camel-
hair brush, but size it first with some weak size.—
JACK OF ALL TRADES.

[45994.]—**French-Polishing.**—I agree with
friend Davies' remarks, and would supplement

them by observing that amateurs usually put far too much polish upon the rubber at a time. Shake up the bottle, then place rubber on top, and turn it over once only for small jobs like this; then touch the end of your finger in the raw linseed oil, and cautiously apply a modicum on the outside old linen.—J. J. A., Liverpool.

[45994].—French-Polishing Fret-Work.—I have had occasion to polish various pieces of fret-work, but did not find the fine parts "clogged" up, though I used French polish. My plan of proceeding was this: I rubbed the fret-work with sand-paper of different degrees of fineness, beginning with the coarsest and finishing with the finest; by which the fret-work became quite smooth. Then I soaked it for some time (the longer the better) in linseed oil, rubbed it over with gypsum to fill all holes, &c., and then with French polish, a little at a time and rubbing well. If I found it was hard to rub, and the polish thick, I rubbed the wood over with linseed oil and then proceeded with the polishing.—F. BARKER COOKE.

[45998].—Slide-Valve.—Notwithstanding our friend "Sunlight's" reply to this query, I think that both he and the querist will find that an ordinary slide-valve cannot be made to cut off steam at less than half stroke without causing a most unnecessary amount of compression. I have tried to do it many times, but never succeeded in doing it. The last time I tried to do it was with an engine driving a cotton-mill. Result: could not get the engine to run full speed. If "Crescent" wants to cut off at one-third, the best thing he can do will be to apply an expansion-valve, to work on back of main-valve; he can then arrange to cut off at any part of stroke, without interfering with the exhaust.—LABOR OMNIA VINCIT.

[46001].—Thermometer Screens.—There are several varieties of screens; but Stevenson's is one of the best you can have, and a convenient size is 18in. long, 12in. high, and 9in. deep; the door to face the north, and the thermometer to be hung at the back of the screen. The screen should be 4ft. from the floor, and, of course, some distance from either trees or a wall. A wooden screen is preferable to a canvas covering.—W. J. LANCASTER.

[46002].—Feed-Water.—"I O SUNLIGHT."—Unquestionably the temperature of the feed of a condensing engine could be increased up to 200° if desired. I was consulted on a similar point last year. After looking at the engine itself and the connections, as the engine was a horizontal condensing one, I decided to apply the heater to the exhaust-pipe, as follows:—The exhaust-pipe was carried up so as to enter the top of a cylindrical chamber carried on the top of the condenser. This chamber consists of a central main tube, through which the exhaust passes, and around this is a jacket, through which the feed is pumped; therefore the water is always passing through as a comparatively thin film, whilst the exhaust steam is made to pass inside in a thicker film by having a casting inside the exhaust-pipe to act as a displacer. In this engine, the feed is taken from the hot-well at an average temperature of 107°. It is then sent through the heater-jacket, when it averages 200°, and is frequently as high as 204°. The heater being directly over the condenser, the condensed steam flows by gravity directly into the condensing chamber, and, therefore, no accumulation of condensed steam can occur. Would this be applicable to your case?—SUNLIGHT.

[46003].—Legal.—Upon the case as stated, A. can set up or set off, by way of counterclaim, the amount he paid for railway charges and demurrage in consequence of B.'s mistake, in any action brought against him for the value of goods sold, and this would be the only proper way of proceeding, as separate actions are now greatly discouraged, and a defendant having such a claim is bound to set it up. But, of course, everything depends upon the accuracy of the original order, which, in the event of an action being brought, should, as soon as possible, be inspected by A., unless his is a press copy, and so could not be erroneous.—FRED. WEATHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall, E.C.

[46004].—Cosine.—In order that $a \sqrt{\frac{A}{BC}}$, which we shall call M, may be capable of having a cosine, it must, of course, represent an angle, or an arc to radius unity. The quantities contained in M are to be taken numerically only. If a, for instance, refers to a line, or a force, &c., it means only a number of units of length, or force, &c. Thus, M itself is but a number or ratio, and it can represent an angle by being taken to mean a number of angular units. In this case the units are most probably units of circular measure. The circular measure of an angle is the proportion between its arc and radius, or the length of its arc to radius unity. The length of the arc of 180° to radius unity is π , or 3.14159...; as the number π represents 180°, so the number M represents an angle π° , which is found from the proportion $\pi : M :: 180^\circ : \pi^\circ$.—DUBLINERUS.

[46005].—Barometer.—You can obtain tables for correction for temperature; and to get accurate readings, you should have a standard barometer that has been verified, with table of corrections for capacity. For correcting and reducing to 32° F. and mean sea-level, you can, for each 10° the thermometer is above 32°, subtract 0.03; and for every 100ft. above sea-level, add 0.10 to the reading. Thus, a barometer at a station 550ft. above sea-level, and at a temperature of 62°, gives a reading of 29.64in.; then the corrected and reduced reading will be, for temperature, $62 - 32 = 30$; then $0.03 \times 3 = 0.09$; then $29.64 - 0.09 = 29.55$; then elevation 550ft. will equal 0.56, to be added to 29.55, giving a corrected and reduced reading of 30.11. For measuring the height of mountains, you should obtain Airy's tables. These will give you the exact height at once; but perhaps you can get sufficiently accurate measurements from table below. The first column gives elevation, the second column gives total fall of barometer, the third, fall per each 50ft.

Feet.	Fall.	Each 50ft.
250	0.28	0.056
500	0.564	0.057
750	0.841	0.058
1,000	1.117	0.058
1,250	1.390	0.056
1,500	1.660	0.054
2,000	2.193	0.053
2,500	2.717	0.052
3,000	3.231	0.051
3,500	3.736	0.050
4,000	4.231	0.049
5,000	5.196	0.048

—W. J. LANCASTER.

[46006].—Comets.—I don't think a star was seen actually through the nucleus, although one was seen very near it, as the following extract from my observation-book will show:—"1881. July 13th, 10h. 45m. The comet is very easily seen without the opera, though considerably diminished in brightness since the last observation, scarcely any of the tail being visible. Through the opera, 1 Draconis is seen quite near to the nucleus (should say within 6' or 8'), and very distinctly seen through the coma. This is an exceedingly interesting observation, showing most unmistakably the gaseous constitution of the comet family. R.A., 1Xh, N. Dec. 82°."—W. STANFORTH, Sheffield.

[46008].—Hot-Water Pipes.—Hot-water pipes, for warming rooms, are best covered with a composition of lampblack and size. A dead-black is the best radiator of heat; the nearer a polished white is approached, the worse the radiation. If you do not like to see the black, I would suggest that the pipes be covered with ornamental open panelling, painted any colour desired. Has not "S. T. J." heard the old saying, that "Saturday's kettle boils the fastest"? Because, on Saturday, the front and top of the kettle are generally cleaned and polished, but the bottom and back of the kettle are never cleaned.—W. DUNKIN.

[46015].—Fowls.—I have no idea how many eggs "Hatch'em" expects daily from his fowls, but certainly think he need not complain of his present number. The probability is, that if he increases his number of eggs that he will reduce the number of his fowls. If he will refer to the "Scientific News" in last week's MECHANIC, p. 541, a little information may be found which no doubt will throw light upon his difficulty.—A. MANOCK.

[46017].—Fan.—I can tell "Engineer" that I tried a fan out on the diggin's for want of a bellows, and the conclusion was that it was very laborious, and did not give pressure enough, for want of an engine to drive it at about, say, 800 revolutions per minute; also, I think it would take up quite as much space as an ordinary octagon portable forge bellows; finally, that four blades would not better than six do; finally final, it must be a funny shop you have if you can't rig your bellows over your head.—J. J. A., Liverpool.

[46021].—Battery Power.—As "Bellringer" evidently wishes the electricity for bellringing, I would not recommend his using any size of bichromate, but stick to the Leclanché, as the two batteries are not to be compared, for although the half-pint bichromate would at first give as much force as four Leclanchés, yet it is not continuous. Bichromates are out of the question for this class of work.—GEORGE BLACKWELL.

[46021].—Battery Power.—The electromotive force of a bichromate cell is, roughly speaking, one-third greater than that of a Leclanché. The E.M.F., therefore, of four Leclanchés, joined up in series, is about three times that of a bichromate. The size of cell does not enter into the calculation. But if it is required to compare the respective currents of these batteries, and this it is, I imagine, that "Bellringer" really wants to do, then the resistance of each cell (which varies with its size) must be known, together with the resist-

ance of the circuit exterior to the battery. "Bellringer" must also bear in mind that two batteries capable of giving currents of the same power are not necessarily of equal value for any particular purpose. One may give a constant current for a long period, another may quickly decline in power. Thus, in the case of the two batteries instanced, the bichromate will give a fairly steady current for some time, whilst, on the other hand, the Leclanché gives a steady current for but a few minutes. Where a momentary current is required at intervals, as for bell-ringing, the latter form of cell is to be preferred to the former.—ALFRED W. SOWARD.

[46022].—Barker's Hydraulic Brake.—The Midland train fitted with Barker's hydraulic brake continued to work the 7.45 a.m. train from Bedford to St. Pancras, returning at 4.40 p.m. until December 31st, 1881, since which time the two engines, Nos. 132 and 135, and the few fitted carriages which now remain have been stationed at St. Alban's, and work as follows:—

9.20 a.m. St. Alban's to St. Pancras
10.49 a.m. St. Pancras to Luton
2.35 p.m. Luton to St. Pancras
10.20 p.m. St. Pancras to St. Alban's.

As I have mentioned in a former letter, the hydraulic brake on the Midland Railway had been removed from fifteen carriages and vans up to June, 1881, leaving only eleven vehicles. In reply to the latter part of the question, the 7.45 train from Bedford, and 4.40 p.m. from London, have, from the commencement of the present year, been provided with steam brakes upon engines and tenders, and the Sanders and Bolitho vacuum brake upon the carriages.—CLEMENT E. STREETON.

[46023].—The Westinghouse Brake.—To "H. S. F." The Scotch express traffic upon the Midland Railway is all worked with the Westinghouse Automatic Brake, consequently it follows that the engines fitted with this brake must be of a class capable of performing the work required at the present time, therefore the brake apparatus has been changed from some of the engines to which it was applied years ago, and placed upon others of greater power. In my letter Vol. XXX. p. 284, I furnished a list of engines "fitted" at that date; but since that time the brake has been changed from the 235 class, also 904, 905, and placed upon engines 101, 102, 803, 812, 815, 824, 826, 829. It will be remembered that when continuous brakes were introduced, many English engineers objected most strongly to their being applied to engine wheels, although such brakes were working most satisfactorily upon American engines. Since the Newark brake trials, much of the absurd prejudice against these brakes has changed into an equally strong feeling in their favour, and at the present time the Midland Company is fitting the Westinghouse driving-wheel brake to all their engines which formerly had the automatic brake upon the tenders only. Other companies have also adopted a similar course, and thus added very considerably to the power and efficiency of the continuous brakes. The main brake-pipe should be continued to the leading end of every engine, in order that the driver of the pilot engine may have control over the whole brake power. This very important addition has a considerable time been brought under the notice of railway companies, but at present very few have followed the suggestion, although its value is admitted by all. The Brighton Company has had great experience of the practical working of the Westinghouse brake: it is therefore at all times instructive to hear the results obtained. At the half-yearly meeting lately held, the chairman informed the shareholders that "this brake has given the most absolute and perfect satisfaction to all the men on the line; that he had no doubt they had escaped accidents on many occasions through its stepping-power, and also that nearly all their rolling-stock was fitted, and that it will be a great addition to their safety when it is completed." This very important statement by Mr. Laing, M.P., cannot fail to show that good continuous brakes are required both in the interests of the companies themselves and of the passengers. In reply to "Triple Valve," page 404, the information relating to brakes in Australia was quoted from a "Return" published at the time. I have obtained conclusive proof that in New South Wales 66 engines and 124 carriages are working with the Westinghouse automatic brake, and 50 more carriages are at the present date being fitted with it.—CLEMENT E. STREETON, Feb. 13.

[46024].—Cementing Silver to Marble.—The best plan I have found for fixing a plate to a marble clock is to solder two stout pins to back of plate, and drill two holes in clock to correspond, and cement it with plaster of Paris.—J. P. N.

[46025].—Midland Engines.—Ten express engines were built at Derby in 1877, and numbered 1347 to 1356 inclusive. In March, 1879, pending a change of numbers, this class was placed upon the A list, and upon the 30th of June, 1879,

engines 1347 A to 1356 A were again changed to 101 to 110, thus taking the place of an old class built in 1866-7, which are now to be seen numbered 101 A to 110 A. No. 101 A, it will be remembered, was in the Desford accident. Since the change mentioned, ten new tank-hunting engines have been built at Derby, and numbered from 1347 to 1356, thus taking the place of the express engines, and these are working in the Nottingham district. —CLEMENT E. STRETTON.

[46028.]—Legal.—A trade name is of no value unless and until it is registered under the recent statute, so that before this is done A. could not found a prosecution for its use by any other person. After registration, and upon proof thereof, such a prosecution could be supported if the infringement came within the provisions of the statutes. —FRED. WATKINFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[46032.]—Legal.—This is a very curious kind of contract to have entered into, but it must be construed reasonably, and much would depend upon facts not disclosed. What was the work, for instance? If, however, B. has been unable to obtain a situation because of his agreement to hold himself in readiness for A., and if A. has not been ready for him through his own fault, or has delayed unreasonably, then I think B. would have some claim for loss of time; though, on the other hand, if B. chose to enter into so strange an agreement, he must take the consequences. Without further facts, I cannot advise more fully—but the case is certainly one for a County Court. —FRED. WATKINFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[46036.]—Gasometer.—I always calculate, as a minimum, to use 4 cubic feet of gas an hour for oxygen, and about 5 ft. of hydrogen. That would be, if the jet be of the mixed-gas form. Except as a permanent stationary arrangement, I should not advise you to try it, as the size would be very large. For the oxygen, the least size for the bell or holder would be 2 ft. by 2 ft., and, say, 3 ft. deep. For the hydrogen, make the gasholder itself, say, 2 ft. 6 in. by 2 ft. 6 in., and 3 ft. deep. A weight of about 70 lb., and that of the bell itself, would be about right. If you paint the boxes with Brunswick black and turp., some six or eight coats, you will find neither gas affect the air-tightness of the holders. Respecting the jet, I hope shortly to give a sketch of this jet, showing the new mode of arrangement; as also the plan I hope to perfect for using the etho-oxygen light. —SUNLIGHT.

[46037.]—Condenser.—Please refer to No. 45947 query, on a similar subject, to which I replied. Have the engine indicated by some experienced person, and you will most likely find that the cause is either a leaky piston or leaky valve. The cause of the vacuum falling, towards night, is because the condensing water gets much hotter during the day's work. Should be most happy to indicate the engine for you gratis, if you were anywhere in my locality. —LABOR OMNIA VINCIT.

[46037.]—Condenser.—Some time ago I was just in the same position as you are with my engines (two), which have their injection-pipes connected. I could get no more than 20 in. on one, 15 in. on the other, at times losing water altogether. I had one of the pump-buckets packed fresh, with no better result. Then I did the same with the other, and cleaned end of suction-pipe; then I had 28 in. on both; not very steady, because of the leak of valves, which I have had put right since. Is your piston tight? If so, try what I have told you. —STRATHEDEN.

[46037.]—Condenser.—To "SUNLIGHT" AND OTHERS.—It looks to me as though there was an air-leak. Probably it might be the rod of the piston, or air-pump, that is the cause; or that the water-supply from which the injection is taken is too low down. I had a somewhat similar case once, and it was traced to the following cause:—The well was fairly deep from which the injection was taken, also of small diameter, and the in-flow of water was but small. During the night the water flowing in accumulated, and hence the level rose in the well; as the water was used up the level fell, so that towards stopping time in fairly dry weather the vacuum became bad and uncertain. This may be the cause in your case. The oscillations of the gauge may be partly due to this and to air-leaks. See also my reply in No. 881, page 551; also that of another gentleman following it. —SUNLIGHT.

[46038.]—Solvent for Coagulated Albumen.—"Yarrum" might try brushing the varnished surface over with strong acetic acid, and after standing a few minutes, wash off with water. —ANALYST.

[46038.]—Solvent for Coagulated Albumen.—This is very difficult to dissolve, except with strong boiling acids. I should advise you to soak it well for two or three days in acetic acid. If you could boil it in that reagent, so much the better. Dr. Ure says that if coagulated albumen is boiled

in water for about 60 hours, it disappears, being transformed into a substance soluble in water. I rather doubt it; but, still, you might try it. —F. BARKER COOKE.

[46039.]—Model Boiler.—To "SUNLIGHT."—The largest pair of cylinders I could advise you to use with the boiler you have would be 1½ in. bore and 2½ in. stroke. Do not go in for too much engine and too little boiler power. As you do not say weight of valve and lever, I take the weight of valve at an average, and the area in square inches being .3712, you would be working the boiler at about 30 lb. on the inch. If it be a well-made boiler you could carry, say, double that pressure with safety, certainly. —SUNLIGHT.

[46040.]—Electro-magnet.—Your battery did not give sufficient power (1) because the resistance of the drain-pipe cells, is too great; (2) because the copper is inside the porous cell, instead of outside it; (3) because you probably did not put enough sulphuric acid to the saturated solution of copper sulphate. To reduce the resistance, divide the battery into two parts, join the zinc poles of each half all together, and likewise the copper poles; then use the battery as two large cells of four times the surface. If you make cells of strong unglazed brown paper (fasten the edges with sealing-wax), you will find them much better than drain-pipe for magnetic effect. Two sheets of copper 10 in. by 6 in., paper cells and zincs 6 in. by 2 in., the copper being outside, will work the magnet with 25 yds. wire. —J. SUTCLIFFE.

[46042.]—Lathe-Bearings.—Your mandril was warped when undergoing the process of hardening, and the way that I would deal with such a case would be to "lead-lap"—that is, there is a wheel with a lead rim, revolving by a strap or gut band on a pulley, on its spindle, from any convenient overhead motion. This lead rim revolves in a trough of tin, containing either very fine flour emery, or, preferably, "hone-dust" and oil, and the mandril is revolving (of course, centered up in another lathe) in the opposite direction, the lap being fed up gently to its grind by means of a slide-rest to which it is attached. —J. J. A., Liverpool.

[46043.]—Cylinder Pistons.—I assume that your engine is a horizontal one, and, I would say, to put in six additional piston-rods, with their attendant paraphernalia of guides and stuffing-boxes, merely to take the weight of the pistons off the "sides" (not the bottoms) of the cylinders, to have these always in motion, to keep in good order, and to eat themselves up by the increased loss by friction of so many parts in constant motion, would be infinitely worse, and cost infinitely more in the long-run than the reboring of the cylinders. —J. J. A., Liverpool.

[46043.]—Cylinder Pistons.—It is a well-known fact that the cylinders of large horizontal engines, having the piston-rod passing through the front cover only, soon wear oval, because the weight of the piston is not properly supported. To remedy this, the piston-rod is often made to pass through both front and back covers, and sometimes, also, a single guide is fixed, and a crosshead or sliding-block secured to back end of the piston-rod. This last is the best arrangement, especially if the back slide block can be adjusted to compensate for the wear. You could not do better than adopt it. —LABOR OMNIA VINCIT.

[46045.]—Battery for Heating.—You may allow one quart cell, Bunsen's, for each inch platinum wire you wish to keep red-hot: four cells for 4 in., eight cells for 8 in. piece of wire. A large cell will keep 1½ in. or 1 in. thick wire red-hot, and a smaller size, perhaps, ½ in. to 1 in. thin wire. —J. SUTCLIFFE.

[46049.]—Time by Electric Current.—"Synchronism" should write to the General Post-Office, St. Martin's-le-Grand, where all information will be given. If the time once a day (10 o'clock, a.m.) will suffice, it is a simple matter, as the same is telegraphed to most of the local post-offices. But if the time every hour is wanted, the Post-office authorities can put you in communication with those who can work this out. Of course the latter would be much more expensive than the former. —GIMEL.

[46050.]—Engine Query.—To "SUNLIGHT."—To save valuable space, I would refer you to description and illustrations at page 480, Vol. XXXI., and page 286, Vol. XXXII. The latter one would be about the right dimensions, the former being too short in the length. You would need, also, the lamp for it, which is illustrated at page 456, Vol. XXXII. The boiler in this latter Vol. is the best form, and would be found to get up, and maintain, the steam far best. I am, of course, assuming you want it for a model boat. As to the cylinder, I should certainly prefer one to two cylinders, that is, as far as the economical use of the steam, the best. But the engine does not start so well, and may stop in the centre. Your

pair of inch-bore engines have a piston area of .7854 square inches each, whilst a single engine, 1½ in. bore, would have 2.074 square inches; and that is the size I should advise you to use as a single engine; you would get more power from it than from the pair of 1 in. cylinders, and use less steam. Carry a good pressure of steam. Throw the exhaust steam into the funnel, having it placed into the funnel so that it enters at the bottom, and, passing up to about the level of the top of the shell, it would act as a heater, utilising the waste heat of the furnace, and, at the same time, preventing the condensed water being so thrown out when running, as the hot exhaust-pipe reconverts the condensed water into steam, and thus gives additional volume to the exhaust, with an increase of draught. Not that the draught so much helps the fire as if coal were burnt; but that, by keeping up a good flow of air past the lamp-flame, it burns better, and also prevents the stagnation of the exhausted gases of combustion against the boiler-plates. Try this form of boiler-lamp and exhaust, and you will find it highly satisfactory. —SUNLIGHT.

[46051.]—Muriate of Zinc Solution.—This is made by dissolving zinc, or its oxide, in hydrochloric acid. Evaporate this solution to dryness, and redissolve in pure distilled water: you will then have a neutral solution of chloride of zinc. According to Kramers, solutions of the following specific gravities have these strengths:—

Sp. gr. at 19° C.	Quantity of ZnCl ₂ in 100 parts water.
1.331	16.7
1.2714	38.8
1.3677	56.3
1.5338	92.4

—F. BARKER COOKE.

[46053.]—Windmill.—If "E. F. C." will write to me at Cobb Court, Cootham, Pulborough, Sussex, I shall be pleased to give him any information respecting the horizontal wind-engine, which I used for ploughing many years at Bawrick, in Sussex, from 1844 to 1848. —PHILIP VALLANCE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last F. B. Cooke has replied to 45392, 4 421; A. W. Soward, 45843; Lockstitch, 45573; S. R., 45759.

- 45460. Model Paddle Steamer, p. 337.
- 45476. Rifle Barrels, 337.
- 45481. Heating Power of Dynamo, 337.
- 45482. Fusible Fluxes, 337.
- 45490. G. and S.W.R. Engines, 337.
- 45501. Stand for Sextant, 337.
- 45685. Picture Frames, p. 433.
- 45698. To "Jack of All Trades," 433.
- 45672. Balloon, 433.
- 45676. Colar Gold Fields, 434.
- 45681. Church Bell Hanging, 434.
- 45684. Wood-Engraving Machinery, 434.
- 45696. Ornamental Glass Work, 434.
- 45697. The Cope and Natta, 434.
- 45702. Yacht, 434.
- 45708. Dynamo-Machine, 434.
- 45707. Cut Crystals, 434.
- 45711. Rotary Drill Machine, 434.
- 45724. Gramme Dynamo Machine, 435.
- 45730. T. Silver Engravers, 435.
- 45732. Japanese or Chinese Kettle, 435.
- 45733. Whiteness Zinc, 435.

The Recent High Barometric Pressure.—In connection with the recent high barometric pressure, some noteworthy phenomena have occurred. Thus, at Antibes (a seaport in the South-east of France), the sea level was depressed about a foot, laying bare portions of shore over which boats can usually sail, and exposing surprised seals and other marine animals to the direct rays of the sun. This continued about a fortnight, and is attributed by M. Faye to the high air-pressure. Again, General de Nansouty reports from the Observatory at the top of the Pic du Midi that the lowest temperature there this winter has been only —5° C., and during the recent high pressure from January 8 to 20, the air being in a state of exceptional purity, temperatures as high as 26° C. were registered. The highest at Bagueres-de-Bigorre is considerably short of this, so that we have here an inversion of temperature with altitude. The General states further that from the 1st of January the zodiacal light was distinctly made out: probably this has never happened before in our climates, so near the winter solstice. Once more, the General and his assistants, on January 20, at 6.30 p.m., saw distinctly the earth-shine on the moon and the thin crescent, though only 25½. 46m. old.

QUERIES.

[46061.]—**Model Engine.**—Could any kind reader give me the size and description of a boiler that would be necessary to drive cylinder 1½ in. bore 3½ in. stroke, and weight of flywheel for same?—MECHANIC.

[46062.]—**Fireclay.**—Will Mr. Fletcher say what proportion of solution of silicate of soda should be used with water in mixing fireclay for making or repairing stove linings? Or is it best to use the silicate undiluted—that is, as received from the soapworks?—J. N. D.

[46063.]—**Carbon Bisulphide.**—Does this liquid change after being exposed to sunlight for a length of time? If so, what are the changes which take place?—NEVICK.

[46064.]—**Estimation of Carbonic Anhydride.**—Will some chemical reader suggest some method of estimating the amount of CO₂ contained in a mineral which contains only two or three per cent of CO₂.—GEOLOGIST.

[46065.]—**Rochelle Salt.**—Will "Analyst," or some other chemical reader, inform me how to estimate the amount of potassium and sodium in Rochelle salt by means of standard silver solution (a deci-normal one)? The process of the final point in the reaction I can manage; but how is it possible to calculate, from the silver nitrate used, how much sodium and potassium are contained in the salt? Please state in ordinary arithmetic, as algebraic equations cannot be understood by—IONORAMUS.

[46066.]—**Furnace.**—I am thinking about building a furnace to melt about 5 cwt. of metal. Will someone kindly give dimensions?—will common building-bricks do for the outside wall?—A WOULD-BE MOULDER.

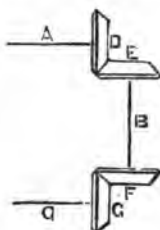
[46067.]—**Lifting Press.**—Will some reader tell me how quickly four pumps, with a 1½ in. ram, ought to lift a press with a 6 in. ram. It has to rise 3 ft., and it goes very slowly, four pumps making 40 strokes each in one minute.—ONE WHO NEVER KNOWS.

[46068.]—**To Alfred H. Allen.**—Would this gentleman kindly favour me with answers to the following, in reference to refined copper?—Best method for the estimation of the copper, detection and estimation of sulphur?—Hampe's method for the estimation of suboxide?—CUPRIC.

[46069.]—**Automatic Arrangement.**—To Mr. LANCASTER.—I am greatly obliged to you for your answer (No. 45882). The drum would answer my purpose admirably, one revolution every three hours being about what I require—i.e., from six o'clock to nine a.m. I shall be glad, therefore, if you will give the further information you so kindly promised.—MORES.

[46070.]—**Air-Gas from Gasoline—Small Generator for Laboratory Use.**—I simply pass in air by an open pipe dipping below the liquid, but with fast working, cold produced checks supply. Can anyone assist me?—ENQUIRER.

[46071.]—**Mechanical Question.**—A and C are



two shafts, B an intermediate shaft, D and E are two bevel wheels of different sizes, F and G another two, the same as D and E. The shaft C is to turn twice for once of A. Find the number of teeth in each of the wheels (not by algebra, if possible).—A. B.

[46072.]—**Wheels and Pinions for Clock.**—Would some correspondent kindly tell me through the columns of "ours" the number of teeth for the wheels and pinions for a four-legged gravity regulator?—A NOVICE.

[46073.]—**Chiming Clock.**—I have a long case eight-day clock; I wish to put the Westminster quarters to chime on gongs. Would some kind correspondent kindly tell me the length and substance of the wire to use to get the notes from, and also the numbers of the teeth for the wheels and pinions?—A NOVICE.

[46074.]—**Dark Slide.**—To Mr. LANCASTER.—Would you kindly inform me through the "E. M." how to make your dark slide to fit the Merveilleux camera?—E. H. EPES.

[46075.]—**Manganese in Steel.**—Will any reader be kind enough to inform me what is the usual degree of richness of manganese ore used in manufacture of steel? Also where and in what industries it is most used?—J. EDGAR.

[46076.]—**Governors.**—I want to put governors on my 1-h.p. engine. I want her to run at 120 revolutions per minute. What weight of balls, length of arms, and size of pulleys? Also, what is the best kind of throttle-valve, easiest to get out of order? My engine is 3 in. bore 6 in. stroke, supplied with steam with a ½ in. bore iron pipe.—WOOD TURNER.

[46077.]—**Enamel Paint.**—Can any reader tell me how to make and apply the white enamel paint such as seen on the inside of copper boxes? I think it is impervious to acids.—E. W. M.

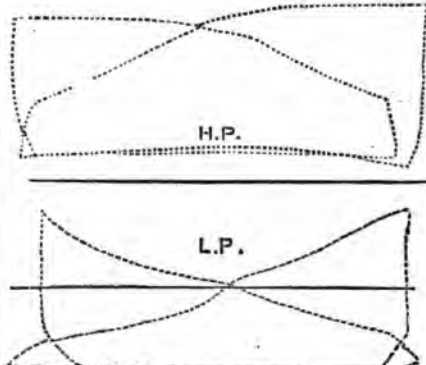
[46078.]—**Shrink on Yarn.**—Could any of your numerous readers say how to say what per cent. to allow for shrink caused by the twist given to cotton or linen yarn? As, for example, suppose a yarn got eight turns

per inch, what would be the shrink on, say, 100 in. 1?—AMATEUR.

[46079.]—**Oiled Cloth, &c.**—Can anything be done to, or recent articles made of oiled cloth becoming sticky when laid aside, or to restore them when they have so become sticky?—J. F. H.

[46080.]—**Boring in the Lathe.**—What is the best means of fitting the Morse twist-drill in a 5½ in. centre screw-cutting lathe, and what is the largest hole this drill will bore by the Morse drill?—FARMER.

[46081.]—**Engine Diagrams.**—I inclose set of diagrams of our engines, and I want "Labor Omnia Vincit," or other of "ours," to advise me how to reduce the back-pressure; we think it far too great. Is there too much lap on low-pressure valve? Dimensions are as follows:—H. P. cyl., 20 in. dia.; L. P. cyl., 35 in. dia.,



4 ft. stroke; speed 45 rev. per minute; boiler-pressure, 62 lb.; cranks at right angles; cut-off valves on H.P., worked by two eccentrics, and adjustable by wheel outside valve-box; L. P. plain slide-valve; ordinary throttle-valve; there is a receiver between the two engines, 6 ft. long by 2 ft. dia. Will some of "ours" kindly give advice on the above? The ordinary load is 250 h.p.—ALPHA.

[46082.]—**Driving Smith's Fan.**—I want to make a small engine and boiler to drive a smith's fan. The fan is 14 in. diameter, and is at present blown by hand with a pole, bellows fashion, and gives a good wind, but is rather hard work. Would an engine 1½ in. bore and 2 in. stroke be large enough; and about what speed would it run at? Please tell me the dimensions of boiler, and thickness of plate-iron for the same. Also, size of rivets, and distance apart of the holes. Should be glad of description of the simplest and most economical boiler for a country blacksmith to make. I can easily make the engine, but have never made a boiler.—HOT IRON.

[46083.]—**Tanah-Ampo.**—What is this, and what is its composition? I understand that the natives of Java use it as food. Is it so?—JAVA.

[46084.]—**Boiler.**—I am making a small horizontal steam-engine; size of cylinder, 2 in. bore, 3½ in. stroke. I want a boiler to work it. I may add I intend the engine driving a lathe 3½ in. centre. Would someone advise as to best kind of boiler I could have to work it, stating size of boiler, and what pressure of steam I should require, and if it would be possible to heat the boiler with gas, or would it be better to use coke or coal? Also please inform me of the best material to use in putting on cylinder ends and steam-chest of my engine. I think there is a composition better than white-lead; and what do you use to pack the stuffing-boxes of steam-chest and cylinder with?—TYRO.

[46085.]—**Coco.**—Where does this plant grow, to what height, and is it plentiful? I understand that the underground stems are sometimes substituted for potatoes and yams. Is it so?—COCO.

[46086.]—**Midland Railway.**—Will "C. E. S." please tell me what the name of safety-valve is over the manhole on the Midland engines, and what it is pressed at?—H. P.

[46087.]—**Air-Pump.**—To "LABOR OMNIA VINCIT."—Having to put some pipes to air-pump for condenser, would it be best to put them in with fall to the pump, or fall to the well?—FISHER.

[46088.]—**Solubility in Alcohol.**—Will some reader say to what extent carbonate of soda and carbonate of potash are soluble in alcohol, and whether methylated spirit would dissolve any greater quantity than alcohol? Is there any table published, giving the solubility of the different salts in alcohol?—CHEMICAL STUDENT.

[46089.]—**Muffle Furnaces.**—Will some reader inform me if it is possible to make a portable muffle furnace? It is only wanted occasionally for refining gold and silver. If portable ones are not to be had, which are of the most service for refining the above metals?—DENTIST.

[46090.]—**Spectroscope.**—I wish to try some elementary experiments with the spectroscope; but there is no gas within five miles. What kind of burner should I use? Is there any book that would help me?—C. R. T.

[46091.]—**Mechanical Law.**—What law in mechanics accounts for the sudden reverse motion in a circular top when the edge of the disc touches the table?—C. R. T.

[46092.]—**Gas from Oils, Fat, &c.**—Will some kind reader state how to make gas from the above? I am told it would require no purifying or scrubbing, while giving a better light than coal-gas.—DERBY.

[46093.]—**Gun-Barrel Staining.**—Would some of "ours" kindly tell me how to stain barrel of fowling-piece?—MOSSVALE.

[46094.]—**Paper Negatives.**—Can any reader give me any practical information as to how to take negative on Morgan's, or other paper, direct in the camera, with explanations for fixing the paper best in slide, and printing from it?—F. C.

[46095.]—**Preserving and Arranging Fossil Shells.**—I have a good many fossils, chiefly from the London clay and kindred formations. Some of these are shells, and others vegetable remains. Of these, the shells after a time decay, and among the vegetable remains some break out into crystals, having a taste like common writing-ink, and then go to powder. I have also had impressions of leaves, but these disappear in a very few days. Now, would any of your readers kindly tell me if there are any compositions that would remedy this? And, also, what is the best way to arrange fossil shells in a collection?—MOLLUSCA.

[46096.]—**Iceland Spar.**—How is Iceland spar ground and polished?—E. H.

[46097.]—**Photography.**—I have a 9 in. condenser, and I want to enlarge on Morgan's paper by means of a lantern, from half-plate negatives. Can I do so with my single condenser, or must I get another the same size and place the two together? Any information would oblige, and is there any work which would give me full information about the lantern and condensers?—G. B.

[46098.]—**N. B. Railway.**—Would your correspondent, "Carstairs," or some other, give the gradient between the Queen-street Station, Glasgow, and Corlairs Station, and the distance between the two stations? I have heard that all trains have to be hauled up this incline by a wire rope attached to a winding engine at Corlairs.—E. L. P.

[46099.]—**Bronzing Brass.**—I should feel obliged if any reader of "ours" would inform me how I could get a good steel-bronze surface on brass?—VITAL SPARK.

[46100.]—**Lever Escapement.**—I have a lever escapement that misses looking on the short, and at the same time looks fairly well on the long, pallet. Will some one tell me how to alter the pallet stones?—LOD AND DRAW.

[46101.]—**Things Suitable for Emigrant.**—Could any reader kindly say what would be a suitable outfit for a young man going out to Western Canada, as a servant to a cattle-raiser? Any hints would oblige.—ROCKY MOUNTAINS.

[46102.]—**Facing Plates.**—I have 30 plates, 30 in. by 5 in., with an inch strip all round to be faced up, and have no planing machine or lathe large enough for them. I thought of grinding them until I got through the skin, and then finishing with file and scraper; but find, when done with grinding, the surface is very lumpy and uneven. Is there anything I could rig up to assist in making a better job?—FITTER.

[46103.]—**Hard Steel.**—I got a bottom for pottery moulds to turn up. They are of hard cast steel, about 6 in. diameter, by 3 in. thick. I could not get a tool to touch them, so I softened one and finished it; but it all cracked in hardening. What is the cause of this? Can I do anything to make the tools cut it without softening?—FITTER.

[46104.]—**Fairlie Engines.**—While travelling in Mexico, I was much impressed with the great size of the Fairlie (English) engines used in the mountain divisions of the Veracruz (Mexico) line, and with the power developed. These engines, which have four cylinders and 12 driving-wheels, haul a train of six or eight coaches each as long as an American railway coach, though much lighter, to a height of 8,000 ft. above the sea, traverse curves of very short radius, and start up a grade of 1 in 100. Can any correspondent furnish information of the dimensions of these engines, and some record of the performance?—J. W. BARNEY, Providence, R. I., U. S. A.

[46105.]—**Power from Falling Weight.**—I want to drive a light-running Wheeler and Wilson machine by means of a falling weight. Will someone kindly help me, and advise as to particulars, stating the weight required, and the method of transforming its motion into a rotary one of sufficient speed to drive the above? I have an available drop of 35 ft., and want the arrangement to work, if possible, with only one winding-up per day, the machine to run from 9 a.m. to 6 p.m. continuously. Should the motion of the weight be transmitted directly by means of a rope and single pulley to revolving drum, the speed of which is multiplied afterwards by gearing or otherwise? or should the motion of rope be increased before it comes on drum, by suspending the weight by means of two or three pulleys? In either case, will not a fly be required to moderate the speed at which the movement runs? Should rope, gut, or chain be used for suspending weight, and what size would be necessary? If cogged gearing is to be used, state what pitch and breadth of teeth would give sufficient strength.—GRAVITY.

[46106.]—**To "Sunlight."**—I have an engine cylinder 1 in. bore 1½ in. stroke, what form and size of boiler would you suggest? What power, working at 15 lb., could I use to drive a foot-power fret-saw? Kindly state how to make boiler-test.—C. HOWARD PHILLIPS.

[46107.]—**Indigestion and Gallstones.**—Dr. Edmunds' article on Diet, &c., in the number of the ENGLISH MECHANIC for Jan. 27, interested me very much, as I had been a great sufferer from the severest form of dyspepsia, accompanied at times during the last few years with an obstruction in the gall-bladder. If Dr. Edmunds would kindly give me some advice as to the best diet, &c., to prevent a recurrence of this most painful and dangerous complaint, I should be very grateful. I am 46 years of age, and have been subject since I was seven years old to rheumatism, and have had several attacks of rheumatic fever, besides many other short attacks of rheumatism. I am thankful to say that in the intervals between the attacks my joints are entirely free from swelling, &c., and my heart is sound, but of weak action, although during three of the fevers the doctor thought it was affected. I lead an active life, never touch spirits or liquors, but occasionally have one glass of whisky daily.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, FEBRUARY 24, 1882.

COMPOUND AND FOUR-CYLINDER LOCOMOTIVES.

WE mentioned last week, p. 564, that Mr. Webb's new compound locomotive had been tried, and had given satisfaction—so much so, we now learn, that the designer intends to repeat the experiment. On p. 102 of this volume, we referred to what had been done by M. A. Mallet on the Continent with the compound principle applied to locomotives, and to a novel type of self-balanced engine, built in the United States from the designs of Mr. H. F. Shaw. The latter engine, which has now been running some time, is not a compound, but a four-cylinder locomotive, the cylinders being so arranged that the reciprocating parts are almost perfectly balanced. The object is merely to attain high speed without damaging the road and setting up excessive racking strains in the frame of the engine. On p. 464, we gave a few details of a new type of express locomotive for use on the Central Railroad of New Jersey, which may be taken as an example of the degree of perfection to which American engineers have attained. In this country, where the weight of passenger-trains tends to increase, and where at present there is no desire to travel at 90 miles an hour, the problem to be solved is how to construct more powerful locomotives without having more weight on a pair of wheels than the road can carry with economy, and while keeping up the speed reducing the coal-bills. Mr. Webb has endeavoured to solve this problem by utilising the compound principle, and it would seem that he has also settled the vexed question of coupled v. single drivers, for the high-pressure cylinders are connected to one pair of drivers, while the low pressure cylinder works another pair. Thus it will be understood Mr. Webb obtains the effect of coupling, so far as adhesion is concerned, without the disadvantages of the coupling-rods. He acknowledges that he has been enabled to do so much without complication by means of the valve-motion patented by Mr. D. Joy, which we described on p. 611, Vol. XXXI., and which dispenses with the eccentrics—rather troublesome contrivances unless there is room to give them tolerably wide bearings. The new engine has been named "Experiment," and after running from Crewe to Euston as assistant, made the first round trip to Holyhead and back with the Irish mail, 528 miles, keeping steam up to blowing-off point all the way, and consuming only 23·54lb. of coal per mile for the whole trip including the preliminary firing. Mr. Webb says the bearings were as cool at the finish as at the commencement of the trip, and remembering that the engine had only 80 minutes' rest at Holyhead, it must be conceded that the performance was a remarkable one. While there is nothing like a practical trial to test the merits of a locomotive, or, in fact, any other engine, there are many points that can be examined and digested on paper; and to start with there is a theoretical gain in passing steam through two cylinders. The advocates of the single drivers contend that they burn less coal than the coupled engines, while the advocates of the latter type affirm just as stoutly that the advantage is really with the

engines having four or more coupled wheels, because they do not slip, and consequently do not throw away steam, and at the same time shake the fire to pieces. Comparing Mr. Webb's compound with the ordinary four-coupled type of passenger engine, we have on the one side the extra friction of an additional cylinder and its accessories as a set-off to the two coupling-rods, and the frictional resistance of the latter must be less than that due to an entire engine, which the additional cylinder of the compound practically represents. However, as the new engine is similar in its general features to the four-coupled type, a comparison can be readily made when a little more experience has been gained. The high-pressure cylinders are 11½in. in diameter by 24in. stroke, and are placed outside just in front of the leading drivers. Single-slide bars of square section are used, the piston-rod head being as it were suspended from them, as in some well-known types. The connecting-rods are connected with the trailing drivers. The low-pressure cylinder is placed just beneath the smoke-box, and is 26in. in diameter by 24in. stroke, the connecting-rod working a crank in the centre of the axle of the leading drivers. The exhaust from the high-pressure cylinder passes into an intermediate receiver and then through a coil of copper pipe in the smoke box to the valve-chest of the low-pressure cylinder. It is thus reheated and dried to a certain extent. It will be readily seen from this description that the two sets of driving wheels are independent of one another, and the question will naturally arise, What effect will slipping of the high-pressed or trailing drivers have upon the leading drivers? The answer appears to be that practically the drivers balance one another. If the wheels connected to the high-pressure engine slip, more steam is sent into the receiver than the large or low-pressure cylinder can take, and the back-pressure increasing, checks or stops the slipping; if, on the other hand, the single-engine slips first, which is scarcely possible, it will be in a position to take more steam than is passing through the high-pressure cylinders—in fact, will cease to slip for want of pressure. The two sets of drivers in effect mutually counter-act any tendency to slip, and yet run quite independently of one another. Whether the low pressure acts as a brake on the high pressure, or the latter act as drivers to the single engine cannot be determined until a number of experiments with diagrams are made; but the facts above mentioned, which are given by Mr. Webb himself, show that the engine runs very economically on coal, for we may assume that the Irish mail was a fairly heavy train. It must not be overlooked, though, that the use of a third cylinder adds to the wear and tear, and introduces a consequent increase in the cost of lubrication and repairs, while the first outlay is necessarily greater. The advantages of the new device may however be sufficient to outweigh the disadvantages, and though the designer is himself unable to answer the question definitely, it is clear from what he has said that he thinks the innovation a decided improvement.

The Shaw locomotive, which is praised highly in the United States for its steadiness, is, as mentioned above, a four-cylinder engine in which the cylinders are so arranged that an equal amount of force is applied on both sides of the locomotive at the same time. The two cylinders are of such area as to give the equivalent of the single cylinder, the sole object of the designer being the most perfect degree of balancing possible, with a view to running at high-speeds on the not altogether first-class road-beds, so common in America. That the action is well-balanced may be gathered from the fact that an engine raised on four jack-screws, and supported solely by them, has been run at

a speed of 275 revolutions per minute, without disturbing its supports, and on the road has accomplished several miles in 58 seconds each. Comparing these two engines it may be asked whether, if the compound system is really advantageous in locomotives, the best results would not be attained by a combination of the devices of Messrs. Webb and Shaw. The cylinders might be arranged, for instance, so that one pair of drivers would be actuated by the high-pressure engine, while the other pair would be driven by the low-pressure engine, and it might perhaps be possible to contrive that the stroke of one pair should be in the opposite direction to that of the other pair. If, further, both pairs could be supplied with steam from the boiler when required, as M. Mallet has insisted is absolutely necessary in a successful compound locomotive we ought, theoretically, to have the most powerful, economical, and steady engine that it is possible to make. That Mr. Webb has used only one low-pressure cylinder of rather large diameter (comparatively speaking) may be due to the fact that he saw a difficulty in getting two within the frames, or that he thinks one sufficient for all beneficial purposes. We shall probably hear a full explanation at one of the meetings of the Institution of Mechanical Engineers, as soon as the new engine has been fairly tested in practice; for it is obvious that so important a departure—it may be an improvement—in locomotive practice is sure to create the liveliest interest amongst engineers.

REVIEWS.

Commercial Organic Analysis. By ALFRED H. ALLEN, F.I.C.; F.C.S., Lecturer on Chemistry at the Sheffield School of Medicine, &c. Volume II. London: J. and A. Churchill.

WE must congratulate Mr. Allen on the appearance of the second volume of his unique work on the analysis of organic products. Those of our readers who are interested in the subject have long been aware that the volume was in preparation, and many will have perused the extracts from advanced sheets which we have published in several recent numbers. Mr. Allen is so well known as an authority on the difficult subject of proximate organic analysis, that a collection of reliable processes arranged by him and enriched by the results of his own researches is certain to have a peculiar value and interest. The volume now under notice is divided into five main sections or chapters, each of which is almost wholly complete in itself; and this naturally suggests the question whether it would not have been in some respects a preferable plan to have published these sections in separate covers as monographs. In the chapter on "Hydrocarbons," the author gives a mass of valuable details respecting the assay of petroleum, benzol, anthracene, &c., and these sections, as also the one on aniline oils, will probably prove invaluable to the tar-distiller and gas manager. The chapter on "Fixed Oils and Fats" appears to have been written with great care, and forms the most complete account of the leading commercial oils which we have hitherto met with. Although the difficulties inherent in the scientific treatment of such a subject have evidently been felt by Mr. Allen, he has succeeded in surmounting very many of them, and has supplied that long-sought-for desideratum—a reliable work on the analysis of oils. The two following chapters are devoted to "Sugars," and to "Starch and its Isomers," and in these cases also the author has succeeded in collecting and arranging a mass of information not to be found in any other single work. The analytical data are not limited to cane-sugar, full instructions being

also given for the technical examination of brewers' glucose, honey, and malt. The chapter on "Alkaloids" contains a very full description of the analytical characters of the cinchona bases, with a detailed description of the methods of assaying quinine bark. Opium bases are also very fully treated, and the same remark applies to strychnine. The accounts given of some other alkaloids are very insufficient, and, in some cases, the space might as well have been saved altogether. We do not hold this view, however, of the section on the Basic Derivatives of Aniline, which contains a short but clear and valuable description of the nature and characters of the various aniline dyes. These are the only colouring matters treated of in the volume, the author holding that most dyes have already been adequately treated by Calvert and other authors. Apart from the fact that Calvert's work is not very recent and is now out of print, we think the omission a matter for regret, and trust that the author has merely "postponed their consideration till a demand shall arise for an additional volume, or for a second edition of those already published." That such a demand will arise we cannot doubt. Mr. Allen's book already occupies the position of a standard work on a subject on which very few have written, and the constant changes and improvements made in the mode of manufacture, and consequent methods of examining commercial organic products, will afford him ample employment in the future. Mr. Allen's second volume considerably exceeds the first in size. It is very clearly printed, and the use of displayed type and an unusually copious index render reference an easy matter. The volume is calculated to add greatly to the reputation of the author, and will certainly be welcomed by all who have occasion to analyse organic products.

Physics of the Earth's Crust. By the Rev. OSMOND FISHER, M.A., F.G.S. London: Macmillan and Co.

THE physics of the earth's crust has always been a subject of much interest to geologists, physicists, and even chemists, perhaps because, owing to the absence of trustworthy data on many points, it is open to much speculation and theorising. Although Mr. Fisher applies to the solution of various questions in physical geology, a simple mathematical reasoning and quantitative treatment with the view of answering them negatively, if not positively, his work may be fairly described as a most readable and interesting book for those even who cannot follow him when he uses formulae, and it certainly justifies his modest hope that it will not be without value in advancing the study of the Physics of the Earth's Crust. The title of the book shows that the author opposes the hypothesis of solidity put forward by Sir W. Thomson, and he asserts that any physical hypothesis regarding the condition of the interior of the earth may be tested by comparing the average height of the elevations it would produce with that which is found to exist. It seems obvious at first sight that deep shafts and bore-holes, shallow as they are, compared to the earth's radius, ought to throw some light on the question, for if the centre is still fluid, we may fairly suppose that temperature would increase the nearer we get to that centre. Although there are several points to be considered before we can accept such a test as proving incontrovertibly the fluid condition of the earth's interior, and as a matter of fact, such borings as are available have not always yielded uniform results, it is probable that if we could eliminate the effects of local conditions, the observed rates of increase of temperature would be found to be tolerably uniform, and very near the old assumption of one degree Fahr. for every 51ft. of depth.

It is true that the rate has been found to decrease towards the bottom of some bore-holes, and it has been asserted that at a depth of 5,000ft., the increase of temperature would cease; but the author gives reasons for believing that some of the observations in which a diminution of the rate of increase of temperature has been noticed have been vitiated by the disturbance of the column of water in the borehole by convection currents. Nevertheless, he does not suppose that the law of equable increase of temperature can hold good for all depths, for, if it did, we should have at the depth of from 200 to 400 miles temperatures which have been assigned to the sun himself. Still, he thinks that the equable law may be so far depended on as to lead to the conclusion that at a depth of 30 miles the temperature is so great that the rocks would melt. On the other hand, he acknowledges that if it could be conclusively proved by observation, due allowance being made for disturbing causes, that the rate began to diminish, it would be an argument in favour of the earth being a solid cooling by conduction from its entire mass, and not from an internal liquid reservoir. The shortest age that can be assigned to the world's history is, however, too long to allow us to expect that the depth requisite to put the question to the test can ever be reached. Besides the comparatively cold solid centre, and the intensely hot fluid interior, there is another hypothesis which makes the centre of the earth "potentially fluid," that is, it is solid in consequence of the pressure, but is ready to become fluid on account of its high temperature whenever the pressure is relieved. That is the gist of the controversy which the work before us is an effort to settle. Sir W. Thomson contends that unless the earth as a whole were extremely rigid, the solid crust would yield so freely to the deforming influence of the sun and moon, that it would simply carry the water up and down with it, and there would be no sensible rise and fall, which we call tides. Mr. Fisher, however, says that it does not appear necessary that the earth should be absolutely solid from the centre to the surface to satisfy the requirements of great rigidity as a whole, and he asks whether the hypothesis of a rigid nucleus nearly approaching the size of the whole globe, covered by a fluid substratum of no great thickness compared to the radius, upon which a crust of lesser density floats in a state of equilibrium, will not satisfy the known conditions, and he says that such an hypothesis best answers the requirements both of geology and physics. The nucleus owes its solidity to the enormous pressure of the superincumbent matter, while the crust owes its solidity to having become cool; the fluid substratum is not under sufficient pressure to be rendered solid, and is sufficiently hot to be fluid. The mean density of the earth is known, as well as the surface density, but the actual densities of the layers down to the centre can not be ascertained. Waltherhausen put forth an hypothesis in which he expressed the downward increment of density by the increment of the heavy bases as found by chemists. Waltherhausen calculates the density of the earth's centre at 9.57, and the pressure at about 2,500,000 atmospheres. Laplace's law of density makes the pressure 3,000,000 atmospheres. Earthquakes and volcanic eruptions give evidence of the state of some parts of the earth's interior, and we find the energy necessary to produce those phenomena in gravitation and the heat stored up. The great lateral compression observed in the stratified rocks is explained by the supposition that the earth has contracted through secular cooling. The author has calculated what this lateral pressure would be, supposing the interior were to shrink away from the crust of the earth, and he finds

that it amounts to the weight of a column of rock of the surface density, of the same section as the stratum, and 2,000 miles long, or about 830,200 tons upon the square foot. Such a pressure as that would be abundant for the purpose; but as that is no proof that the work has been accomplished in that way, Mr. Fisher proceeds to define what he terms the "upper datum level" and the "lower datum level," that is the upper and lower surfaces of a smooth crust. If we assume the earth to be solid—no fluid substratum beneath the crust—it is clear that all the inequalities which compression would produce would be in the shape of elevations above the upper datum level. The existing inequalities, if levelled down and spread out, Mr. Fisher says, would form a layer of 9,500 to 13,000ft. thick over the whole earth, and that estimate is not, he says, likely to be too large. Taking Sir W. Thomson's loss of the temperature within the earth, if it be a solid cooling by conduction, and comparing it with Mr. Mallet's experiments on the contraction of silicious slags cooling from a state of fusion, he finds that the inequalities formed by the hypothesis of a solid cooling by conduction would make a layer not exceeding 900ft. in thickness on the most extravagant supposition, whereas the actual inequalities would make a layer 10,000ft. thick. The hypothesis is, therefore, he considers, untenable. The author does not accept the view that water gains access to the heated springs of a volcano by means of fissures, or by capillary absorption; but he holds that in the fluid substratum underlying the crust, there still exists an intensely hot layer of water—dissolved silicates, in a state of igneous fusion, which is ever ready to furnish the steam, gases, and ejectamenta of the volcano. As a rough estimate, Mr. Fisher takes the thickness of the earth's crust at an undisturbed part as 25 miles, and he explains how, in the event of lateral compression, ridges would be formed with depressions on each side, the depression being greatest on the steeper side of the ridge. The argument followed out, leads to the conclusion that the crust beneath the ocean is denser than it is at the margin. The existence of the roots of the mountains ought, says Mr. Fisher, to be revealed by phenomena of underground temperature, for whether the crust be thick or thin, the temperature of its under surface is the melting temperature, consequently any difference in the rates of increment of temperature found on descending at different localities will indicate, as a measure, the thickness of the crust at those spots. These so-called roots of the mountains being depressed into the fluid substratum, would be gradually melted and spread underneath the crust, an hypothesis which accounts for the order of succession in which different kinds of lava have been erupted. The theory of mountain roots also explains the fact that ejections in regions lying upon opposite sides of a mountain chain appear to have come from different reservoirs of molten rock. This theory of mountain roots, in fact, offers a satisfactory explanation of five classes of phenomena—viz., the support of the mountains themselves, the apparently insufficient attraction of the Himalayas, the slower increment of temperature beneath mountains, the gradual elevation of a tract concurrently with its denudation, and the natural sequence of volcanic rocks. Volcanic cones having no roots to support them, sink and rupturing the crust around them, tend to perpetuate volcanic activity in their vicinity. We have attempted to give some ideas of the views of the author; but as each of his chapters might very easily be developed into a volume, it will be obvious that it is impossible to follow his arguments throughout in the space at our disposal. It is sufficient to say that Mr. Fisher has fairly established a good working hypothesis, and has presented it to the world in a readable

and interesting book which will, no doubt, receive as it deserves, the respectful attention of geologists and scientists in general.

ASTRONOMICAL NOTES FOR MARCH, 1882.

The Sun.

Day of Month.	At Greenwich Mean Noon.			
	Souths.	Right Ascension.	Declination.	Sidereal Time.
	h. m. s. p.m.	h. m. s.	° ' "	h. m. s.
1	0 12 39.82	22 49 16.7	30 26.8	22 36 45.27
6	0 11 24.62	23 7 53.5	35 13.1	22 56 28.03
11	0 10 8.26	23 26 19.3	38 6.1	23 16 10.79
16	0 8 44.57	23 44 38.1	39 52.1	23 35 53.55
21	0 7 15.89	0 2 52.0	18 42.8	23 55 36.31
26	0 5 44.38	0 21 4.2	16 47.1	0 15 19.07
31	0 4 12.30	0 39 14.4	13 38.1	0 35 1.84

The Method of finding the Sidereal Time at Mean Noon for any other Station will be found on p. 390.

At 5 p.m. on March 20th, the Sun is said technically to enter Aries, and Spring is then supposed to commence. This, too, is the date of the Equinox. Spots, facule, and prominences continue to be developed. The Zodiacal Light should now be looked for in the West every evening after sunset.

The Moon

Is Full at 12h. 39.5m. on the night of the 4th, and enters her Last Quarter at 9h. 27.7m. p.m. on the 12th. She will be New 17.2 minutes after noon on the 19th, and enter her First Quarter at 1h. 33.1m. in the early afternoon of the 26th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	11.4	9 56.1 p.m.
6	16.4	12 44.8 "
11	21.4	4 35.7 a.m.
16	26.4	9 15.3 "
21	2.0	1 49.6 p.m.
26	7.0	6 18.7 "
31	12.0	10 1.3 "

* After the midnight of the 5th.

The Moon will be in conjunction with Mercury at 5 p.m. on the 17th; with Venus at 4 a.m. on the 20th; with Saturn at 10 a.m. on the 22nd; with Jupiter at 8 a.m. on the 23rd; and, lastly, with Mars at 10 p.m. on the 26th.

Mercury

Is a Morning Star during the whole of March, attaining his greatest Western Elongation (27° 44') at 6 a.m. on the 21st. His south declination, though not very great, is sufficiently so to place him in a somewhat inferior position for observation. His angular diameter decreases from 10.2" on the 1st of the month to 6.2" by the end of it.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ' "	h. m.
1	21 52.7	9 46.3	11 16.1 a.m.
6	21 46.8	11 28.5	10 50.6 "
11	21 51.2	12 19.1	10 35.2 "
16	22 3.5	12 18.4	10 27.9 "
21	22 21.5	11 31.8	10 26.1 "
26	22 43.3	10 4.6	10 28.2 "
31	23 7.9	8 1.1	10 33.2 "

This path lies wholly in Aquarius; but the planet never approaches any star of sufficient size to be visible in daylight.

Venus.

Is an Evening Star, in the sense of passing the Meridian after the Sun; but she is at no great distance from, and sets very soon after, him. She is becoming faintly gibbous, and her

angular diameter, increasing imperceptibly from 9.6" to 9.8", appears sensibly invariable.

Day of Month.	Right Ascension.	Declination	Souths.
	h. m.	° ' "	h. m.
1	22 59.3	8 2.0 S.	0 22.6 p.m.
6	23 22.5	5 35.6 "	0 25.9 "
11	23 45.4	3 5.4 "	0 29.1 "
16	0 8.2	0 33.0 "	0 32.2 "
21	0 30.9	2 0.0 N.	0 35.2 "
26	0 53.6	4 32.2 "	0 38.2 "
31	1 16.4	7 1.9 "	0 41.3 "

Hence, it will be seen, that Venus travels from Aquarius into Pisces.

Mars

Is visible all night long, but is becoming a comparatively insignificant object, his angular diameter decreasing from 11" at the beginning of March to 8.6" at the end of it. A powerful telescope is now required to discern any detail on his surface; but his markedly gibbous form is perceptible with inferior instrumental means.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ' "	h. m.
1	6 4.2	26 21.5	7 26.3 p.m.
6	6 10.7	26 14.3	7 13.0 "
11	6 17.8	26 6.0	7 0.5 "
16	6 25.6	25 56.3	6 48.6 "
21	6 33.9	25 44.9	6 37.2 "
26	6 42.7	25 31.6	6 26.3 "
31	6 51.9	25 16.1	6 15.9 "

The path indicated by the above Ephemeris lies entirely in Gemini. He will be just North of that wide double Star ϵ Geminorum on the night of the 23rd.

Jupiter

Now souths in bright daylight, and is so rapidly approaching the West as to be very indifferently placed for the observer by the time it

is actually dark. His diameter continues to decrease, and, in fact, we may now take leave of him until his reappearance in the autumn. We give an Ephemeris of him for the first third of the month, but it would needlessly occupy space to extend it.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ' "	h. m.
1	3 11.9	17 3.8	4 34.4 p.m.
6	3 15.6	17 17.0	4 17.8 "
11	3 18.3	17 30.7	4 1.4 "

This short arc lies in Aries to the East and South of δ in that constellation.

Our Table of the Phenomena of his Satellites extends to the same date only as our Ephemeris.

Saturn

Has now practically left us for the season.

Uranus

Is an Evening Star, and coming as he does into opposition to the Sun at 4 a.m. on March 7th, with his North Declination increasing, is very well placed for the observer. His angular diameter remains sensibly constant at 4" during the month.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ' "	h. m.
1	11 12.5	5 59.0	12 33.7 p.m.
6	11 11.7	6 4.1	12 13.2 "
11	11 10.9	6 9.2	11 52.7 "
16	11 10.1	6 14.2	11 32.3 "
21	11 9.3	6 19.0	11 11.9 "
26	11 8.6	6 23.7	10 51.5 "
31	11 7.9	6 28.2	10 31.1 "

Hence, it will be seen, that Uranus is travelling slowly away from ϵ Leonis.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	I	Tr I	10	47	p.m.	3	I	Sh E	8	44	p.m.	9	III	Ec R	11	11	50 p.m.
1	I	Sh I	12	2	"	3	II	Tr I	9	54	"	10	I	Tr I	7	16	"
2	III	Ec R	7	9	1.1	4	I	Ec R	6	1	2.1	10	I	Sh I	8	27	"
2	I	Oc D	8	7	"	5	II	Ec R	9	12	56.1	10	I	Tr E	9	29	"
2	I	Ec R	11	32	3.1	9	III	Oc R	6	37	"	10	I	Sh E	10	39	"
3	I	Sh I	6	31	"	9	III	Ec D	9	29	26.1	11	I	Ec R	7	56	46.1
3	I	Tr E	7	30	"	9	I	Oc D	10	6	"	12	II	Oc D	6	54	"

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or from Jupiter's proximity to the horizon.

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.				h. m.			
1	A ¹ Cancri	6	11 22 p.m.	Dark	18	38	12 15 p.m.	Bright.	292	821
2	A ² Cancri	6	12 21 a.m.	S.S.W.	337	16				
2	ω Leonis	6	10 27 p.m.	Dark	31	28	11 37 "	Bright.	274	288
3	14 Sextantis	6	5 59 "	Dark	17	338	6 37 "	Bright.	303	265
4	B.A.C. 3726	6	16 55 "	S.S.W.	338	300				
4	55 Leonis	6	8 59 "	Dark*	359	329	9 31 "	Bright.	308	282
5	ρ Leonis	6	2 17 a.m.	Bright.	88	112	3 24 a.m.	Dark	217	249
9	B.A.C. 4700	6	13 30 "	N. by E.	160	165				
17	ϵ Capricorni	6	14 15 "	Bright.	85	47	5 7 "	Dark	311	274
22	53 Arietis	6	10 10 p.m.	Dark	32	69	10 32 p.m.	Bright.	340	15
23	B.A.C. 1242	6	8 25 "	Dark	109	151	9 22 "	Bright.	253	294
25	B.A.C. 1835	6 $\frac{1}{2}$	5 32 "	Dark	90	91	6 53 "	Bright.	259	282
25	χ Orionis	4 $\frac{1}{2}$	19 47 "	S. by W.	350	31				
29	B.A.C. 2872	6	1 27 a.m.	Dark	89	129	2 22 a.m.	Bright.	231	270
31	14 Sextantis	6	12 55 "	N.N.E.	158	196				

† Near approaches. * But apparently Bright. § Star setting.

Neptune

Is now so far towards the West as to be invisible for the observer's purpose until next October.

Shooting Stars

May be looked for between the 1st and 4th, and again on the 16th.

Greenwich Mean Time of Southing of Eleven of the Principal Fixed Stars on the Night of March 1st, 1892.

Star	Souths.	
	h. m.	s.
α Leporis	6 49	40.56 p.m.
α Orionis	7 10	52.94 "
Sirius	8 1	54.42 "
Castor	8 48	54.91 "
Procyon	8 54	56.78 "
β Cancri	9 31	50.30 "
α Ursæ Majoris	10 12	45.04 "
α Hydre	10 43	18.99 "
Regulus	11 23	30.46 "
α Ursæ Majoris	12 17	43.89 "
δ Crateris	12 34	40.08 "

The Method of finding the Greenwich Mean Time of Transit of either of the Stars in the above List for any other night in March, as also that of determining the instant of its Local Southing at any other Station, will be found on p. 392.

ON THE IRRATIONALITY OF THE SPECTRUM IN ITS RELATION TO THE ACHROMATISM OF OPTICAL INSTRUMENTS.—VI.

By "ORDERIO VITAL."

(Continued from page 512.)

Part III.—Experiments Showing the Counteraction of Secondary and Tertiary Spectra.

66. A PRISM of crown glass, with an angle of $41^{\circ} 11'$, is inclined so as to correct the dispersion of a flint-glass prism whose angle is 68° ; the uncorrected green is towards the vertex of the first prism.

67. The same crown prism is used, but a smaller flint prism, whose angle is $50^{\circ} 28'$, is opposed to it; the uncorrected green is towards the vertex of the second prism.

68. The crown-glass prism, angle $41^{\circ} 11'$, is inclined to correct a flint prism, angle 62° . In this case there is no outstanding colour.

The experiments detailed in Part I. show that different substances produce spectra varying in the proportion of space allotted to each colour; when any two are achromatised, a secondary spectrum is formed, in accordance with the principles explained in the previous pages. The green fringe is always on the same side of the bar as the vertex of the smaller prism of greater dispersive power.

With regard to the extent of uncombined colour, Brewster gives the following table, in which the substances are arranged according to the order of magnitude of the secondary spectra, when compared with a standard prism of oil of cassia. If any two substances be used to form an achromatic combination, the width of the outstanding fringes will depend, comparatively, on the difference in their tabular position; and the green will be towards the vertex of the prism of that substance which stands below the other.

1. Water.	11. Flint glass.
2. Ice.	12. Diamond.
3. Rock Crystal.	13. Amber.
4. Fluor Spar.	14. Oil of turpentine.
5. Blue Topaz.	15. Canada balsam.
6. Beryl.	16. Red Glass.
7. Alcohol.	17. Orange glass.
8. Crown glass.	18. Carbonate of lead.
9. Calc Spar.	19. Sulphuret of carbon.
10. Zircon.	20. Oil of Cassia.

From this table we infer that, as a general rule,

1. "The action of transparent substances on green light diminishes as their dispersive power increases." That is, the red and green portion of the spectrum is contracted by increasing the dispersive power.

2. "The exceptions are oil of cloves, oil of lavender, oil of turpentine, and Canada balsam, which have less action on green light than flint glass, though they are inferior to it in dispersive power. Fluor spar, rock crystal, and others are also exceptions."

3. "Sulphuric acid exceeds all transparent substances in its action on green, while oil of cassia exerts least action on green. These two substances might be used with great advantage to construct a fluid object-glass."

I extract the refractive and dispersive powers of most of the substances above mentioned from a comprehensive table in Brewster's book.

TABLE OF REFRACTIVE INDICES AND DISPERSIVE POWERS.

Medium.	μ	$d\mu$	$\frac{d\mu}{\mu-1}$
Sulphuric acid	1.430	.014	.031
1. Water	1.336	.012	.035
4. Fluor spar	1.436	.010	.022
7. Alcohol	1.372	.011	.029
8. Crown glass	1.525	.014	.027
Plate Glass	1.563	.018	.033
9. Calc or Iceland spar— lesser index	1.519	.016	.026
greater index	1.676	.027	.04
11. Flint glass	1.576	.029	.048
12. Diamond	2.417	.032	.052
13. Amber	1.568	.023	.041
14. Oil of turpentine, line E ..	1.478	.02	.042
15. Canada balsam	1.532	.023	.045
16. Red glass	1.729	.044	.06
17. Orange glass	1.792	.042	.053
18. Carbonate of lead— lesser index	1.813	.056	.066
greater index	2.084	.091	.091
19. Sulphuret of carbon	1.678	.077	.115
20. Oil of cassia	1.635	.089	.139

With regard to the experiments detailed in Part II., Brewster observes, "there is a tertiary spectrum, as it may be called, produced by varying the inclination of the first prism to the incident rays. As this new spectrum is formed when two prisms are used, made of the same substance, and consequently exercising the same action on different coloured rays; it is obviously owing to the deflection of the mean refrangible ray, which, as we have shown, must occur from the constant ratio of the sines of the angles of incidence and refraction. This spectrum is not composed of such vivid colours as the secondary, but the fringes are sufficiently distinct, and the uncorrected green is always towards the vertex of the smaller prism, which is inclined to produce a dispersion equal to that of the larger one."

"Hence it follows, in conformity with theoretical deductions, that, by increasing the refraction, either by means of a larger angle of incidence at the first surface, red and green are contracted, and blue and violet expanded."

"The same experiment which proves the existence of the tertiary spectrum, exhibits the no less singular phenomenon of a refraction without colour, by means of two prisms of the same substance. This effect, which has hitherto been considered impossible, appears to arise from the dispersion increasing at a greater rate than the mean refraction, in consequence of the alteration in inclination of the incident ray, and seems to hold out the probability of constructing an achromatic object-glass by means of two lenses of the same substance."

For, as the spectrum is chiefly produced by the second refraction, if two prisms of the same substance form equal spectra, it is evident that the interior angle of incidence on the second surface must be the same for both. This angle may be constant while the angle of the prism is varied; but an alteration in the refracting angle produces a greater alteration in the incident angle, for the sines of the angles of incidence and emergence must be in the ratio $1:\mu$, which is greater than unity. Therefore two unequal prisms may produce equal and opposite spectra, and yet cause a deflection of the original ray.

The experiments in Part III. exhibit some singular results. Brewster says "the variation in the uncorrected green spaces is obviously produced by a difference in action of the refractive substances upon different coloured rays; for the effect of the augmentation of the refracting angle of the prism, in contracting red and green and expanding blue and violet, is of an opposite nature to that which is actually produced."

In experiment 67, with the flint of smallest angle, the green fringe occupies the position which is assigned to it in secondary spectra. But in 66, with the flint of greatest angle, its

position is reversed. Now, by increasing the angle of the prism, we increase the contraction of the red and green part; so that the green fringe, though broader, should still preserve the same position as in the first experiment. The explanation of its change of place must be sought for in connection with the first prism. In order to correct the larger angle, this prism must be much more inclined than in the first case, and this inclination contracts the red and green, but of course in an opposite direction to the flint prism. Hence we may infer that the tertiary has over-corrected the secondary spectrum. If this supposition be correct, then by taking for the flint angle a value between the two extremes, the two dispersions should exactly balance each other, and it appears from exp. 68 that such is the case.

Hence the secondary spectrum, which in exp. 67 is partially corrected, and in 66 over-corrected, is exactly neutralised by the tertiary in exp. 68.

"As the tertiary spectrum is not produced by virtue of any specific quality of the refracting medium, but depends on the angles by which light is refracted at the surfaces, its magnitude may be determined by direct calculation."

"To find when the tertiary spectrum corrects the secondary, as in exp. 68, we have only to compute the magnitude of the former, or the deviation of the mean refrangible ray, as produced by the crown prism; and by calculating the magnitude of the small tertiary spectrum or the minute deviation of the mean ray, occasioned by the flint prism, we obtain a measure of the secondary spectrum of the flint, arising from its specific attraction for different coloured rays."

The experiments described in part I. may be utilised in another way; they furnish a pretty accurate indication of position of mean refrangible ray of a substance. For we know that in a crown glass prism the mean ray is at the junction of the blue and green spaces; and when it is used in combination the extent of outstanding colour will show comparatively which part of the spectrum is most expanded. "In determining the mean refractive power of chromate of lead, realgar, and oil of cassia, which exert such a powerful influence in separating the extreme rays, this information is absolutely necessary to obtain a correct result: for the refractive index of the bisecting ray cannot by any method be deduced from that of the extreme red and violet parts."

But with flint glass the extremes of the spectrum are sufficiently well defined to enable the observer to determine, with the unassisted eye, the ray by which the spectrum is bisected; but in chromate of lead, realgar, and oil of cassia, which are not very transparent substances, and which form the spectrum by a small refracting angle, the extreme violet rays cease to be visible, and the eye is no longer able to determine the colour and position of the mean ray."

(To be continued.)

PRACTICAL NOTES ON PLUMBING.—XXVII.*

By P. J. DAVIES, H.M.A.S.P., &c.

Valve-Closets (Ventilating, Wiring, and Flushing).

HAVING explained and shown the construction of the pan-closet, together with the method of ventilating and flushing the same, I will now similarly treat the valve-closet, of which Fig. 147 is an elevation, with cistern and supply valve. B is the basin, 26 is the large valve and box, best made with lead, generally cast in sand, at other times slopped out; for section, see Fig. 128, B; also see the regulator valve-closet which appears in section at Figs. 83 and 84. These last-named diagrams illustrate the outlet valve at F. Now, again, examine Fig. 147. Into the lead box 26 is branched an overflow-pipe 32, 33, 34, 35, 36, and 37, also a vent pipe V P; but this pipe is often branched into the back of the box at F, Fig. 83. This closet is drawn in section, the back being towards the reader; otherwise, this closet would be left-handed. Fig. 147 is an elevation of the front of the same, to show the lever 5, 7, 25, and, consequently, is drawn to appear right-

* From the Building News. All rights reserved.

handed. Although recommended by some sanitary engineers, I must express a decided opinion that the ventilation of the lead box is simply nonsense, for the reason that if the closet is properly flushed after using, all the soil, &c., must or should pass off to the other side of the diaphragm of the closet-trap, whether it be O, Q, or U; but as our sanitary engineers seem pleased with the idea I have here shown (although I do not recommend it) this ventilating-pipe V P, which, by the way, I have in winter time found greatly to the disadvantage of the closet, because, as a rule, this pipe is taken only just through the outer wall off the closet, and is consequently exposed to the rough cold winds of winter; it, however, has one virtue—viz., should the trap be badly constructed or get out of order, it will afford a vent for the foul air and

so the valve will again cover the valve seating; this done, let go the handle, and the sucker valve-spindle will fall back and the lever E will in its turn bring up the other sucker spindle 45, thereby opening the after flush-valve, which after a given time will again drop off and close the seating, but not until the closet-basin is filled up with water, known as the after-flush. G H is the air-pipe branched into the down pipe at 50. For the further description and section of these after-flush valves, see Fig. 162, &c. When fixing valve-closets the greatest care is necessary to prevent any hard substance being secreted under the large valve, as it would probably result in the face of the valve being notched or otherwise damaged. They should always be fixed over a proper lead safe, with overflow-pipe thereto, as spoken of in Pan-

Allowing the true value to these exceptions, the best plan is to arrange the overflow so that it should fall over or into a well-supplied trap, or into the open air; but when neither of the latter methods are practicable, its mouth or inlet may be covered with a valve and opened by the rising of a float having a rod, or the float may be fixed directly over the mouth of the overflow-pipe. It is quite as well, when adopting the float arrangement, if the bottom valve is fitted with an inverted cup to cover the top of the overflow-pipe and so form a trap when the water is within 2 or 3 inches of this pipe, which compensates for the valve being partially open as the water rises in the cistern.

54, 55, 56 and 57, Fig. 147, illustrate the float arrangement as fixed on some cisterns that I have lately lined. 77, 78, 79, 80, 81, 82, &c., in the same Fig., illustrate one of my patent hydrostatic supply-valves for cisterns.

This valve entirely dispenses with the ball-valve, and is fixed to work in the bottom of the cistern, in lieu of the top. This will, to some of my readers, be quite a new feature—viz., to fix the inlet valve in the bottom of the cistern and cause it to work without a float or ball.

THE ART OF SEEING STEREO-SCOPIC PICTURES WITHOUT A STEREOSCOPE.*

IN order, to describe in what manner any individual possessing eyes in fair condition may be able to bring both pictures of a stereoscopic card into one, it is not at all necessary to go into the somewhat abstruse question of the convergence of the optic axes, which, although necessary if we were discussing binocular vision in the abstract, is not so when giving, as we propose to do, simple directions by which the stereoscopic effect may be seen without the stereoscope.

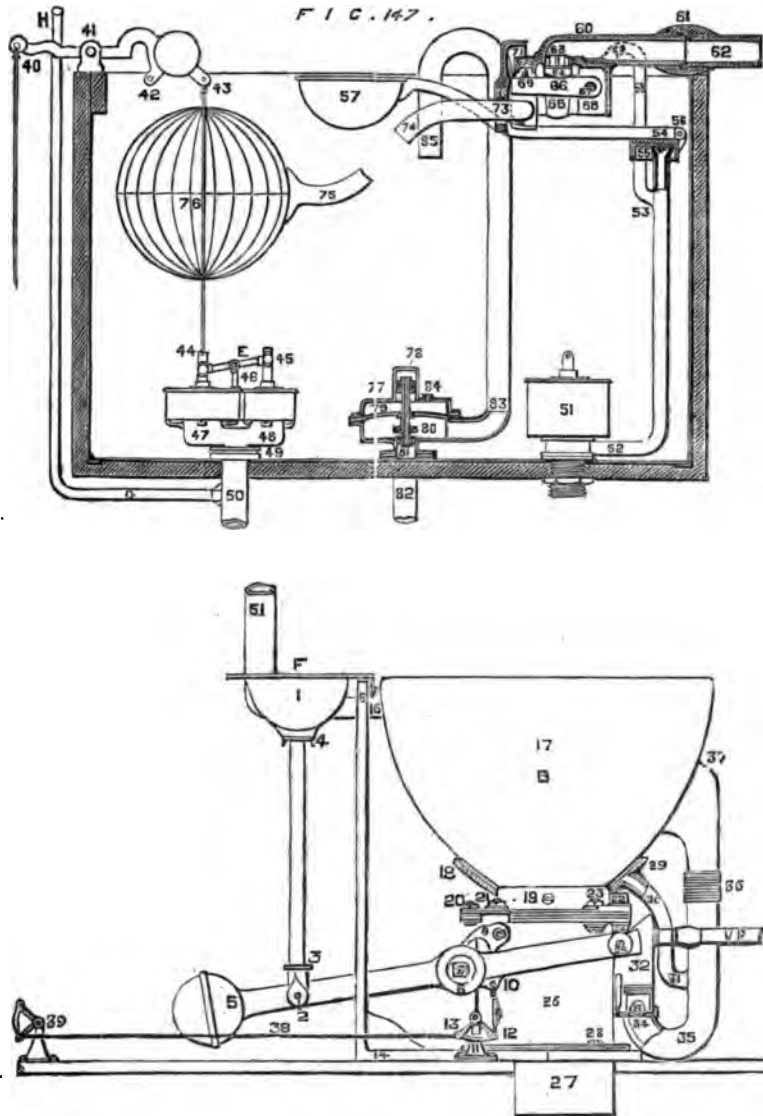
The eyes must, first of all, be tutored, by giving them a somewhat simple lesson to perform. The way by which we have invariably succeeded best in this tuition of the eyes is to make two bold ink marks, such as a cross, at a distance of an inch apart, upon a sheet of white paper, and within a half inch of the upper edge of the sheet. Now, upon a second sheet of paper make another single mark, similar to the two others. We prefer a cross for this purpose, although any other form will answer. Hold this latter sheet about twenty inches from the eyes, which must then be directed to the cross. While this is being done, hold the other paper, with its two marks, about half way between the eyes and the single cross sheet. Upon looking intently at the single or more distant mark, the mind will soon become conscious of there now appearing to be three crosses upon the nearer sheet. Should they not coalesce immediately, move the paper a little way nearer to or farther from the eyes till they do so.

It is now requisite that the eyes be diverted from the distant mark to the central one of the three that are apparent on the nearer paper, and after a minute's practice this can readily be done. The next step in advance is to practise upon a card having two similar crosses at a much greater distance apart than the former pair; and when these can be with facility brought into one, in doing which it may be necessary to hold them at a greater distance away than in the former case, then may a stereoscopic slide be substituted.

At first it is best to employ a stereoscopic picture specially selected for the purpose—one having a well-defined bold object in the centre, such as a tree. Not only so, but it will be advantageous to cut this picture into two halves and remove a piece from the centre, so as to bring the objects much closer together than is usually the case; for the nearer the two pictures are together, the more easy will it be for the eyes to unite them by the process described. There will be three pictures visible, but the centre one, being composed of the other two, will stand out in full stereoscopic relief.

While examining this divided photographic picture upon a table, as soon as the eyes have acquired facility in individualising every detail in them, the halves may be slowly separated; and if, during this operation, the eyes are fixed upon one point of the scene depicted, a separation to the extent of the distance between the two eyes may be made.

Should there be more difficulty in getting the photographs to combine than was experienced in the case of the two ink crosses, let them be treated as in the original experiment; that is to say, hold up the single-cross sheet at a distance of thirty or forty inches, and hold up the pictures at eighteen or twenty inches away. Now look at the cross until you realise that the slide which intervenes con-



stink to escape. In the bottom part of the overflow 32, 33, &c., is fixed a ball-trap which I consider is again going to the extreme, and although greatly advocated by some of the sanitary members of the trade as a great advantage, is really useless in general practice, for, by a reference to Fig. 83, it will be evident to any practical man that, at each pull of the closet the water (if the basin is properly flushed) must, run over the outlet holes at 4 into the overflow-pipe; then, again, this pipe should be flushed by allowing the water to rise to its proper height within the basin, which would be above the overflow 4, Figs. 83 and 84. Once more turn to Fig. 147, and examine the water supply, 44, 45, 47, 48, is one of my double action waste-preventing valves (for section see Fig. 162 further on). The action of this waste-preventing valve, is viz.:—that, by pulling up the handle F of the closet, you raise the lever, thus actuating the cranks, ball-lever, and finally the valve-spindle 44: this opens the sucker-valve, which if held up long enough will drop off, and

closet work. Common putty should never be used when setting these closets, as by reason of its stinking properties it, after a certain time, becomes exceedingly offensive; the best kind of putty for this work (although expensive) is red lead and gold size. When fixing the trap be certain to have large enough dip-pipe to receive the trunk of the valve-box. The distance from the front of the safe to the centre of the dip-pipe of the trap should be 7 inches.

"Cistern Overflows when Branched into the Closet Supply Pipe."

A cistern overflow is often branched into the down or supply-pipe to the closet, and answers as an air-pipe. That, if properly trapped below the closet, is good enough for any closet-work, excepting that in very severe weather it is apt to become frozen, and that this trap to some extent interferes with the flow of water at the first moment of supply, by reason of the confined air between the trap and the water-plug after the valve has been lifted.

* From the Photographic Times, New York.

tains three pictures, and let the eyes be then gently transferred from the contemplation of the cross to the centre figure on the stereoscopic slide, which will be in the same line of vision. The stereoscopic effect will now be seen in all its boldness.

After this art has been acquired, it will not again be forgotten, and it will afford a high degree of pleasure to its possessor, who, when turning over a quantity of stereoscopic pictures on the table of a friend, or when examining them in the window of a store, can realise their full beauty without requiring to use an instrument.

AN IMPROVED WHITE METAL AND MALLEABLE BRONZE.

AN improved white metal and a laminable or malleable bronze have been patented by the Société Reynaud, Béchade Gire, et Cie., of Paris, through Mr. J. C. Mewburn, patent agent, of Fleet-street. The invention consists in the manufacture of a white metal and a laminable or malleable bronze by the decolouration of copper by means of ferro-manganese of high standard without the aid of nickel. For the manufacture of this metal the patentees commence by reducing binoxide or protoxide of manganese in a blast, reverberatory, or other furnace, and when they have obtained ferro-manganese of a composition of metallic manganese 80 parts, iron 14 parts, carbon 6 parts, they make the first melting in a reverberatory furnace by mixing together about 60 per cent. of ferro-manganese of the nature or quality above described, and 40 per cent. of copper, adding the necessary and ordinary fluxes. When the mixture is perfectly melted on the hearth, it is run into ingots. The composition gives a metal as white as silver, and as malleable as German silver generally obtained with nickel. In order to make a laminable white metal in plates, the metal obtained as above receives an addition of from 20 to 25 per cent. of zinc and brass, is run into ingots, and, after reheating, is laminated in the ordinary manner. The reheating is effected as follows: The metal is brought to cherry red, and is then submitted to a current of carbonic acid which removes the slight impurities which may remain in the metal. This metal is inoxidisable with the fatty acids and stearic acids. Experiments which have been made have shown that armour-plates can be made with the first metal (from the first melting). A plate of the metal cast and rolled to a thickness of two inches has been tried against a two inch plate of steel similar to that which forms the armour-plates of ships. These plates have been fired at with a Gras gun at an equal distance, with the result that the steel plate was broken into several pieces, while that made according to this invention was hardly dented.

When it is desired to obtain a malleable or laminable bronze, protoxide of manganese (MnO) and protoxide of iron (FeO) are reduced to the metallic state, and copper is added in the proportions above indicated. When the two metals are melted, a malleable bronze resembling aluminium bronze is the result.

All the alloys of copper and manganese are ductile; these two metals have much affinity for each other; without the presence of copper only a small quantity of manganese is reduced, but when ferro-manganese of the nature and quality above described is used, any quantities that may be desired may be added, and a metal obtained which is very white and very ductile. This ferro-manganese perfectly decolourises the copper.

MECHANICAL DRAWING.—X.*

By PROF. JOHN E. SWEET.

(Continued from page 490.)

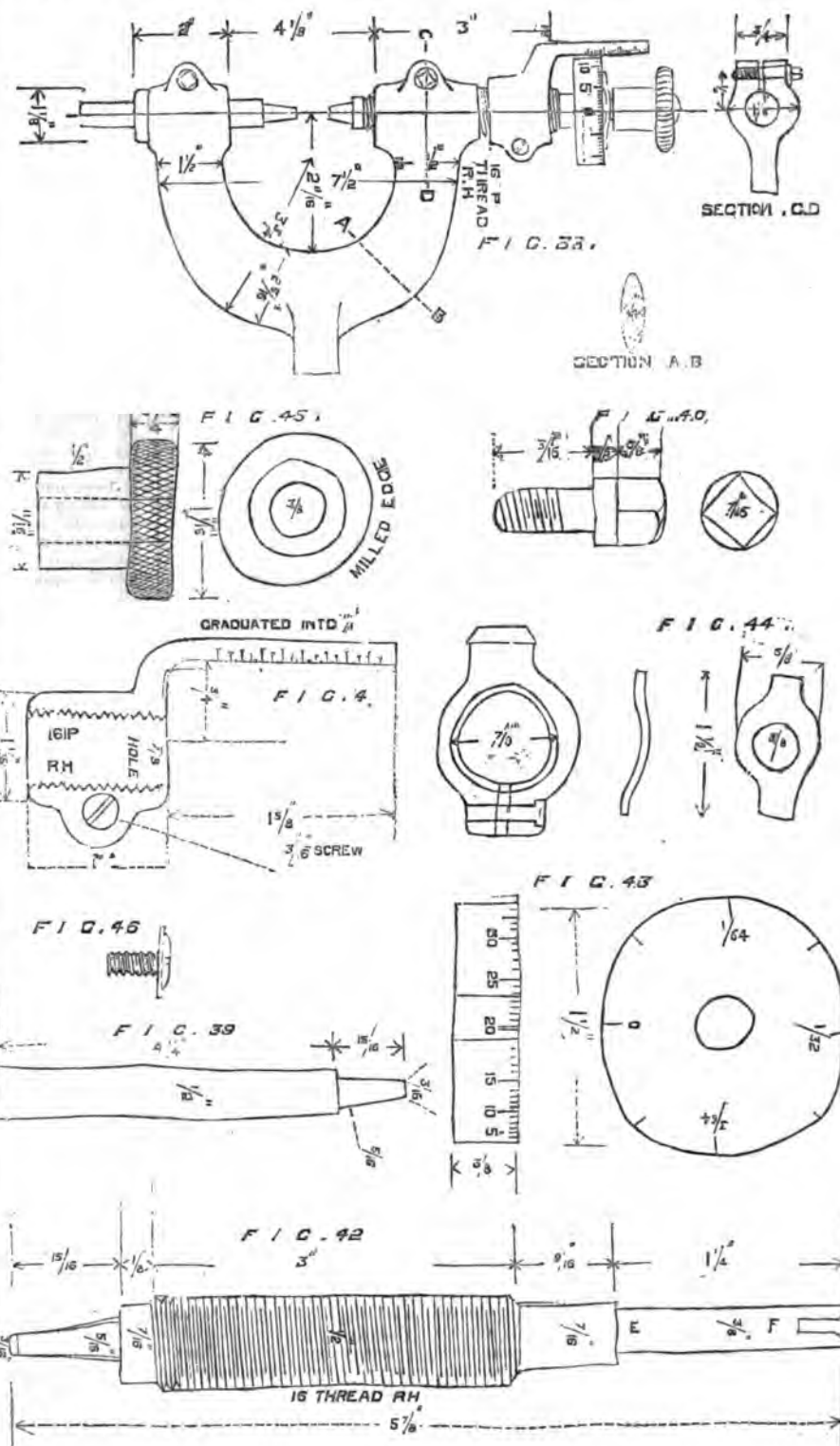
Drawing from Sketches.

IN the manner of teaching as in the manner of learning drawing, like teaching and learning everything else, there are many ways; good ways and poor, and the best way never the best way in all cases. There may be one way to teach better than all others nine times in ten (although no one seems to have found out that way altogether); still some awkward individual needs to devise an awkward way to teach the awkward tenth man successfully. There may be a general principle that will hold good in all cases; that is, to begin with the simple and approach the difficult by degrees, rather than to try and master the difficult at a bound. This is a principle I have not followed very closely—in fact, have not cared to follow at all; partly because I do not know my class, if I have any; and mainly, because it is of far more interest to me and the young men themselves to get at making the marks than just what routine they pursue; and to get them to thinking more of

the why than of the how. If I succeed in telling things to the apprentice that it is useful for him to know, it matters little to me whether it aids him in learning to draw a pencil or shove a jack-plane.

So prominent have I endeavoured to make this, that an explanation or confession may be admissible. A good instructor in drawing (and there are many of them) will take a class, and a large class too, some with ability, some with aptitude, and more with neither, and in an incredibly short time train them

proportion of the pupils as they lay aside their lessons, lay aside their pencils for ever after. So rare and so choice is the gift of sketching, that to have one disheartened by overtraining is a greater loss than can be ever made up by a school of manufactured automatons working up their show cards for class-day displays. A very common, and in the mind of instructors a very successful, method of teaching mechanical drawing, is to give the student well-executed drawings to copy. In many of these cases the excellence of the drawing is more of a



to make good, and many of them splendid drawings; sometimes, too, those with the least sense make the best copy. To all and each of these students, the drawing, the knowledge, and the training are of value, and such a student may all the sooner make a draughtsman; but so far as what they can do in real work, they might well be rated like asparagus, at so much a bunch. In this forced training in drawing, as in some other forced training that I have heard of, the final result falls far short of the first promise. Especially and lamentably true is this in freehand work, when the forcing and the drill become so obnoxious that a large

recommendation than the excellence of the subject it represents. In my opinion a much better plan would be to give the student rough sketches of a meritorious thing, figured more or less as the case required, with dimensions, and require of him complete drawings; also, to require of him a written description of the thing he has drawn, its nature, purpose, mode of action, material, construction, &c. What a field this opens for the training of thought. What a lesson it gives in the learning of that language the mechanic needs to know, and in the handling of that language he will often want to use. A compliance with these re-

*From the American Machinist.

quirements the instructor in drawing can enforce. I can only recommend, and most earnestly do recommend, them to every young man endeavouring to follow these lessons.

As an illustration of the sketch notion, I will say to you, my students, there is given in Fig. 38 a sketch of a moderately simple piece of apparatus, which I think you can venture to make a drawing from according to the dimensions given and of full size. The dimensions not given on the main drawing may be found on the separate or detail parts, shown in the succeeding figures. I will not say what is its use, for that you will be likely to find out long before your drawing is done. Having found that out, you can easily find out how it works, where the different parts go, &c. After having completed your drawing, write out a description of all you have found out about it. You need have no fears of there not being enough to say, for this page would not contain a condensed description of the thought and work expended on the subject. There were a number of fine mechanical problems to solve in its construction.

Figs. 39 to 46 are details of Fig. 38. Fig. 40 is to be marked on the drawings, "two $\frac{1}{16}$ in. screws"; Fig. 43, "drive fit at E, Fig. 42," and left hand portion, "edge graduated into 125 parts"; Fig. 44, "spring washer, No. 18 steel"; Fig. 45, "free fit at F, Fig. 42"; Fig. 46, " $\frac{1}{16}$ in. gun screw at G, Fig. 42."

A NEW ELECTRICAL BAROMETER.

AT the sixth meeting of the sixty-first session of the Royal Scottish Society of Arts, held last week, Mr. D. W. Kemp, Trinity, gave a description of an electric barometer, a new apparatus for ascertaining atmospheric pressure at any distance from the observer or at any altitude. The electric barometer consists of twenty-five tubes placed side by side on a board or round a pillar. Into each of the upper ends is fused a fine platinum wire, dipping down by tenths of an inch, so as to get a range of twenty-five tenths, or two and a half inches, with the whole instrument. A wire is taken from each of the twenty-five wires, carefully insulated from each other, together with a return wire from the cistern ends. In all, twenty-six wires are made into a cable and continued to any convenient place for the observer. In the observing apartment the wires are separated and attached to a dial, which is connected with an electric bell and battery. If the barometer were placed on a hill, and a cable taken therefrom to the observer, he could ascertain the height of the mercury, by finding the shortest wire, when in circuit, which would ring the bell. To arguments which might be urged that readings of tenths were not fine enough, he would reply that surely such readings were better than no observations at all. An interesting discussion followed, in which the idea embodied in Mr. Kemp's invention was commended on account of its simplicity and probable value. A committee was appointed to consider the instrument. The next communication was by Mr. C. A. Stevenson on "A New Form of Seismograph," designed to indicate the extent and direction of earthquakes. After some discussion, this paper was also referred to a committee.

MEASURING THE FLEXURE OF TELESCOPES.

IN a recent paper to the Belgian Academy, M. Houzeau treats this subject. His observations are to the following effect:

The means used for measuring the flexure of telescopes are subject to many inconveniences. Attention was at first confined to determining this flexure in the horizontal position of the instrument, with the purpose of deducing thence the correction relating to different inclinations, on the hypothesis of a given law. Later on, it was remarked that the zenith distances of various stars, taken directly and by reflection, would give the flexure for various inclinations; but it was necessary to suppose (what experience falsified) that all the conditions remained precisely the same in the two parts of each double observation. Then observers tried substituting the eyepiece for the objective, and reciprocally. Apart from any other objection, this substitution cannot be effected in all instruments, especially in those whose construction dates half a century back, like the mural circle of Brussels. By reason of these difficulties, the correction of flexure has not been applied, in observatories, in so complete or systematic a manner as the other instrumental corrections, although it deserves as much attention, and may be of the same order of magnitude.

Recently, two astronomers, M. Nobile, in Naples, and M. Loewy, in Paris, have applied to their vertical instruments, with the view of studying flexure, systems of reflectors, by which the luminous ray is brought into the direction of the axis of rotation. One may then see, during the passage

through a circle, the displacement of the cross of wires relatively to this fixed straight line.

This means, however, is complicated in execution, and the geometrical conditions that have to be fulfilled in giving the ray the required course render the application very delicate, and the installation laborious.

Happily, there exists a means much more simple, and which it is surprising that no one seems to have proposed. When one makes observation of the nadir in mercury, one covers the direct image of the wires by their reflected image. If, at this moment, one could render the mercury solid, attaching it to the objective, and raising it with the telescope in revolution of the latter, the two images, flexure aside, would continue to coincide in all inclinations of the instrument, that is to say, at all zenith distances. But if flexure exist, these images will move apart as the objective is raised, and their separation will give in each position, the measure of the flexure. One might thus study this correction at all angles with the greatest facility.

If, instead of the mercury, we take a plane mirror of an artificial horizon, and apply it fixedly to the objective, the combination required will be realised. This mirror may be made sufficiently light not to increase sensibly the flexure of the tube—a circumstance as to which one may be assured on recommencing operations, after having charged the mirror with an additional weight comparable to its own.

Such was the combination which I proposed to use. But when I wished to apply it to the mural circle of our observatory, the first plane mirror which I employed gave only very imperfect and distorted images of the wires. I have been inclined to think that this unexpected difficulty is the reason why a process so simple had not been indicated before. The least faults of the reflecting surface are, in fact, magnified by the instrument, and as nothing is so difficult to execute as a plane mirror, the question occurred—Is the method impossible in practice, in the present state of the optician's art?

This difficulty having been expressed to MM. Steinhell and Sons, of Munich, these able makers sent me a plane mirror about 10cm. in diameter, blackened on one of its faces. This, placed before the objective, gave excellent images. The difficulty presented then, is not capital, and optics is in a position to supply astronomy with the needed aid.

With this mirror of superior make, the study of the flexure of our mural circle has been commenced by M. Goemans. It may be already concluded, from the first observations, that in this fine instrument, the correction for flexure will be considerable.

The simplicity of this process, and the easiness of applying the mirror to the end of the telescope, allowing the study of flexure at all inclinations, and in all circumstances, will render, I trust, a certain service to practical astronomy.

USEFUL AND SCIENTIFIC NOTES.

Geology of the Diamond.—To the February number of the *American Journal of Science* Mr. O. A. Derby contributes an interesting paper on this subject, giving the results of his personal researches in Brazil. It is generally said that the Brazilian diamond has its matrix in itacolomite, which is a granular quartzose rock sometimes flexible. But Mr. Derby shows that, under the name of itacolomite rocks, two distinct geological series have hitherto been confounded. The diamond-bearing rock of the famous locality of Grao Mogol probably belongs to the newer of the two series; but the gems have not been formed in these rocks, and occur there only as derivative bodies like the associated pebbles. At Sao Joao da Chapada the diamond is worked in a deposit of clay; and its original matrix appears to be a vein of quartz accompanying a rock of unknown nature, but containing iron and crystals of tourmaline, traversing a series of schists and itacolomite. Mr. Derby concludes that the original diamond formation in Brazil is probably of Cambrian age.

The average production per acre of the three principal cereals grown in America is, for the whole country: Corn, 28 bushels; oats, 25 bushels; and wheat, less than 13 bushels. Of the great wheat-growing States, Ohio has the largest average yield, 18 bushels per acre; and Iowa the smallest, 10½ bushels per acre. Iowa takes the Johnny cake in corn yields, 42 bushels per acre; and Minnesota in oats, 38 bushels per acre.

The number of patents issued during the past year by the Dominion Government of Canada was 1,700, or 350 more than in 1880. The total amount paid by the patentees in fees was £10,571, or £2,143 more than in the previous year.

SCIENTIFIC NEWS.

THE death is announced of Adam von Burg, a distinguished writer on mathematical and mechanical subjects. He was a vice-president of the Vienna Academy, and had reached his 86th year. Prof. Joseph Decaisne, the eminent naturalist, died recently in his 76th year.

The Valz prize of the French Academy of Sciences has been awarded to Mr. David Gill, and the Lalande prize to Mr. Lewis Swift, of Rochester, New York, who has discovered no fewer than seven comets in the course of four years. These prizes are offered in 1882, and in addition that instituted by the Baronne de Damoiseau, the value of which is £400. The subject is a study of the theory of Jupiter's satellites, especially those observations which assist in the determination of the velocity of light.

Professor R. B. Clifton, the professor of experimental philosophy at Oxford, has been elected president of the Physical Society.

Mr. G. Sharman has been appointed senior palaeontologist of the Geological Survey, and curator of the fossils in the Museum of Practical Geology, and Mr. E. T. Newton second palaeontologist and curator.

In connection with the Electric Exhibition a course of lectures is being delivered by Professor S. P. Thompson at the Crystal Palace. The first was delivered on Wednesday last, to be followed on next and succeeding Wednesdays by lectures on Electric Currents—how to make them by Steam; Electric Arc Lights; and Electric Incandescent Lamps. Arrangements are being made for other lectures on the various systems of electric lighting. In his first lecture, Prof. Thompson gave an historical résumé of the progress of electrical science, and after referring to the relation between the power of electric currents and the power that is spent in producing them, spoke of the certainty that in the near future all heavy mechanical work will be done by electric currents in the place of steam, a theme which will have further attention in a subsequent lecture. Developing the question of the production of electric currents in voltaic batteries, the lecturer referred to the discovery that such batteries were reversible, and that in this reversibility lay the newly-discovered power of storing or accumulating electric energy in cells which could be charged and discharged at pleasure. The magnetic, thermal, and physiological properties of the electric current were illustrated experimentally, the lecturer remarking with much emphasis that the mistake of confounding physiological with medical or remedial effects led to the gross impositions of the quacks and rogues who deal in so-called magnetic appliances. The nature of electric currents was reverted to, and an outline given of the theory of Clerk-Maxwell that all electric phenomena are due to actions going on in the thin medium that fills the whole universe—the ether—vibrations of which are light and heat, the accumulations of which are electric charges, the streams in which are electric currents, and which, where it was made to spin round in vortices or whirlpools, gave rise to magnetic attractions.

The New York Board of Fire Underwriters have adopted rules for insuring premises in which the electric light is used. For arc lights they consider the conducting-wires (leads) should be of a weight equal to that of the wire forming the main circuit of the regulator, or of the armature of the machine, if that should be larger. For incandescent lamps, the wires must be so large as never to be unpleasantly warm, and in no case are they to be connected with earth or with the water and gaspipes. On walls and ceilings the wires, which must be covered with two coatings, should not be nearer than 8in. for arc lights, or 2½in. for incandescent lamps. Where the wires enter a building, a switch must be provided to cut out the building from the circuit if required.

At Dolcoath copper mine, near Camborne, the telephone has been laid on between the surface and the bottom of the shaft. The actual depth is 350 fathoms. The result is stated to be satisfactory.

During last week several trials of "new" brakes were made in the presence of ~~directors~~

and officials of the London and North-Western, Midland, Great Northern, and some of the Scotch lines. Those made between Derby and Leicester were trials of the Gresham and the Sanders-Bolitho automatic brakes; those made near Crewe were with the vacuum brake as modified by Mr. Webb. For some reason this brake is preferred to be non-automatic for ordinary use; but if the train is parted the brake becomes automatic on the guard's van. All the trials are reported as "highly satisfactory."

M. Arnold calls attention to some novel reactions of milk in the *Journal de Pharmacie*. Tincture of guaiacum gives a blue colour to new milk and sour milk, but not when mineral acids and alkalis are present, nor if the milk is heated to 192° Fahr. and upwards. If a little starch paste mixed with iodide of potassium is added to milk which has been mixed with old oil of turpentine, a fine blue band forms at the surface.

On behalf of M. Faure, a "disclaimer" has been filed at the Patent Office, from which it appears that what he claims is, first, improved secondary batteries for enabling a large quantity of electro-chemical energy to be stored up in a small space and small weight; secondly, the process of obtaining plates capable of retaining or preserving electro-chemical energy by covering them with a layer of porous or spongy metallic matter deposited to any required thickness by galvanising, chemical precipitation, or mechanical adhesion.

The Iron and Steel Institute will hold its autumn meeting in Vienna, commencing on Sept. 20. A visit will be made to Gratz, the capital of Styria, and other places of interest. The spring meeting will be held in London on May 9.

Mr. W. T. Lynn, writing to *Notes and Queries*, says:—We shall keep Easter this year on the anniversary of the day on which the Resurrection really occurred. The only real doubt now about the year of that great event is whether it was A.D. 29 or 30. If the latter, the Paschal full moon fell that year on Thursday, April 6; the Crucifixion would be the next day, April 7, and the Resurrection April 9.

The prize-awards of the Paris Academy of Sciences are published in the *Comptes Rendus* of Feb. 6, together with the lists of prize-subjects for 1882 and following years. The latter are very varied, including the elasticity of crystalline bodies, atmospheric electricity and phenomena of thunder-clouds, inoculation against contagious disease, distribution of marine animals on the French coast, coloured parts of the tegumentary system of animals, fecundating matter, cure of Asiatic cholera, the nervous system, recent marine and other deposits on the French coasts, transmission of force to a distance, botany of the North of France, influence of medium on the structure of vegetative organs, histological development of insects in metamorphosis, aerial locomotion, embryology applied to physiology and medicine, diagnostic signs of death, &c.

M. Menuisier has recently submitted to the French Society for Encouragement of National Industry, a plan of the following nature: Lay a telegraph cable between Saint-Nazaire, Bordeaux, and New York, with branch in Mid-Ocean to Panama. Every sixty leagues (the average daily distance covered by a ship), connect to the principal cable a vertical cable, ending in a buoy at the surface. To the right and left of the principal cable lay two branch cables, ten to twenty leagues each, ending in a vertical cable with buoys. (These branches would form two crosses with the main cable). The chances of ships sighting buoys would thus be frequent. Each buoy has a number, and its position in mid-ocean is known from special tables. When a ship passing near a buoy wishes to telegraph, it connects its apparatus wires, one with the wire of the buoy, the other with the buoy itself (serving as earthwire). Thus the ship might communicate with a central post which should be established on an island or rock, or a ship moored according to M. Menuisier's system. A vessel in distress near one buoy might, through the central station, get help from a ship passing near the next buoy. The difficult matter is the buoy, and the question is asked, How would it resist storms that have broken cables? M. Menuisier has not yet described

his buoy in detail, but says it is pronounced quite successful by competent navigators. It is luminous by night, sonorous in fog, and easily accessible in any weather.

The January number of the *Electrotechnische Zeitschrift* contains, among other interesting matter, a lecture by Dr. Siemens on "Electricity and the Danger from Fire," also papers on electro-technical education, the use of the Lelanché element for telephones in cities, medical microphones, a tele-anemometer, and statistical tables of electrical arrangements on railways.

The Geographical Service of the French Ministry of War has commenced the publication of a map of Africa on the scale of two-thousandths, prepared by Capt. Lannoy de Bissey. It will comprise sixty sheets, and will appear in two editions, one provisional, the other definitive. The provisional is meant to afford the public as quickly as possible a map enabling them to follow African explorations. Prepared by a monochrome (i.e., one colour) photoincographic process, and merely giving plane measurements, it could be easily kept an courant of the numerous advances made every day in knowledge of the vast continent. The definitive edition, to be executed by the much-slower process of engraving, will be published in several colours, and it will give the figures of mountains. The three sheets of the provisional edition, now issued, comprise the Cape, Caffraria, Basutoland, and part of Natal.

Exhibitions multiply in these times. The following are some that take place this year:—Berlin—Hygiene and Life-Saving Apparatus; Bordeaux—Agriculture, Industry, and Art; Buenos Ayres—Continental Exhibition; Leipzig—Graphic Art and Book Trades; Lille—Art Industry; Madrid—Mining, Mineralogy, Ceramic, and Glass Industry; Nürnberg—Agricultural Industry, Trade, and Art Exhibition; Trieste, Austria-Hungary—Industrial and Agricultural Exhibition; Vienna—Printing-art and International Art Exhibition. The first "philatelic," or postage-stamp exhibition in Germany, has lately taken place in Dresden. The total value of the exhibits was estimated at about £1,000. There was shown, as a curiosity, a post-card which had gone round the world in 183 days from Germany, by the Cape, Ceylon, India, Hong-Kong, New South Wales, and America.

At Breslau University, since the beginning of the winter session, gratuitous lectures have been delivered on railway law, transport, and tariffs, to employees of the railways in that town. The provision of similar advantages at the Universities of Berlin and Bonn is under consideration.

The iron-works of Flursheim, in Gaggenau, now supply a small lamp for benzine, called, on account of its cylindrical form, a (benzine) candle. The cylinder for holding the benzine is about 8 in. long, and into it is screwed a thin tube, air-tight, 6 in. long, for the wick, which has an asbestos tip. The cylinder has a double bottom, of which the lower part has a hole in the middle, and the upper one at the side; and from the latter rises a tube to the top, for conveyance of air, and terminating in a round bent point. A small cap covers the wick-cylinder when not in use. By reason of the firm screwing of wick-tube and cylinder, the candle is considered quite free from danger. It may be used with advantage in place of the ordinary stearine candle; there is no dropping, nor smell on extinction. It is also economical, the consumption being put, for one size of flame, at about $\frac{1}{4}$ d. an hour, for another 1-24 d. an hour, as against $\frac{1}{4}$ d. for stearine candles.

Recent experiments by Prof. Pflügge, with aconitine, appear to prove that different samples of it sold on the Continent are of very different nature. Thus, he found the nitrate of aconite of Petit, in Paris, at least eight times as powerful as that of the German Merck, and at least 170 times as powerful as that of another German, Friedländer. Merck's nitrate of aconite was 20 to 30 times as poisonous as Friedländer's; there being thus a greater difference between the two German preparations than between the French and the strongest German ones.

In application of the electro-magnet to various minerals, it has been observed by Prof. Doelter that the absolute quantity of iron in the minerals does not give a measure of the

power of attraction. Thus sulphides, sulphates, and phosphates very rich in iron were but little attracted in comparison with oxides, carbonates, and silicates. This various attractive power may be utilised for mechanical separation and purifying, as also for an approximate quantitative examination of the minerals.

The German Society for Promotion of Industry offers prizes of various values, from £25 to £300, in connection with the following subjects: Isolation of the textile fibres from nettles, and removal of the plant gum; manufacture of vessels for transport of nitric acid; investigation of photographic pyroxylin; spark-arresting and spark-extinguishing apparatus for locomotives, &c.; fireproof furnace-lining material with earthy base; anthracite extraction; the German paving-stone industry; chemical examination of the glass fluxes of Italian enamels and mosaics; German hemp cultivation and industry; the laws of ductility.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

* * In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physics: a vice from whence great inconveniences derive their original."
—Montaigne's Essays.

THE SPECTROSCOPE AND METEOROLOGY—A COMET PASSING OVER A FIXED STAR—TIME BY ELECTRIC CURRENT—CRABTREE THE ASTRONOMER—THE ROYAL ASTRONOMICAL SOCIETY—A MISSING SCIENCE(?)—COMITES TO ALDEBARAN—THE SPECTROSCOPE—PRESERVING AND ARRANGING FOSSIL SHELLS.

[19741.]—SINCE writing letter 19701 (p. 541), I have had an opportunity of reading Mr. Rand Capron's very interesting brochure, "A Plea for the Rainband." Having carefully studied the account of the author's experiments, and the results at which he has arrived, I am wholly at a loss to understand upon what grounds Mr. W. J. Lancaster (reply 45866, p. 527) can assert that "the spectroscope has done more harm to the legitimate study of meteorology than anything else"—always supposing that this dictum has reference to the method pursued by Mr. Capron. Every one knows how lines referable to aqueous vapour increase and multiply as we approach the horizon; and all that Mr. Capron seems to contend is, that when such lines are perceptible at some considerable elevation, producing a darkening on the less refrangible side of the sodium lines, then the air is near saturation, and rain probable. Possibly, the same result might be arrived at by simply reading a Mason's wet and dry-bulb hygrometer; but this does not invalidate the method. I am bound to add, by the bye, that Mr. Rand Capron's results are by no means all coherent or consistent. Perhaps, though, Mr. Lancaster was thinking of certain mendacious promises that, if observations of the spectra of sunspots and prominences were persistently made (and handsomely subsidised by the nation), storms, droughts, rain, heat, commercial panics, and shipwrecks would soon be foretold unerringly. If this be his meaning, then am I most heartily in accord with him that the spectroscope has done harm to the legitimate study of meteorology; and not only to that, but, what is of infinitely more importance, to the cause of scientific honesty and morality. How, in this sense, the spectroscope has done irreparable harm, may be seen in that paltry sham, "The Committee on Solar Physics," which picks the national pocket of £r per annum for the private benefit of the little ring who compose it. But for Mr. Mundella's woful ignorance of science, this is a scandal and abuse which must have long since been swept from the face of the earth.

In reply to query 46006 (p. 553), the nucleus of

Comet δ did pass almost centrally over a star of a magnitude between the 8th and 9th on the night of June 29, 1881. I unfortunately had visitors sight-seeing in my observatory at the time, so did not catch this until the nucleus had fairly passed over it. From what I saw, though, I should be tempted to think that the star must have been as perceptible as ever while the nucleus was actually superposed on it.

"Synchronism" (query 46049, p. 554) should read p. 266 of the sixpenny "Post Office Guide" for January, 1882.

Everyone who has paid any attention to the history of the progress of astronomy in England must be familiar with the story of the first observation of the Transit of Venus ever beheld by human eye. The credit of correctly predicting this passage of the planet over the Sun's disc belongs solely to an obscure young curate, of Hooke, in Lancashire, the Rev. Jeremiah "Horrox," as it is now the fashion to spell his name, although, in his autograph, in his own copy of Lansberg's "Tabula Perpetua," still extant, he himself spells it Horrocks. One of a band of four zealous astronomers, Horrocks communicated the results of his calculations to his greatest friend among them, a certain William Crabtree, a clothier, resident at Broughton, near Manchester; and on Sunday, December 4, 1639, these two friends had the inexpressible delight of seeing Venus actually upon the Sun's face. Anybody who may be curious to enter into the details of this remarkable observation, may refer to Horrocks's own "Venus in Sole Visa," in its English dress, as translated (some two- or three-and-twenty years ago) by the Rev. A. B. Whiston, under the title of "The Transit of Venus Across the Sun." It is—or was—published by Macintosh, of Paternoster-row, London. My more immediate business here, however, is with Crabtree, who died some three or four years after his friend; and concerning whom Mr. John Evans, on the 6th of this month, read a very curious and interesting paper before the Manchester Literary Club.

It would appear that there is extant a copy of an *Astrological Almanac* (doubtless one of a series) for the year 1685, entitled "Merlinus Rusticus," &c., &c., by Henry Crabtree, who was curate of Todmorden, and who has by at least one later writer been credited with the astronomical work of the Broughton draper. By the bye, his name is spelt "Krabtree" on the title-page of his wonderful little book. Mr. Evans's very readable essay is devoted not only to showing that these two men were distinct and separate persons, but that they did not even stand in the relation which has elsewhere been attributed to them of father and son. William Crabtree was unquestionably an astronomer and mathematician of no mean order; in fact, it was he who first drew the attention of Horrocks to the imperfections of Lansberg's Tables. Henry Crabtree was as certainly neither. On the contrary, the Rev. Zachary Taylor, who defended him against an attack in which he was described as a conjuror or "wise man," says explicitly that "He was no great scholar, a blunt, but an honest man, and served at a poor place for about twelve pounds a year, which he augmented by venturing to give physic to the country people." We may laugh at the ignorance which led our forefathers in the seventeenth century to confuse astronomy with astrology; but just as long as hundreds of thousands of fairly-educated men in this country, even now, can detect no difference between the character and worth of the work performed by our Airys, Balls, Christies, Gills, and Stones, and nature of the advertising astrological quackery put forth by the clique of which I have spoken in a previous paragraph, just so long, should we studiously abstain from casting stones at those who had much more excuse for their ignorance than we have.

Reading your report of the Annual Meeting of the Royal Astronomical Society, on pp. 562 and 563, I learn that the attempt made by Mr. Ranyard to obtain the removal of Professor H. J. Smith from the Council failed, and that the "House List" was returned in its integrity. I think, however, that this can scarcely surprise anyone; inasmuch as but few present at the Meeting would have the time or opportunity to make the suggested alteration so suddenly sprung upon them. Speaking for myself, I regard it as a pity that there was not some prior arrangement made among those who object to see the Government of the Society carried on from Greenwich, Willis's Rooms, and Brompton, to displace, at all events, those most notoriously prepared to advance the interests of the Solar Physical Ring. We have been lectured before now, as to the necessity of "Astronomers" forming a preponderating element on the Council (by "Astronomers" meaning men whose lives have been devoted to the utterly mechanical routine of meridianal observations!) but I have yet to learn that Professor H. J. Smith has ever done anything for Astronomy in the slightest degree to justify the Society in electing him one of its Vice-Presidents—or, in fact, to entitle him to sit on its Council at all. I may as well, though, enlighten those not behind the scenes, by pointing out that

the House List this year was a mere juggle and colourable evasion of the spirit of our 6th By-law, perpetrated in order that none of the clique who dine together at their "Club," and claim to rule the Society from a tavern-table, should lose their seats. The by-law in question recites that "Eight only of the Twelve Members of the Council who may have served during any one year, shall be eligible in the same capacity during the ensuing year," but as the tavern party hang on, *per fas aut nefas*, to office, they merely shuffle the cards, and by putting up two ordinary members of council to the vice-presidency, and bringing down two vice-presidents as ordinary members of council, they entirely evade the spirit of the by-law, while seemingly adhering to its letter. It is time that the Fellows of the Society looked to this, and took means to insure that seats in their governing body shall not become the freeholds of certain persons, be their official position what it may. Let me recommend all who care for the promotion of astronomy, and not merely for that of personal interest, to look back for the last twenty years to the lists of officers and council, and note how certain names have never been absent from them on a single occasion. One of these gentlemen has been known publicly to express his wish for "an infusion of new blood" into the council. His own conduct in the matter, though, is highly suggestive of Sydney Smith's definition of English charity. "A. never sees B. in distress but what he immediately feels that C. ought to relieve him." He may wish for the "infusion" referred to; but he will take most singularly good care not to facilitate it by personal retirement. One name I fully expected to have found in the House List this time; but for some reason unknown to me it did not appear. It is that of a Fellow of the Society who, until quite recently, has rarely, if ever, entered its walls since the Council declined to recommend Government to create a situation for him, and whose recent sudden reappearance there led me, and a great many others besides, into the belief that the restoration of his name among the "List of Officers and Council for the Ensuing Year" was imminent. The members of the Council with whom he dines seem, however, either to have ignored him or to have been numerically too weak to carry his name. I shall be most agreeably surprised to learn that he has returned among us with any other object than that almost universally attributed to him. We shall see what next February brings forth.

Without expressing any opinion as to whether the theory of Mr. W. G. Wenley (letter 19740, p. 570), is or is not a sound one, it seems difficult to disagree with him in his assumption as to the unsoundness of existing ones—always assuming that anything in the shape of a scientific meteorological theory can be said to exist at all. One of these days, that long-suffering animal, the British taxpayer, will find out that the Meteorological Office (with its concomitant "Meteorological Committee of the Royal Society"), exists wholly and solely for the private pecuniary benefit of the officials: and this bubble once burst, the money now wasted (or part of it) may conceivably be devoted to some philosophical investigation of the laws governing atmospheric changes. The so-called "predictions," or "forecasts," issued daily from Victoria-street are about as valuable as those contained in *Zadkiel's Almanac*—neither more nor less so.

Writing these lines on Friday afternoon to save the post, I cannot possibly look at Aldebaran for the purpose of giving a categorical reply to "Zenias" (45836, p. 572). But I will do so on the first available opportunity.

"C. R. T." (query 46090, p. 578), may use a spirit-lamp to volatilise many of the salts exhibiting remarkable spectra. The chlorides of metals generally are the most manageable. Browning's "How to Work with the Spectroscope" he will find a most admirable eighteenpenny-worth.

I, like "Mollusca" (query 46095, p. 578), suffered in days gone by from the crumbling and disappearance of a very interesting collection of fossil fruits, &c., which I made in the Isle of Sheppey. Consulting my friend, the late Dr. Bowerbank, I was recommended by him to keep them in naphtha—or, failing that, in stoppered bottles of water. I may add that I varnished a crab, from the same locality, which is still in a perfect state of preservation. My own fossil shells are stratigraphically arranged in cardboard trays.

A Fellow of the Royal Astronomical Society.

STAR COLOURS.—BLUE STAR.

[19742].—I HAVE long thought that the varied colours of stars offer an interesting, and as yet imperfectly-explored, field of inquiry, in which the labours of amateurs (supposing only that they are gifted with a normal sense of colour) may be profitably employed. The unpublished researches of Franks, presented to the library of the Royal Astronomical Society, including all the naked-eye stars (I believe as far as 5 mag.) visible in our

latitudes, have made a worthy beginning. But the subject is almost boundless. Red stars have attracted the notice of many observers; and the especially valuable catalogue of Birmingham, which may be procured from Messrs. Williams and Norgate for a trifling sum, should be in the hands of every amateur who is interested in these singular objects. But while even these are as yet by no means exhausted, it may be remarked that (with the exception of some of the orange stars) no attempt has been made, as far as I am aware, to enumerate or classify those of other hues, some of which are sufficiently conspicuous and worthy of being recorded. Many of them, where associated with more brilliant companions of a decided red or yellow cast, may, no doubt, owe their colour to mere contrast—a deception which, by the way, is inoperative as regards the other end of the spectrum, few bright stars being so distinctly blue or green as to induce a complementary hue in any minute neighbour. But there are also a considerable number so insulated as to be free from any such suspicion. One of these—a very insignificant specimen certainly, but we must bear in mind the motto of the Royal Astronomical Society, *Quidquid nitet notandum*—came under my notice on the evening of Feb. 18, while I was sweeping in Gemini with my 9½ in. mirror, and a very fine low-power Kellner ocular by Parkes, of Birmingham; and if any of our readers should feel disposed to search for it, I should like to know whether their opinion confirms mine as to its decided, though dull, blue aspect. It lies about 5m. p., 5' s. from ϵ , being the smaller component of a coarse pair which I roughly estimated 10, 10½ mags., about 1' apart, with a position-angle of 130°. The larger star is, I think, yellowish, but not to an extent which would disturb the sense of colour in any neighbouring object.

T. W. Webb.
Hardwick Vicarage, Feb. 20.

DARK SPOTS ON JUPITER.

[19743].—A FEW additional transit times of the dark masses situate on the south equatorial belt have enabled me trace with ease and certainty the motions of six of these noteworthy objects. Out of twenty-eight observations, two spots have been seen on the central meridian six times; one, five times; two, four times; and one, three times. And as the period of observation extends over sixty days, and the individual observations are usually very accordant, and separated by a considerable interval of time from each other, it is hoped that the rotation periods of these spots will be ascertained with considerable accuracy, and thus add a little to our knowledge of the various motions of the Jovian spots.

Observations should be commenced at least three hours before the times given for the white spot by Mr. Marth, on page 565, and continued till the white spot has passed the central meridian.

Considerable instrumental power will probably be requisite, for on a recent night, with very bad definition, no spot of sufficient plainness could be seen near the centre, though several were fairly evident when about midway between the centre and the limb.

A. Stanley Williams.
Brighton, February 20.

ERRATUM.—In the last line of letter 19703, page 542, for "observation" read obscuration.

LATHES AND LATHE-MAKING.

[19744].—IN reply to Mr. Holtzapffel (letter 19731), I can only express my regret that he should exhibit so clearly the extremely hostile feeling he entertains towards myself. His remark which insinuates that the threads under discussion came into my possession by any other than fair means, is, to say the least of it, most ungenerous. But I take the opportunity of explaining that the screw-threads have been in the possession of our firm for very many years, and my remark as to their privacy was intended to convey the fact that they were not what might be termed a public standard, in the same sense as the celebrated threads introduced by Sir Joseph Whitworth, of which no praise can be too high; and I trust all who read my letter, without prejudice, will accept it in that light, since Mr. Holtzapffel is kind enough to suggest a want of knowledge on my part upon what matters I treat; also of the threads alluded to, I would submit that if he did really think such to be the case, it would have been more generous if he had endeavoured to correct any error, for which I should have been obliged, instead of endeavouring to cast a slur upon one whom he knows full well he is quite incapable of teaching in any branch of our respective businesses. I will refrain from saying more upon a matter of so little importance to me.

I will, however, take the opportunity of remarking upon the question of the rose-cutter. As to the origin of the instrument, I believe the first one was made by Messrs. Holtzapffel, but many years ago, and if I had thought that any ill-feeling would have arisen through my not mentioning the fact, it would have given

me great pleasure to have done so. The instrument from which the drawings of my article were made is one that I made myself 15 years ago, and as we have made some 30 of them within the last 20 years, it certainly cannot be said to be a copy of any instrument of Messrs. Holtzapffel's make, especially as it has had many improvements made in it since its origin; and the only one of which I claim to have had anything to do with is the small drill for deep figures, which is most certainly a great addition; at the same time I am quite aware of the alteration inherent to all patterns cut with a drill, on account of the diameter of the drill. Mr. Holtzapffel also generously endeavours to point out a mechanical defect in my arrangement; but for all this I am glad to say that it does its work perfectly, and I have made a number of them; also, I am glad to say that imperfect as my articles may have been, I have been rewarded by seeing some most excellent work made from those that I have written. In conclusion, I respectfully submit that it can only be regarded as extremely bad taste on Mr. Holtzapffel's part to make use of such expressions as are contained in the fourth paragraph of his letter, especially upon one whose time and exertions are spent in the same commercial pursuits as his own.

159, Wardour-street

John H. Evans.

[19745].—MAY I add a word or two to what has been said by Dr. Edmunds and others, as to Mr. J. H. Evans' articles on the construction of chucks, &c., which, though of great value, seem to be wanting in one important particular? For some time I have been anxious to make an elliptic chuck, and when his article on this subject appeared I thought of course that I should find such instructions as would enable me to do so. It contained very full details as to the construction of the parts, and some few hints as to the putting of them together; but this is not sufficient for an amateur who, like myself, has never seen an elliptic chuck, and has no means of access to one. It seems to me that no chuck can possibly produce an elliptical outline or an oval cylinder, unless some part of it is connected with a fixed, or rather with an unrevolving, point outside of it. We hear nothing of any point that is not in the chuck except the mandril nose, which is, I presume, not the point in question.

A few remarks as to the principle on which the nose of the chuck is made to describe an ellipse, would make the article of real practical value; at present it reads too much like the written instructions to an artisan who is not expected to use his brains; but amateurs, like myself, are exceedingly apt, not content with knowing "how," to ask "why." These "why" people are always troublesome, by the way. Has an elliptical chuck without slides, worked by some sort of gearing, ever been patented? Such a thing would be far simpler to make.

Scorpio.

LATHE MATTERS.

[19746].—I MUST ask you to allow me to acknowledge the kindness of "O. J. L." and Mr. Evans in replying to my queries. With regard to the slide-saddle in front, instead of on the top of the bed, I should like to hear some of your readers' opinions as to the best arrangement of the V's for resisting the strain of the cut.

I regret that Mr. Evans does not seem willing to notice my request about the chief dimensions of his lathe apparatus. I cannot see that Dr. Edmunds has written anything at which Mr. Evans should reasonably take offence. He has simply described, in plain English, the feelings of many, very many, amateurs who eagerly devour every word of Mr. Evans's instructions. His use of the word "degrade," though it may sound harsh, could not be intended to be offensive. I thought the Doctor's meaning was, that he considered Mr. Evans's articles might be made very much more useful, by giving more details; and in this respect I thoroughly agree with him. The ENGLISH MECHANIC is essentially a practical journal, and articles on high-class mechanism should be such as will fairly enable the amateur to help himself; not merely such as will show him how to pull a thing to pieces and put it together again correctly. I was certainly surprised at the way Mr. Evans replied to the query on screw-threads. He recommends in his articles the use of J-thread and N-thread. Dr. Edmunds, very naturally, asks, What are J-thread and N-thread? Mr. Evans's reply is to the effect—J-thread and N-thread are simply J-thread and N-thread, but you can, if you choose, use a Whitworth thread. Now, had it not been for the kindness of Mr. Holtzapffel, nothing more would have been known respecting these alphabetical taps. Mr. Evans very kindly offers to show, or lend, these taps, or to supply castings of his apparatus; but I would respectfully submit to him, that for every one who can avail himself of such a chance, there are twenty who cannot. Mr. Evans is evidently a skilled artist, working with the best tools, and his very familiarity with his apparatus may cause him to omit matters which, to a master, may seem trifling, but which, to a pupil, are of much consequence. A desire to see

Mr. Evans's articles made as useful as possible to the greatest number, is the sole object which prompts me to criticise his manner of dealing with his subject. He has already given a large amount of interesting information, which no one but an accomplished mechanic, constantly in contact with the best work, could have done. I trust he will continue and extend his articles; and also that Mr. Holtzapffel will favour us occasionally with his instructive letters.

Orderic Vital.

ORNAMENTAL LATHE-THREADS.

[19747].—I HAVE to thank Mr. Holtzapffel for the further valuable data which he has published in the ENGLISH MECHANIC at page 566. And I am encouraged to submit to him such further particulars as are now required, in order to enable the possessors of Holtzapffel lathes to completely understand their threads.

(1) The diameters given at page 566 are, I presume, those of the bolts to be screwed. Perhaps Mr. Holtzapffel will say if this be so, and will favour us also with the complementary data, so that we may be able to gauge the holes to be tapped as well as the bolts to be screwed. When using the shallow thread screw tools, are the bolts to be made smaller, or the holes to be bored larger? And what is the third set of diameters then required?

(2) Measuring the nose of a 5in. Holtzapffel mandril in my possession, I find its diameter to be about thirteen-sixteenths of an inch (.8125in.) outside the thread. The nose of a 6in. Holtzapffel mandril in a friend's lathe-room measures nearly fifteen-sixteenths of an inch (.9375in.) also outside the thread. It is not easy to judge how much these mandril noses have worn down by use, but they both appear to be screwed with the thread 9-45 to the inch, and, comparing these measurements with the data given at page 566, I conclude that the diameters of the mandril-noses are not included therein. To bore-out, screw, and turn up a brass or cast-iron chuck is one of the tasks frequently attempted by an ambitious amateur, and it would be of great value if Mr. Holtzapffel would give us the threads of his various mandril-noses with diameters outside the thread, and the inside diameters both for the deep and the shallow thread. The deep thread of 50° is, I believe, always used for screwing the steel Holtzapffel mandril-nose, and it follows that, in screwing a cast-iron or brass chuck with the shallow thread of 60°, a larger D-bit must be used to bore out the hole than in making a steel or gun-metal chuck with the deep thread of 50°. As to the materials and cases for which the shallow tools should be used, more specific instruction from Mr. Holtzapffel would be greatly appreciated. In Vol. IV., page 376 ("Turning and Mechanical Manipulation") Holtzapffel says:—"Cast iron requires coarse and shallow threads, produced either with a tool of considerable angle, or one with the points rounded." For an internal screw in a cast-iron chuck I assume that the shallow tool of 60° would be prescribed. In this case the hole should be bored out a shade larger than for the deep thread of 50°, but for this the lathe-bit and taps do not provide, and I do not find in the vols. any reference to the point. It is, however, of some importance. One of our most accomplished amateur turners—an old client of Holtzapffel and Co., and admirably furnished by them—proceeded some time since to make for a beautiful traversing mandril a chuck in cast iron. This he bored out with the regular D-bit furnished with the lathe, and he screwed it with the proper thread (9-45 to the inch), but using, of course, a shallow thread tool of 60°. The inside thread being perfected, and the chuck not running on easily, he proceeded to force it on, thinking that it was a little tight, but that it must fit. The result was that he flattened down at the apex the first two turns of the thread, and thus deformed a mandril to which a large series of exquisite chucks had been made. Only after having thus damaged the nose of his beautiful mandril did it occur to him that, in screwing a cast-iron chuck with the shallow thread, he must begin by using a D-bit rather larger than that furnished for the deep screw. Less accurate workmen would have worked away at the inside screw by rule of thumb, until the chuck went on easily, and they would not have deformed the mandril nose in this way. But were I at liberty to name this gentleman, Mr. Holtzapffel would say that, upon the books of his firm, there is no client whose senses and fingers are in more perfect condition—whose intellectual acumen or manual skill at the lathe it would be more difficult to surpass.

James Edmunds, M.D.

Grafton-street, Bond-street.

THE ARMSTRONG LATHE.

[19748].—SHOULD Mr. Carre be unacquainted with a shaping-attachment for 4in. or 6in. lathes, made by a Dublin firm, I will do my best to give him a short account of it. It is said to combine thorough efficiency with lightness in weight.

"O. J. L." letter 19687, will not be surprised

to learn that the Yorkshire firm's lathe under notice is specially constructed to allow the saddle and back-poppet to cross each other on the bed.

C. H. D.

COMBINATION LATHES.

[19749].—ANY one who has been reading the correspondence on this subject will not fail to note how completely "F. W. G.'s" remarks in letter 19735 fall in with what I have written by way of reply to objections made to the Armstrong lathe on the score that it could not be suitable for ornamental work, or that any lathe made ostensibly for metal-work could, except under grave disadvantages, be used for ornamental turning. While admitting that I was not an ornamental turner, and therefore not daring to speak with the delightful confidence in myself that others assumed, my argument was—that a very great part of ornamental work was done by cutters driven from the overhead; that the mandril and flywheel had comparatively little to say to the perfection of the work. I am, therefore, naturally rather anxious to hear how those who recommended me "only to write about what I knew" will answer the exact same argument when coming from one who can speak from experience, as "F. W. G." states he can.

At any rate, "F. W. G.'s" letter, in which he gives us a list of what tools he has made with his combination lathe, is a sufficient answer to objections which have been made, that all such combinations are unsatisfactory and inefficient.

"F. W. G.'s" drawing is certainly not of the very first order; but it is quite sufficient to explain his combination, and is, moreover, quite as good as the majority of the illustrations in some books on the lathe, which are very expensive.

Using the quick hand traverse of the saddle, for working the planer table *in itself*, seems not a bad plan; but I hardly think the arrangement is a whole is so good as others that have been suggested. First, there is a comparatively small range of thickness which can be admitted, for the tool must not hang too much. Secondly, the strain on the bottom slide of rest is severe. It comes in a direction it is ill-suited to bear it, and which with anything but very light cuts would tax its strength unduly.

No arrangement is shown for obtaining a vertical feed for the milling attachment which would take away greatly from its general utility, which would be confined to slotting and shaping to the width of the drill used, and this might be as well done under the planing head.

I hope it may yet be proved that there is more "apathy" in connection with lathe combinations amongst the readers of the "E. M." than there is on any other point connected with lathe construction. I think the apathy is more imaginary than real, the writers on any one subject never being very numerous.

Fred. Carre.

SCREW PROPELLERS.

[19750].—"KHODA BUX," letter 19729, is informed that the compositor made pie of my letter. I stick to my text, "that the motion of the bar, as generated by a scientific sculler, is that of an imperfect screw, accompanied by the loss of effect at the moments of reversal, and that were the aforesaid bar converted into a screw, with the one blade working continuously, the boat would attain, say, almost double the speed of the slipping sculler." "Khoda Bux" is not a curious considerer of cause and effect, or he would not affirm that a boat gets along speedily when the bar lays out almost parallel with the run, as this is usually a one-handed operation; but when the performer feels the necessity for going in to win, he gets the bar as deep and as like the action of a screw as he possibly can, consistently with the preserving of his own position, as well as that of the bar in the cradle; and if Mr. Root or any other man says that a screw has more propelling power when placed at "any" angle from the straight course, unless he means the sinking of said screw into denser water, then do I dub him a dunce. Messrs. Harland and Wolff's vessel had a large aperture in her tail, and a portion of the shaft was connected to the remainder by, if I am not deficient in memory, a species of Hook's universal joint. Sorry to hear that you are an invalid. Am professionally perfecting a large works manufacturing Portland cement, or concrete; would like to hear anything from you upon this topic. Ours bore a strain of 1,000lb. upon 1 1/2 in. square before giving way, after soaking for one week in water.

J. J. A.

[19751].—If I may be allowed a word or two on this subject, possibly they may be of assistance to "Khoda Bux." In the first place, I fully endorse his theory that under certain conditions a screw placed at an angle from the horizontal has a greater propelling force or has greater efficiency than when parallel with the water's surface. The case cited by "J. J. A." has very little to

do with the matter, as the failure of the s.s. *Britannic*, after one or two runs, was simply owing to the immense friction of the universal joint where the angled shaft diverged from the horizontal. If the whole length of the shaft had been placed at an angle, the result would have been different as regards propulsion. However, this is impracticable in large ships, on account of docking, &c. As for the originality of this method, a Captain Kincaid, of Greenock, patented a deflecting-shaft with a universal joint, long before the firm of Harland and Wolff were in existence; and, I believe, the apparatus as fitted to the *Britannic* was his patent: also a steam coasting-lighter, named the *Camel*, was in existence, with a similar lowering propeller many years before the *Britannic* was thought of. And I know of at least two average-sized coasters fitted with the same lowering screws in daily use at the present time.

However, a deeply immersed screw, with a deflecting axis placed at an angle from the surface, has been conclusively proved by some of the first authorities to be an advantage. Some time ago, while experimenting for another purpose, I was astonished at a result of this kind, and at once saw a means of applying the principle to a practical use, which I protected provisionally at the time, but had it filched from me by the first capitalist I showed it to, through not being sharp enough in my own interests. This is now in operation satisfactorily; but unfortunately, or, rather, fortunately, the principle of the application has not been grasped, and it still remains to be developed in its entirety.

As for "J. J. A.'s" finale: the common twin screw, under certain conditions, is certainly the best propeller known; the same may be said of sculling, and of paddles, though not so universally applicable as the former.

Mersey Engineer.

[19752.]—As it seems that "White Swallow" is spending money on an improvement in screw-propulsion, I may, perhaps, so far encroach upon your valuable space as to say a few words on what has already been done; this will, may be, prove of interest to many of "ours," and if it prevents only one of the number wasting money and energy, I shall rest contented in the knowledge of having done some good.

A pair of large sculls have been placed at the stern, and so actuated that they alternately dip into the keelwater, in the fashion in which a Venetian gondolier oar dips.

A paddle-wheel has been placed at the stern, and it has even been proposed to drive this horizontally, i.e., around a vertical shaft.

Screws have been placed at all sorts of angles, there being dozens of patents for this idea.

One patentee describes a long shaft running in a tunnel formed in the hull, the latter having almost the form of a twin hull. On said long shaft screw blades are placed, so as to dip one after the other, each wing being apart from the other.

Another inventor proposes to employ an archimedean screw, working in a tunnel.

Scores of patents have been taken out for propelling vessels by jets of steam, of water, and even of air.

The very products of combustion have been proposed as auxiliary motive power.

I quote all these instances from memory. They will all be found in the Patent Specifications, classified under the heading "Propelling Ships," "Locomotion on Water"; and though I am far from saying that the screw propeller is not capable of improvement, I yet wish to caution inventors and others how they spend money and time on "new notions." It has often been said, and cannot be too often reiterated, that every man who thinks he has made an invention or discovery ought, before going any further, to make a search as to the novelty of his idea.

Let "Khoda Bax," "White Swallow," and other friends, remember that hundreds, nay, thousands (and among them master minds) are continually applying themselves to the solution of industrial problems, and let them not be astonished or disheartened if they (or at least "White Swallow") find that they are too late, or that practical working offers difficulties which no model will show, however well it may be made.

Upton Park, Feb. 15.

Polyglot.

[19753.]—I quite agree with "J. J. A." in his view of "sculling." Though a very handy plan for getting about a harbour in a dinghy, in narrow places, among warps and shipping, &c., it is a terrible waste of labour compared with the use of a pair of sculls in the same boat. It is true it is analogous to the action of a fish,—but then we are not fish. A fish is provided with immense muscular power on purpose to move with great speed a very powerful, large-bladed scull in its stern. But it can use it for direct thrust, and is not obliged, as we are, to use an angular thrust to keep the scull in its notch. As to a screw-propeller set at an angle, it looks wrong on the face of it. It is as if

a man, having to push a cart along a road, put his shoulder under the tailboard instead of against it. Besides, in a ship, upward pressure under the stern would surely tend to depress the bows, and so set up extra resistance. If the screw could be carried at the end of a long shaft, so as to work in water undisturbed by the vessel, instead of in the eddy of her run, that would be an obvious gain. A certain amount of this advantage is got in small vessels by carrying the shaft through a divided rudder, and having the screw abaft the rudder instead of in the deadwood. But this is limited to launches for river work, as far as I know. The reason "twin-screws" have not proved the grand success that was expected is mainly their working in eddy water under the quarters.

I can make nothing out of "White Swallow's" plan; but it reads like some kind of paddle-wheel. No doubt the paddle-wheel gives a better "duty," as is evidenced by its continued use in tug-boats; but any plan working part in and part out of the water has been proved unsuited to ocean work or war ships, in comparison with the less efficacious but totally submerged screw.

Treadle.

[19754.]—As facts are worth recording, I have heard my friend Staff-Commander Farrant, R.A., now dock-master at Gloucester, state that the *Euphrates* troop-ship, when trimmed by the stern 6ft., "that is putting her down 6ft. by the stern," the reduced expenditure of coal was from 80 to 50 tons per diem, or about 30 per cent. keeping up the same speed of ten knots. He says the chief engineer, Mr. Egers, whose address you could obtain from the Admiralty, could give you more reliable information. I have heard Mr. Griffiths, the great authority on the screw, say we know very little about it at present.

I may remark, when at Gloucester some years ago, I asked the engineer of the dock-manager or surveyor's boat, why he trimmed her by the stern "so much." He said, "I could not get so much speed if an even keel or thereabout." I think that you will find the screw collars trimmed by the stern very much; they must have good reason for so doing. If your readers watch ducks swimming, they will, I think, observe that they do not strike out in a direct line, "but on their quarters," and I think double screws should do the same, and the inflowing water comes in behind to assist in the progress of the bird. If the bird struck out in a direct line opposite to its movement it would materially retard the progress of the bird. I have been punting in narrow water, and the ducks literally propel themselves out of the water, like, or somewhat more than, a Thorneycroft torpedo. I should like very much to see "White Swallow's" propeller, and have a talk with him.

Captain Brown, R.A., the inventor of chain cables, had two circles with paddles that feathered, passing through the keel, feathering as required. I saw the apparatus, in a boat 32ft. long, at Woolwich, in 1849. I fancy the circles were very much in the way of fouling, and taking the ground. I do not pretend to be very scientific—scientific men very often make great mistakes: when they put their science into practice, there happens to be something they did not account for; and they should not speak dogmatically, but pay due respect to old salts and men of practice. It appears to me that the screw meets greater resistance by being placed at an angle with the keel of the ship; hence the better result. It cannot lift the ship to any extent. You cannot practically depress water, and it may allow the water to inflow to the ship in a better manner. It is all very well to say the screw should be in the same line with the ship. Take a screw-jack. If you apply it in a direct line against the object to be moved, if your resisting-power is not strong enough, you will move it, rather than the object you wish to move. Your readers may say, That is not a fluid. The argument is the same. I could explain what I mean personally.

Jas. D. Curtis, Capt. R.N.

9, Chepstow-villas, Twickenham.

TRICYCLES.

[19755.]—"SUNLIGHT" asks what the result would be if, when running fast on a "Salvo," the rider sat back, and lifted his steerer off the ground. I have done that thing scores of times, and the result was—nothing particular. To begin with, when running fast, you are doing work, and, therefore, if you do sit back, it can only be for a moment, or the speed will diminish. If the speed is due to gravity, going down hill, your feet are on the rests over the steerer, and you are, though sitting well back, yet putting ample weight on it. Also, if the rest is too exactly over centre to allow of sitting comfortably, there is no difficulty in shifting it so as to get the proper steering weight on when in the position you like best to ride in. For myself, I adjusted my seat so that, when driving hard, I sat on the edge of it, and when going down hill, or taking it easy, I could sit fair back, and be as comfortable as in an armchair. Like "Sunlight," I ride for comfort, not for speed,

for which reason I prefer a seat to a saddle. The balance of weight in the "Salvo" is a mere matter of adjustment.

Treadle.

HOLTZAPFFEL'S VOLUME FIVE.

[19756.]—I HAVE seen no words in the *ENGLISH MECHANIC* for some time past that have given me more satisfaction than Mr. Holtzapffel's own statement that his Vol. V. "has now made considerable progress."

I sincerely hope that the time is not now far distant when this long-hoped-for volume will be in the hands of those who have craved for it for years. Your editorial footnote to Mr. Holtzapffel's first letter is well timed, and I am sure every true lover of ornamental turning *does* endorse your appeal to him to occasionally say a few words in your columns upon this subject. Could he not be induced to give, now and again, an illustration, with short descriptive text, of really elaborate high-class works in ivory and the hard woods, such as would test to the utmost the skill of those possessing the valuable complex tools, separately and in combination, for which he is so celebrated.

Contributions of this character from so able an author would be gratefully received by a numerous section of your readers, as well as by myself.

Altrincham, Feb. 14th.

Ivory.

DANGERS OF OXYGEN-MAKING.

[19757.]—WHY not follow the method of "Fresenius" for oxygen-making—viz., mix the potass-chlorate with 1-1000 its weight of ferrous oxide? Surely this could be obtained free from organic matter with certainty.

I have used the above for laboratory purposes over three years, and am perfectly satisfied with its action, the gas being given off rapidly and at a very uniform rate.

Marylander.

DYNAMO-ELECTRIC MACHINE.

[19758.]—I HAVE tried in vain to get information as to the best form and construction of a small dynamo-electric machine, such as Mr. Caplatzi mentioned.

I have made a small machine as an experiment, previous to making a larger one, some time ago, from directions given in *Design and Work*, 30th April, 1881. It was No. 9 I made, the dimensions being for armature lin. by 4in. It works right enough as a motor, but I can get no results whatever when I use it as a generating machine, unless I substitute a permanent for the electro-magnet. I revolved it by means of back-motion of my lathe at a very high speed, and could ring a bell with it, but could not make even the thinnest platinum wire hot, and when I use the electro-magnet instead of steel-magnet, there was no current at all, although I made the connection as directed, and altered the position of commutator to every possible angle. Now, the thing I want to know is whether the Siemens machine is the best for lighting, say, one incandescent lamp, and to be driven by foot-power or a small engine? There was a description in *Design and Work*, 6th August, 1881, of a dynamo-electric machine, made by the Brady Manufacturing Company, Brooklyn, the dimensions of same being 10.11 x 11in., and giving one light of 2,500 candle-power, whereas the small Siemens, with dimensions 24 x 24 x 11in., gives only a light of 1,200 candle-power, both with the expenditure of 1½ horse-power.

Now, I have no room for an engine of that size, and I do not want that amount of light, but just one or two incandescent lights, and to be driven either by a heavy fly-wheel or a small engine of about half horse-power.

If Mr. Caplatzi would describe the machine made by Brady and Co., or the Bürgin, which both seem to give better results than the Siemens machine, or any other which he thinks the most suitable for the work, he would do me and some friends who are anxious to make a start, a great favour.

Fritz.

[19759.]—Now that the exhibition of dynamos and electrical apparatus is in full swing, it is to be hoped that some further particulars will appear in "ours," relative to the construction and proportion of dynamo machines.

If in all our correspondents there is not one who is willing or able to give the required information it is extremely curious. There are hundreds of readers who are most anxious to begin if they only had working drawings of small machines which would require, say, one or two horse-power to drive. I think we do not want to hear so much about the resistance and length of wire, as we require to have drawings of a good armature to scale with weight and number of wire it will hold, and a clear description of how the wires are joined up and arranged so as to excite the field magnets; and how the current generated should be used in order to give the best results. If it should be divided so as to pass a portion round the field magnets and a

portion to the lamps, or if the same current that excites the field magnets should be simply used in the lamp.

It is to be hoped that Dr. Caplatzi's offer will be accepted, and that we will be able to have some practical letters from him on the subject.

If there is one thing more than another that disgusts amateurs, it is to have a lot of useless inventions in their private attic, on which they have spent money and time without result, and I for one do not, just at present, wish to provide apartments for some twenty odd pounds' worth of cast iron and insulated copper wire, if the result is likely to be the "abortion" which "Sigma" has prognosticated.

Before starting to work, we must get far more minute particulars and drawings than have yet been given.

PLINIUS—THE TRIPLE STARS $\Sigma 1555$ AND 430—H's DOUBLE STARS—THE TRAPEZIUM OF δ ORIONIS.

[19760.]—The following rough copy of Schmidt's map of Plinius (omitting a large mass of detail) may be of interest to Messrs. Elger and Gaudibert (letters 19681, 19682, page 517). The two craters on the floor were discovered by Gruithuisen in

I omitted to state in my letter on the "Trapezium of Orion" (19610, p. 447) that I have found, on consulting the MSS. of Schwabe, that that keen-eyed observer had seen the star numbered 2, as well as that numbered 1, on March 18th, 1880. His place is exactly coincident with that of Mr. Salter's star, and the observations were unquestionably entirely independently made, as Mr. Salter could not possibly have been acquainted with unpublished observations of Schwabe's.

Feb. 18.

H. Sadler.

CONTINUOUS BRAKES.

[19761.]—On Friday, the 10th inst., a very interesting series of experiments was conducted upon the Waverley route of the North British Railway.

The Highland and Great North of Scotland Railway Companies have done very little indeed towards providing efficient brake power upon their trains, the reason assigned being that they were waiting to see which brake the other companies with whom they work would adopt.

Since the replies were sent to the Board of Trade circular of June 10th, 1880, the Caledonian Company has unanimously adopted the Westinghouse automatic brake, and has already applied it to

to an error in signalling, but the brake-power upon the East London train was arranged on a highly unsatisfactory system. The engine belonged to the Brighton Company, and had the Westinghouse brake in working order; the six South-Eastern Company's carriages, which composed the train, were fitted with the Vacuum brake, which of course, under the circumstances, could not be used. Now, from the evidence given, it is perfectly certain that had the train in question been fitted throughout with either system, the collision could have been entirely avoided.

This instance proves that when continuous brakes have been fitted at great cost, every arrangement should be made to insure engines and carriages fitted with one system being worked together upon the same trains. Of course, when through carriages are sent over other lines, this is perfectly impossible; but, in many instances, much inconvenience might be avoided by providing certain through vehicles with connecting-pipes and hose-couplings until a final settlement of the brake question has been attained.

An interesting series of experiments is, at the present time, taking place near Vienna upon the Kaiserin Elisabeth Railway; one of the trains, composed of 16 vehicles, being fitted with the Westinghouse brake. On Wednesday last, experiments were made upon the Midland Railway, when a Midland and London and North-Western train made several "stops" with Vacuum brakes. No official report of these experiments has, at the time I write, been published.

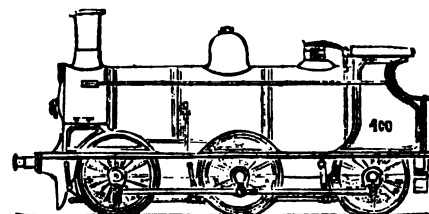
The Continuous Brake "Return" for the past half-year will shortly be placed before the public, who will then be able to see if the companies are making the necessary provision for its safety or not.

Clement E. Stretton:

Saxe Coburg-street, Leicester, Feb. 18.

L. AND S.W.R. GOODS ENGINES.

[19762.]—In answer to "Clyde" (letter 19686), I inclose a few particulars of the new goods engines, built by Messrs. Neilson and Co., for the above railway, with a sketch for the benefit of those having no opportunity of seeing them: Particulars as follows: Cylinders, 17½ in. diameter, by 26 in. stroke; wheels, 5 ft. 1 in. diameter; boiler, 4 ft. 4 in. outside diameter; wheel base, from



leading to driving-wheels, 8 ft.; from driving to trailing-wheels, 8 ft. 6 in.; weight in working order, 38 tons. These engines are two tons heavier than the "Thames" class described by "Clyde" which, if he will allow me to correct him, would scarcely be 45 tons. I think "Clyde" must be confusing "Beattie's Patent" with the new American apparatus for heating the feed-water. In the former, which is being removed by Mr. Adams from all engines so fitted, the exhaust-steam is turned into the tender; but, in the latter, the steam blown off at the safety-valves is used. There is, I believe, only one engine ("Castor"), 7 ft. express, fitted with the American safety-valve, which is the same as that which has lately been tried on the Great Northern Railway.

Motion-Plate.

DR. HASTINGS AND STEINHELL'S METHOD OF MAKING AND TESTING FLAT SURFACES—APOLOGY TO MR. CALVER—A REMARKABLE FEAT IN PRACTICAL OPTICS.

[19763.]—I HAVE been so very busy for many weeks past, working sixteen or seventeen hours a day, that I have found it impossible to keep my promise in writing the promised article on my visit to the optical works of Alvan Clark and Sons, and I must ask still further "grace" for that letter, and in its place, for the present, I will endeavour to answer the requests made by Mr. Calver and Mr. Wassell, and give in detail the process used by Dr. Hastings, of the Johns Hopkins University, Baltimore, U.S.A., in making and testing flats. When I wrote to Dr. Hastings about the matter, asking for the privilege of publishing it for the benefit of your readers, he, with a most gentlemanly spirit, replied, "Certainly, do so." He made this statement to me, however, that while he discovered and used it independently, yet he found, on his visit to Munich, that it had been used there by Dr. Steinhell for some years, though his process

1822. Mr. Elger's two small craterlets on the S. and S.W. of the slope are new, as are also his two craterlets on the N.W. portion of the floor.

The faint distant companion of $\Sigma 1555$ has seldom been observed. The following are the only reliable measures I know of:—

Engelmann 142° 4' 13.42" 1865-27

De. 145° 4' 21.1" 1871-31 (Flammarion).

I would suggest that Engelmann's distance be augmented by 7.3" (i.e., ¼ rev. of micr. screw), it will then be 20.72" in very satisfactory agreement with Dembowski's result. As is well known, a similar correction must be applied to Σ 's two measures of the distance of his 2318, making the true value 20.508" instead of 12.850". The principal star of $\Sigma 1555$ is P xi. iii. Ursa Maj. Smyth calls the faint star "plum colour" 13 mag; as I see it with my 6 in. Calver. The purple hue is very marked. Would Messrs. Hunt, Gledhill, or Knott measure this again this year? 39 Tauri ($\Sigma 430$). Mr. Burnham has suggested that Σ 's distance of C may be a misprint for 37.40". The only measures are—

Σ 301.87° 39.400" 1831-23

De. 301.05° 37.761" 1863-12

β 301.0° 37.74 1878 03

Or would it be preferable to diminish each of Σ 's three distances on p. 200 of the *M. M.* by 1.532" (cf. *M. M.*, p. lxiii.)? Σ 's mean distance is then 37.87". If Mr. Burnham sees this, I should be glad to have his opinion on the matter.

I may, perhaps, mention here that I have succeeded in identifying every one of the double stars in Sir W. Herschel's first three classes in the Synoptical Catalogue, with only one exception (δ iii., 31), and am preparing a paper for the R.A.S., giving additional identifications and corrections to those already supplied by Sir J. Herschel and Mr. Burnham. In many cases the errors in the assigned places are very large.

a considerable amount of rolling-stock, and, as your readers are aware, this brake has long since been adopted by the North British and Glasgow and South-Western Railways. The Highland and Great Northern of Scotland, seeing that these three important companies have for some time had an efficient brake in use, fulfilling all the conditions of the Board of Trade, consider that the time has arrived when brake-power ought to be provided for their passenger traffic, especially now that the Right Hon. Earl De-la-Warr is about to introduce the Continuous Brakes Bill mentioned upon page 562.

The directors and officials of the Highland, and other Scotch lines were present at the North British experiments on the 10th inst., in order that they might see the practical working of the Westinghouse brake.

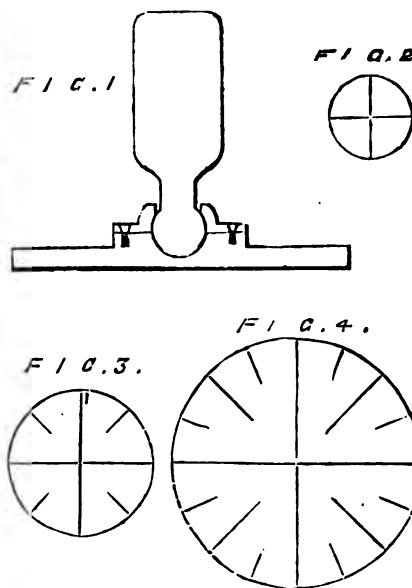
The trial train consisted of 7 carriages and a van, which left Edinburgh and ran on to the Waverley line. Quick stops by driver; stops from van by guard; and automatic stops by "slipping" the train were made with very satisfactory results. The official data and report have not yet been published, but I should mention that when running upon a gradient of 1 in 70, at a speed of 60 miles an hour, the rear part of the train was "slipped," the brake automatically applied itself, and brought even the engine and front portion to rest in 300 yards, steam being kept full on the whole time. Every day furnishes further proof that the continuous brake question ought to be settled as soon as possible. Numerous instances occur daily in which a carriage with one system of brake has to be run upon a train fitted with another system, the result being that the brake-power upon some vehicles is cut off and rendered useless.

This fact is also clearly shown in General Hutchinson's report upon the recent collision between Park's-bridge and St. John's on the South-Eastern Railway. This accident was due

was more nearly automatic than Dr. Steinheil's. Just here I wish to make an apology to Mr. Calver for the wording of the article in which I referred to his method. I wanted to say that for large surfaces the process described by him in his "hints" was all that was desired, but for small ones, when the large disc had to be cut up, there was likely to be some error, owing to a molecular strain in the glass from imperfect annealing, or may be from strain in cementing. Mr. Calver himself knew of these difficulties, and he guards the amateur against them in lines 6 to 20 and 21, page 11, of his excellent work. I cannot speak too highly of this work, and the very many useful hints contained in it, from which I and many others have profited. It is very true what he says, that there is "more in working out methods than in the methods themselves." And this will be found true in the process I am about to describe as well as any other; but the means of detecting errors are so simple, and the methods of correction so certain, and the results so satisfactory, that I think it worthy a high place in practical optics. I shall endeavour to condense this subject into one letter, and shall try to be as concise as is consistent with clearness.

First, as to the test. This is the extremely simple one of placing a flat plate of glass in contact with the surface to be tested, whether of glass or metal, and observing, by an oblique view, the colours produced. If the tint, which should be of the first or second order, is either perfectly uniform, or there are broad parallel straight bands of colour, then the surface perfectly fits the test-plate, and, provided the test-plate is perfectly flat, then the surface tested is perfectly flat. Now, to make such a test-plate, three must be ground and polished, which fitted together two and two with the resultant of the above broad parallel straight bands of colour, or a uniform tint, meet the conditions necessary for a test-plate for future use, any one of which may be kept for the test-plate and the other two used. In testing metal plates such as speculum metal, Dr. Hastings uses sodium light, from the difficulty of seeing colours on such plates. To produce these rigorously flat surfaces, it is absolutely necessary that the discs should be circular. I will now describe the method of grinding and polishing, and then make some additional remarks. For flats for the Newtonian a circular disc is cut out of plate glass not too thin, say $\frac{1}{16}$ in. larger than the major axis of the flat. Of course, if we have no test-plate we must have three discs to work on. These may be ground on one another alternating as in the usual way, or they may be ground on the discs Mr. Calver speaks of. The discs of iron, I think, produce the finest surface for commencing the polishing, but I would not advise the amateur to go to this trouble if he has not the discs already, for it is an enormous job to make three iron discs in the usual way; and the result of carefully grinding three discs of glass together is sufficiently accurate to make a very fine flat. When the glass has been brought to a nice semi-polish by grinding they may be cemented by soft pitch (I prefer glue and molasses, as not being likely to strain the glass) to the lathe chuck or upright spindle. My own plan is to work them on an upright spindle on which is a chuck, flat on top, and on which a piece of soft cloth is laid. To hold them in place I cut three discs from stiff leather about 3-16 in. thick, and screw them to the outside of chuck, the screws being out of centre of the leather disc, say $\frac{1}{16}$ in. They thus act as cams, and the discs can be nicely centred in a few moments by changing one or the other, and there is no fear of strain. Now for the polisher: I am not certain whether Dr. Hastings uses any method of moving the polisher save by hand, but I can see that it could readily be done. He writes me that he reads while polishing, and after a little practice I find it no trouble to read and polish too. The base of the polisher, whatever it be made of (mine is of brass), is made from $\frac{1}{16}$ in. to $\frac{1}{8}$ in. less in diameter than the glass. This polisher must be made to rotate on a pivot at the centre of the back, and should be made so that the handle would have a free movement so as not to tilt the polisher. I have given a rough sketch of it in Fig. 1, a sectional view that can be readily understood without further description. The polisher is made of pitch, preferably that used for roofing purposes, made from coal-tar, with one-twentieth of its weight of beeswax added. This pitch can be made harder or softer by more or less boiling. Of course, any good pitch that is used for other polishers will answer well, this being a matter of taste. For the shape of the polishers, which allows of some change, I give the sketches as given me by Dr. Hastings. Fig. 2 is the shape he uses for very small surfaces, say $\frac{1}{16}$ in. diameter; Fig. 3, from $\frac{1}{16}$ in. diameter up to, say, $\frac{1}{4}$ in.; and Fig. 4 from $\frac{1}{4}$ in. up to as large as can be made by this process. These radial grooves are readily made in the pitch I speak of, as it does not break easily. Now, the beauty of this method of making flat surfaces is that you always know what you are doing. If it is polishing too fast at centre, increase the eccentricity of the strokes. If polishing too fast at the edge, diminish the eccentricity of the

strokes, or reduce size of polisher. If polishing in rings or forming a knob in centre, increase excursion, &c. The pressure is determined by what the pitch will bear. If the tool is too small it will fail to run or rotate, which is very essential to success; and if it is too large the surface near the edge will be convex. At first the tool works unpleasantly, but after the knack of holding it is attained, it is very easy to manipulate. I find it is best to make rather short eccentric strokes until the surface is bright enough to test, as a concave surface is more



readily worked down than a convex one. I will now make some remarks on the subject. First, to know whether the surface is concave or convex. After the test-plate is carefully slipped on the plate that is being worked, hold them to the light (sky-light, not direct sunlight), so that the colours produced may be well seen. Then either raise the glass or lower the eye, and if the coloured rings or bands travel towards the edge, the surface is convex. If they travel towards the centre, the surface is concave, as the bands travel always towards the thickest film of air. Irregularly-distributed colours I generally find produced by minute dust-particles; for, on again cleaning the glass, the result is different. One has only to place a hand or finger on the back of one or both surfaces, to see the delicacy of this test, as the colours almost instantly change by the expansion of the back, caused by the heat from the hand or finger. This cautions us to be careful to have them of equal temperatures; and they should be handled with care to avoid straining from this cause. In Dr. Hastings' own words, which I have already frequently used, the disadvantages of this process are:—

1. The surface must be circular.
2. The danger of scratching the surface in applying the test-plate.
3. Surfaces of large diameter are very tedious to work by this process.
4. Equilibrium of temperatures is a necessity.

The advantages of the method are:—

1. The surfaces can readily be made optically perfect—i.e., not much less than 1-10th wave-length.
2. The error of a surface can readily be determined, both in amount and in direction.
3. The process is largely automatic, and the test, showing the error, the polishing-tool may be made to correct it by the kind of stroke given. In testing them after dark, I find it best to diffuse the light used by ground glass. The greatest difficulty I find is in getting the glass clean enough for the test. So far, I have found the palm of the hand the best, and then holding them with faces down to keep dust from settling on them. After being placed together they should be allowed to stand for some time so as to recover their normal condition. With a true parabolic reflector and a plane such as can be made this way, splendid results may be obtained, and I am free to say that more than one good speculum has been condemned when it was the fault of the flat. A telescope with two perfect optical surfaces of the Newtonian form will bear a poor mount and shabby clothing, yet do good work; but let the flat be bad, then no amount of setting the eyetube square, arranging and rearranging will do any good; but finally it is blamed on the weather, and we quit for the time in disgust, only to try it again and meet with disappointment. Permit me to say to our esteemed correspondent "Orderic Vital" that Dr. Van der

Weyde, of New York, uses such a telescope as he mentions, though not for a transit instrument, but for observing the sun. The plate-glass is set at the polarising angle in front of the objective. By the way, in closing, I wish to record a remarkable feat in practical optics by the author of the method I have just given. Dr. Hastings recently undertook the construction of a 9 4-10 in. objective. A machinist spent 15 days in making the four tools. The glasses were roughed into shape by steam power. Dr. Hastings then commenced on them, and in 50 hours the objective was pronounced perfect; and of that 50 hours 10 was spent in centring the lenses. The telescope is now at the Cincinnati Observatory undergoing a thorough testing. The curves were calculated by Dr. H., and then worked to by himself.

Have any of your readers heard of such quick work and such perfect results in so short a time? I hope I have fulfilled my task at least intelligently, and that the process I have described may still further advance the good cause.

J. A. Brashear.

Pittsburg, February 2.

P.S.—I forgot to say that I have had the privilege of testing some of Mr. Calver's work, both specula and flats; and unhesitatingly pronounce them of the highest order of excellence. For beauty, and absolute symmetry of curve, two 10 in. that he made for Mr. Frank M. Bookwalter, of Springfield, Ohio, equal anything I ever looked at. Of course, my humble testimony is not needed to enhance Mr. Calver's reputation, but I am only too glad to add my mite. I should be glad if Mr. Calver would give us his plan of "edging" flats. What does he use? Stone, iron, or copper disc, and how does he manage to keep the edges of the flat from chipping? His flats are edged very beautifully. Any additional contribution to this subject I will be glad to give, so far as it is in my power.

THE SPECTROSCOPE AND METEOROLOGY.

[19764.]—I AM sorry Mr. Capron differs from me as to the benefits accruing to meteorology from the use of the spectroscope. I can only repeat what I wrote before, and what Mr. Capron has inserted in his letter, "That the spectroscope has done more harm to the legitimate study of meteorology than anything else." I know all about the rain-bands, &c.; but I, at the same time, know that an endless amount of mischief has been the result of, so-called, magnificent spectroscopic discoveries in connection with forecasting storms, famines, &c. The subject is one that would occupy many pages, to show the ill effects upon meteorology that spectroscopy has been the father of.

W. J. Lancaster.

MEDICAL REPLIES.

[19765.]—LEAD POISONING (46010).—"Painter" is undoubtedly suffering from lead in the system, which is affecting his nerves and paralysing his muscles. (1) To get the lead out he should wear clothes which are scrupulously free from lead; practise extreme personal cleanliness; and take a Turkish bath twice a week. He may also take three grains of iodide of potassium and five grains of carbonate of soda twice a day in a wineglassful of water. For the constipation castor-oil is the best remedy, but so soon as the lead is eliminated from the system the constipation will cease. It is due to a form of paralysis of the intestines. Various theories as to taking sulphates to make the lead insoluble have been constructed; but they are all a delusion, and only add to the evils caused by the lead. The fact of lead being in the system is always demonstrated if there should be a blue or slate-coloured line round the gums at the margin of the teeth, and which is seen on turning aside the lips, generally most distinct over the upper front teeth. This line is probably a sulphide of lead. (2) To keep the lead out of the system the following facts and precautions must be borne in mind. Lead and other poisonous substances used in the arts enter the system by three ways. (a) As vapour actually existing in the atmosphere of the workshop, and which, being breathed by the operative, is thus conveyed in a volatile form into the system of the operative. Examples: Quicksilver, phosphorus, arsenical preparations, and other rarer substances under special cases, as the osmium vapour in platinum melting, thallium vapour in certain rarer works, zinc vapour in brass founding, &c. Taking quicksilver as an example, some manufacturers have been known vile enough to keep the rooms in which looking-glasses stand to drain, in which their men have to work, at a high temperature, and refuse to allow the windows to be open, partly to make the glasses drain more speedily, and partly to prevent the quicksilver vapours from being diffused and carried away by ventilation. The result is that men who do not know better than to work in such shops, become afflicted with a form of shaking palsy, which is due simply to mercurial poisoning. Moral: Shops in which silvering work is done should be kept very cool, so

as to prevent the mercury from volatilising into the air; and they should be freely ventilated, so as to carry off the atmosphere rapidly and prevent the vapour from accumulating in the air of the room to any great extent. In match factories, where phosphorus is used, the vapours of phosphorus again volatilise and accumulate in the air breathed by the operatives. A terrible disease of the jaw was produced in such operatives as had decayed teeth, through which the phosphorous vapour could pass into the substance of the jaw. It has since been found that the vapour of turpentine in the atmosphere of such workshops prevents the poisonous influence of the phosphorus, and a modification of the ordinary phosphorus is, I believe, also used. The result is, that while in former years I often saw such cases of phosphorous disease in hospital practice, I now never see them.

(b) Fine powder diffused through the air is another way in which non-volatile substances enter the system by being breathed as fine dust and adhering to the lining membrane of the nose, mouth, and air-passages in the lungs. In the carbonate of lead factories by the dry way this is a fertile cause of lead poisoning. In the making of artificial flowers, girls often get poisoned by dry arsenical, plumbeous, and other powdered pigments being dusted about and breathed. In grinding dry colours such results, again, may be induced. Some of these methods of manufacture are unnecessary, and ought to be entirely prohibited when dangerous to workpeople and capable of being superseded by other processes, though these may be rather more expensive, and may add somewhat to the cost of the product. The use of arsenical, chromium, and sometimes of cupreous and of lead pigments, ought only to be allowed under special regulations. Operatives in such trades should take care not to breathe such dust; to use the pigments in such way as to produce as little dust as possible, and to work only in well-ventilated rooms. (c) Some substances enter the system neither as vapours nor as fine powders diffused through the air, but simply through dirty and careless habits on the part of the sufferers. As painters, many men will work for years and never become in any way contaminated by the lead, unless they are much engaged in dry colour-grinding. Such men will be found to be clean in person, to eat their food carefully, and generally to wear no moustache or hair about the face. In trades such as scissors-grinding, stonework, milling-work, &c., the dust which is breathed is only injurious as a mechanical irritant, and the use of a bushy moustache coming well down over the mouth is an excellent contrivance as a respiratory sieve for the air. But if a man occupied in dry white-lead grinding wear a moustache, it becomes a receptacle for the poisonous dust, and this at meal-time becomes mixed with the food and passes into the stomach. A painter cannot help getting his fingers contaminated with particles of lead paint. If at meal-times he handle his bread and other food with his fingers, some of the lead will find its way into his system. Therefore a painter, &c., should never touch his food except with a clean knife and fork, and he should always carefully cleanse his lips and face before meals. The working clothes of a painter become contaminated with lead. Hence, a clean linen blouse should always be worn over his clothes while at work, or the clothes in which he goes home should be carefully changed before he sits down to meals, to rest, or recreation.

Careful washing also at the end of each day's work should be practised. If particles of lead, &c., are allowed to become imbedded in the skin, and allowed to remain there, absorption through the skin itself may become a source of lead-poisoning. These considerations cover the whole subject of lead-poisoning, so far as it is the result of working in noxious trades. Lead, however, often gets into the system as the result of water acting upon leaden cisterns, pipes, cooking vessels, &c. Such solution of lead in water and articles of food is vastly augmented by the presence of acids in the water—even of carbonic acid, and, in making soda-water, great care has to be exercised, or the leaden vessels become a source of poisoning. Again, the joining together of lead by solder, its connection with copper wires, brass taps, &c., sets up a galvanic action, which makes the lead much more soluble. On examining old leaden cisterns which have been joined by solder, or connected with copper, the lead near will be found corroded away. Autogenous soldering, or burning together of the joints, ought to supersede joining by soldering in all such cases; and the possibility of galvanic action should be guarded against by better forms of construction.

INDIGESTION AND GALL-STONES (46107).—For indigestion read prior replies. For gall-stones, keep down to light weight, live carefully, eat little flesh, and live chiefly on vegetable food. Leave off all intoxicants, such as alcohol and tobacco. Gall-stones are waxy concretions (crystallised cholesterine) formed in the gall-bladder. When once formed, there is no cure but to go through the agony of passing them, which is brought

about by their slipping into the bile-duct, and being gradually forced out by a sort of hydraulic pressure from behind, until they drop into the intestine. If a stone passes, the stools should be evacuated into water, and carefully broken up and examined. The gall-stone will be found floating upon the top of the water, like a pellet of pale-brown wax. If it is faceted there are more in the gall-bladder, and the patient should look out for other seizures. But each seizure dilates the bile-duct, and enables another stone to pass more easily. During the attacks, the hot bath to relax spasm, hot fomentations, and if the pain be very agonising, the inhalation of a few whiffs of the vapour of chloroform, ether, or even of strong, unsweetened rum or whisky, will take the edge off the suffering. Violent exercise is not good, and especially for this querist; but free oxidation, by riding in the open air, and avoiding sedentary occupations, close, hot rooms, &c., is very necessary to prevent the growth of those that have formed, or the formation of fresh ones.

TELEGRAPHIST'S PARALYSIS (46124).—"Telegraphist" has overworked certain muscular bands and nervous connections which constitute the apparatus to perform the particular movement which he has continued so recklessly. These are more or less worn out. His remedy is change of employment, so as to throw his work on to other muscles and nerves. Nothing else will do aught but waste his money and mislead him. Tailors who work a heavy goose iron many hours a day get a form of paralysis which disables them from using the goose. Law-writers, who drive a quill sixteen hours a day for years, get paralysis of the small muscles which do that particular work and get what is very inaccurately called "writer's cramp." It is not cramp in any other sense than that the attempt to do what there is no muscular apparatus remaining to accomplish causes cramp and painful strain on the part of muscles which cannot accomplish the peculiar movements required for the quill-driving. The facts which "Telegraphist" narrates, and which to him are so curious, are thus entirely explained. If one of his wires got overheated and spoiled, he would send his messages round through some other wires, or abandon the effort to communicate with the destination of the damaged wire until a new wire was put up. Now, as he cannot put into his arm a new set of musculo-nervous fibres he must expend his working energies through other channels. Law-writers thus paralysed in the right arm and hand may learn to write with their left, and thus go on again until they have used up that. If "Telegraphist" continues such excessive work with his left hand, he will soon paralyse that. Operatives of this description should learn to work with both hands, and use each hand alternately until tired. The alterations of rest will then allow of repair being kept up, and this utter breakdown will be prevented.

James Edmunds, M.D., &c.
Grafton-street, Boud-street.

THE WORLD BEFORE MAN.—At the Owens College, on Monday last, Prof. W. Boyd Dawkins delivered the first of a course of lectures on "The Ancient World, at the time of the appearance of man." In the three earlier stages of the tertiary period, he said, the forms of life on the earth presented a gradual progress in the direction of man, but in the absence of the higher specialised animals it was unreasonable to look for the presence of man. Among the higher mammalia living genera began to appear in the miocene, and a few living species in the pliocene period. It was only when these began to increase in numbers in the next stage of the inquiry that man appeared. In the eocene and miocene periods Europe was united with Iceland and Greenland, and also with the United States of America by a barrier of land, extending past the Faroe Isles, which was covered by dense forest, composed to a large extent of the same trees, in Europe and in America, and which allowed of a comparatively free migration of animals to and fro between England and the United States. In the rivers of Europe were alligators and fish not to be distinguished from those of America. In the pliocene age the barrier of land became depressed, and for the first time in the history of the world what is now the Atlantic became connected with the Arctic Sea. During all these changes the British Isles formed part of the Continent, and the Atlantic seaboard was marked by the 500-fathom line. As regards the changes in climate in Europe in the three periods, the lecturer said that during the first period the climate was tropical in Britain, palms and breadfruits and other southern trees living in the south-east of England. In the second period the climate was cooler and palms were scarce, but magnolias and tulip trees and wellingtonias abounded. In the third period the climate became temperate. These surroundings of man were gradually shaped in the three earlier stages of the tertiary period until they arrived very early at that equilibrium in which we find ourselves to-day.

REPLIES TO QUERIES.

* * * In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[45389].—Friction.—The question was, the power required to raise 4 tons, including friction dimensions, as follows:—

Diameter	3in.
Pitch	1in.
Lever	4ft.
Weight	4tons.

$8960 \times .5 = 1486$, exclusive of friction. To find $6'28 \times 48$

the friction, I assumed the coefficient of friction iron on iron (well oiled) .08, it would require a weight of 7168lb. over a pulley to move 4 tons. Then, as the circumference of the lever is to that of the screw, so is 7168lb. to the force required to overcome the friction. This is an approximation which, in the absence of any known law, may be of assistance to your correspondent.—GABARAI.

[45415].—Cement for Bicycle Tires (U.Q.).—The great point is in knowing how to apply it. I have put on many a tire as follows, and never failed to make them stick fast:—Heat about 6in. of the rim by a gas-flame (Bunsen burner preferred), plaster some hot cement on to the hot rim, and so on all round; when everything is cold put your rubber tire carefully on, and heat the metal rim as before; they will soon be as firmly bound together as apprentice and master.—CUMRI.

[45516].—Hand Thresher.—Having seen to further information on this subject, I take the liberty to ask "Strathay" what height his machine is from the centre of drum to ground, and whether it is fixed in a loft or on a ground-floor. I do not think that his plan would work satisfactorily, the shakers, in my opinion, being too far from the drum; but, if he would state about height, &c., I would gladly help him so far as I could, although I fear what he wants done will require a great deal more power than he had formerly.—WAS-HELL.

[45570].—Loco. Slide-Bars Cutting.—I thought, by putting my reply (p. 523) to the query in the form of a question, I should save space, and I am inclined to think that the original querist has found my question sufficient. The query is slightly confused, for in the head it is "slide-bars," and in the body "slides." Not to split hairs, however, I asked, Do slide-bars cut more when running tender first? "Locksmith" says, "of course they do" (p. 571); and I reply, "of course they do" not. I suspect that what the querist wanted to know was why the lower slide-bar cuts (or wears) more when the engine runs tender first than when the chimney leads, and the answer to that is, for exactly the same reason that the upper slide-bar cuts more than the lower when the engine runs in forward gear. If your correspondents will, with a few strokes of a pen, draw a wheel, a connecting-rod, and the sliding head of the piston-rod, and consider the strains as the wheel is driven round, it will be seen that for each revolution part is a thrusting motion, part a pulling motion, and during the thrust there is necessarily more friction on one of the bars than on the other. When the engine runs chimney first the wear falls on the upper bar. There is no charge of bad work in my reply, for I do not admit the existence of the excessive cutting.—NUN. DOB.

[45579].—Metallurgical.—My very best thanks are due to "S. E." for his very interesting reply under above heading. But a serious difficulty—at least to me—occurs at the outset. Captain Bay says:—"While quite wet the plate is plunged into the copper solution." "Ay, but there's the rub." What copper solution? If a solution of sulphate of copper is used, the zinc is attacked violently, and no deposit of copper can be made. If a solution of cyanide of copper is meant it attacks the printing ink and dissolves it. So here is the dilemma, and I have to confess that I am not acquainted with any other "copper solution." Perhaps "S. E." could inform me as to how to arrive at this much-coveted "copper solution."—D'EVILX.

[45665].—Picture-Frames (U.Q.).—Picture-frames, I believe, are frequently "gilt" by being first coated with white bronze powder, and then varnished with gold lacquer. I should imagine that in oak frames treated by this process the grain of the wood would be distinctly visible.—ALAN W. SOWARD.

[45759].—Noisy Fan.—It is impossible to say without examining it. Does it run without scraping or grating when turned slowly, and are the parts properly fitted?—T. P.

[45761].—Concrete Pigsties.—A great deal of valuable information on concrete, from our friend

"Khoda Bux," appeared in Vols. XV. and XVI. Perhaps, if his attention is directed to your query, he can give the information required. Of course, there are books on the subject, and plenty of matter in the *Building News*; but, judging from the letters of "Khoda Bux," I should think he could give a definite reply to your question. The materials are, Portland cement, washed gravel and sand, broken brick, burnt ballast, clinkers, broken flints, &c. The cost depends on the price of materials; but anywhere near such materials as indicated, concrete is cheaper than brickwork, and, I should think, better.—NUN. DOR.

[45781].—**Engine Whistle.**—The whistle is nothing out of the common, as the pitch depends, to a certain extent, on the pressure of the steam. What you hear is probably a harmonic; or perhaps the driver has doctored it, so that "somebody may know it's him." I remember many years ago the driver of one of the early trains from London, whose house happened to be near his terminal station, who produced a very fair imitation of "I'm-a-coming," as a signal to his wife to get breakfast. How he did it I don't know. The engines on the Bow and Fenchurch line, are rather antiquated, I believe, and there may be something peculiar about their whistles; but the advantage is nil.—NUN. DOR.

[45788].—**Wind Power.**—To "SUNLIGHT" AND "T. N. C."—Thanks to above for their replies. The position for proposed windmill is rising ground near the top of a range of hills, where the full benefit of any breeze would be obtained. The mill would be required to pump water to a store tank for domestic and farmyard purposes. What arrangement will be required to turn the wheel to the wind? and do you think that the water from store tank (20ft. high) will have sufficient power to work a motor for chaff-cutting and other purposes? Any suggestions and sketches will be welcome. Will "T. N. C." kindly send sketch of the one he mentions?—VULCAN.

[45834].—**M.R. Engines.**—What I required in the latter part of my query was the size of the cylinders of the engines mentioned, after having been "rebuilt." The 340 class, rebuilt by Mr. Johnson (1876-7), have cylinders 17in. by 24in. What are the sizes of cylinders of those rebuilt by Mr. Kirtley, such as Nos. 340, 346, 348? They have cabs and straight framings. No. 640 had cylinders 16½in. by 24in., but has been rebuilt by Mr. Johnson. To what size have they been enlarged? I should like to know the same about No. 933 (rebuilt 1881). Have any of the 16½in. by 24in. cylinder engines been rebuilt with cylinders 18in. by 26in.? Can Mr. Stretton say anything about the 210-223 class of shunting tanks?—METEOR.

[45867].—**Throttle Valve.**—I don't approve of "Sunlight's" proposed valve; it appears to me novel, and I am sure that it would be very difficult to make, in order to have it even tolerably tight, and then would be very liable to stick fast at times. Also, it would require too much movement to fully open and shut it. The way I would go to work would be first, turn out the ring, as shown in diagram; but I would have this of cast-iron with stuffing-box on one side for the spindle, as at Fig. 2, and not a thick ring, as shown, but as a piece of the steam-pipe having two flanges, the diameter of bore being slightly larger than the rest of the pipe. Next, I would fix a piece of boxwood or beech in a suitable chuck or face-plate, turn it to a little larger than would fit the pipe. Next, with tenon saw, cut through said wooden cylinder at an angle of, say, 45°, then another sawcut parallel to the first, and of the desired thickness for the valve pattern; lay aside the chuck with the remaining piece of wood in it; glue and spring a thickening slip on each side of pattern, where the axle is to go through; get it cast in brass; drill two small holes in the brass. For wood screws, bed the axle part on the face of the piece of wood remaining in the chuck; screw it firmly to it, then mount upon lathe and trip it with slide-rest until it fits into its place. If you have provision for fastening the mandril securely and drilling the axle hole before unchucking, why, do so, and you will then have a perfect fitting throttle-valve, which will be fully open or shut with very much less rise or fall. Q.E.D. P.S.—I forgot to plug up the two screw-holes.—J. J. A., Liverpool.

[45870].—**Waterwheel.**—To "SUNLIGHT."—I will give the question a little consideration, and will give him some further ideas as to the question. If possible, in time for next issue.—SUNLIGHT.

[45884].—**Making Gas on a Small Scale.**—Would J. Kendall kindly give a few more particulars about his gas apparatus?—say, the size and how it is to be lined—with lead? Whether it is soldered together or how, and what is the cost of making gas with it?—M. K. C. W.

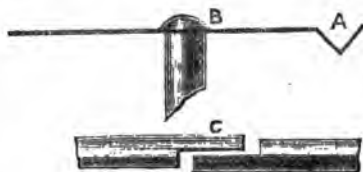
[45920].—**The Audiphone.**—I am much interested in Mr. Fletcher's letter on this subject, but I think he is in error on several points.—1st. He says that it is not necessary to put a strain on the in-

strument when in use. Now, all my experience is the other way: I tried every kind of material set to a rigid curve, but not on strain, and I found as much difference between the two as between a drum-head or a fiddlestring being tight or loose. Mr. F. also says, secondly, that it is of no value to hold the lower end in the hand. Now I have found, in every instance, that it makes a difference of about two notes for the better when held in the hand, by which I conclude that either the bones or the nerves of the arm assist to conduct the sound to the aural nerves, but I consider that the nerves are the principal conductors. Mr. F. says, thirdly, that teeth are absolutely necessary, as the sound is conducted by the bones. I tried my instrument with three of my friends—one is 70 years old, and has not had a tooth or a stump in his mouth for 7 years, and he hears remarkably well with it; another friend, aged 62, has just one tooth, has been deaf 40 years, cannot hear a sound in the ordinary way, has to keep a slate in his pocket for communication, but with my instrument can be made to hear perfectly. Another friend, aged 54, has been deaf 35 years, a very extreme case: she has no natural teeth, but a good set of artificial—I tried her with a common piece of cardboard, and she heard well. I would not, therefore, have anyone despair of hearing because they have no teeth, till they have made the trial.—ROBERT SEAGER, Ipswich.

[45943].—**Pressure of Water.**—It was pressure in pounds per square inch I wanted to know, and will "Labor Omnia Vincit" or "Sunlight" kindly say if 43-35lb., or 100ft. fall, is pressure enough to drive a water motor? I thought a mercury gauge was the best to prove the pressure by.—WATER MOTON.

[45945].—**Expansion Link.**—To "SUNLIGHT."—Thanks for replying. Am sorry I did not make my query understood. I wish to know how the length is determined of the slot-link in the ordinary link-motion, as fitted to locomotives. The eccentric-rods are fixed to the ends of the link, and the radius of slot is equal to length of eccentric-rods. Links of the same class are fitted to the M.R. locos., No. 1482 class; the G.W.R. narrow gauge; the G.N.R. 8ft. Express, No. 93 class; G.E.R. 7ft. 6in. Express, No. 245 to 254, and 600 to 609 class, and to nearly all the tank engines on the above line. I also see that the 6ft. 7in. coupled express on the L. and S.W. have the same form of expansion-link. Hoping you will understand me now.—A TWO YEARS' READER.

[45949].—**Copper Bits.**—I think my answer needs a little explanation. It certainly does look as if I meant soldering zinc with rosin, as "J. J. A., Liverpool," seems to think. In my experience soldering zinc and iron and using acid chloride of zinc does take the tin off and corrode the bit, and so I only use it for those two metals, and expect to tin bit again after using it. For lead I use tallow, and rosin for copper, brass, and tin. I think others must have noticed that if copper wires are soldered, using fluid instead of rosin, unless well washed, the copper near the joint turns green, and that means mischief if the wires are fine and belong to electrical apparatus. The following is a plan I use for soldering wires and small brasswork: Get a piece of sheet-copper, about 1in. by 4in., and bend one end into a small groove, as at *a*, looking edgewise,



and mount it so that either end can be brought over a spirit-lamp. Mine has a stout brass wire, *b*, riveted to the middle, and this goes into a tube standing at side of lamp. This tube is also useful for wire rings, to stand anything on that may require heating. Both the flat and grooved ends of copper-plate are to be filed clean and tinned or covered with solder, which must be renewed as used. Rosin should be used. The thing to be soldered is cleaned, heated, and rubbed in rosin, and then on the solder. Some are best tinned separately, and put together in the lamp-flame; and if the joint is made to fit close, it will be very strong. In soldering stout wires, I always make a splice by filing half of each wire away, and soldering the two flats thus formed together. If the wire is to be bent, it is best done before soldering. I think this little affair will be found very convenient to anyone who tries it. The wire-joint is shown at *c*.—E. F. C.

[45958].—**Vitever.**—Vetever or Viti Vayr is the very sweet scented fibrous root of *Andropogon muricatus* (one of the grass tribe), first imported into Europe about 50 years ago, which is used in India to perfume rooms, and to preserve stuffs and

clothes from insects. According to Vauquelin, it contains an aromatic principle analogous to myrrh. Doubtless, an oil is extracted from it, which possesses the scent, &c., of the plant; but I am unable to say to what uses it is applied, further than by conjecturing that, in all probability, they are similar to those of the root itself.—M. A.

[45968].—**Repairing Large Marble Mortar.**—I have never heard of silicate of soda for repairing marble with: the strongest cement is shellac. Heat the parts of mortar before a fire until it will just melt shellac when laid on, and then attach other parts, and press well together; the shellac must not boil when put on, but only just melt. The best plan, however, will be to purchase a new one, as it will never stand anything but very light pounding.—H. H.

[45982].—**Photo. Transparencies.**—I shall be much obliged to Mr. Lancaster if he will give the necessary instructions he mentions.—MEME.

[45993].—**Railway Distant Signals.**—I think arms are much better for distant signals than discs, being, in my opinion, seen better, which is very essential. I also think it is better to have two distant at a junction. The new arm which swings clear of the signal-post is a decided improvement on the old-fashioned arm, and is not liable to be frozen up, as is the case with the old one, which, when at "all right," gets blocked up with snow, and freezes fast. The new arm is fast taking the place of the old one on this line (G.N.R.) I inclose rough sketch of the new arm as it appears



at "all right," for the benefit of those readers of "ours" who are unable to see one. The idea of having the distant fish-tailed is a good one, as they are then at once distinguished from home signals. I may say the inclosed sketch shows the back of the arm. Now, as to lights: Green is by far the best for an "all-right" light, being not easily mistaken for lights in dwellings, &c. One great advantage is, it cannot be taken for an "all-right" signal, supposing the red glass of a danger signal was broken, as would be the case if white was the "all-right" light. A white light now, where either a green or red light should properly be seen, is taken as a danger signal, and treated accordingly. The same may be said when there is no light at a signal-post. Purple would not be any better for a back light than green, purple being, on this line (G.N.R.), the "all-right" light for the slow lines. I think white as a back light when at danger, and green when at "all right," could not be improved upon. I did not know, as stated by "Titlesworth," that the new arm was also used for home signals. I always understood it was only used for distant. I should like to know Mr. C. E. Stretton's opinion on the above subject.—INOX HORSE.

[45998].—**Slide Valve.**—Perhaps I should have stated that to do what is desired would need special arrangement of the valve-gear, and necessarily that means some little additional complication. The best way perhaps would be to work the slide with a cam motion, when any desired movement could be easily got. I know that there is much difficulty entailed, but let me add that it can be and has been done either by the use of a cam or at the sacrifice of simplicity in the valve gear.—SUNLIGHT.

[46000].—**Automatic Musical Instruments.**—I perceive by the questions asked by "W. R. H." on the construction of the pianista that the explanation given in No. 876 is not sufficient to enable the best mechanic to construct one without further information. Probably, in addition to this, a personal inspection is necessary, the apparatus being unique of its kind. As an amateur, I may not be able to give in each case the proper technical terms, but will add the following to what has already been described, as far as I have been able to examine the instrument. I am not acquainted with the air-reservoirs in barrel organs, or know exactly what a cuckoo-feeder is; but I suppose it to be the usual method of making bellows with fixed

leather hinge at one end, and expanding mouth-like at the other when inflated. This is true of the pianista:—1. The reservoir is composed of two planks: the shelf on which it rests forms the third or base. The middle plank has long narrow openings, one each side, for the admission of air, and of course must have valves inside to retain it, though I cannot see them. It is prolonged beyond the upper plank to receive an iron pin, on which two hard wood rods work connecting the cranks above. 2. Diameter of toothed wheel on crank stem, 1½ in., with 18 teeth; ditto, on upper roller, 2 in., with 32 teeth. Just within the larger toothed wheel are a couple of cogs for working the rollers on one another. The toothed wheels hold an endless chain, 20½ in. from outside of one to outside of other, made of links riveted to each other, and at right angles to divided wire, so as to fall regularly over the teeth. 3. Diameter of vulcanised rollers nearly 1 in.; length, 7¼ in. for the rubber only, fixed on solid iron rods forming the core. 4. The second wheel is on the middle of the case, as before mentioned—a necessary convenience, to allow for the unfolding and refolding of the card-volumes; and may repeat that it is close to, to the right, and parallel with the rollers, that the steel points rise between the ribs of the cylinder. The handle placed at the extreme right of the case, on a level with the right hand of the player, governs the chain communicating the motion to the rollers. Each turn of the handle drags 2½ in. of card between them. 5. The three shelves are made hollow lengthways, but only about 3 in. wide, the rest of the shelf being required to receive the valves, their arms, and the wire springs that press them against the air exits or passages. The horizontal air-tubes communicate with each other, and the reservoir by an upright one at left end of case. 6. Between the shelves holding the note-bellows, there is a space of 4 in. The air-reservoir rises 3 in. The note-bellows 1 in. when inflated. 7. The upright rods are trackers, as mentioned by "W. R. H.," screwed on to the note-bellows arm with brass screw wire, and held fast with hard leather nuts and felt collars. The same above to the striking levers. The rods are ½ in. circular: upper row, 7½ in. long; middle row, 12 in.; lower row, 16½ in.; and are joined to the end of levers where player stands, as the others are over the keys of piano. 8. As far as I understand the action of the wires I will explain. To begin with, the brass ribbed cylinder ½ in. diameter, core of ditto ¼ in., space between ribs ½ in. The steel points are a trifle less to pass freely between them. These all move on a thin rod running through them as a pivot, and have a frame or clamp over them, governed outside by a stop. This turns them on or off. The wires are joined to brass arms or cranks fixed to the points extending an inch below them, and act like levers. The other end of the wire is fixed to a hook in a series of wood ribs at right angles, with a pin at each end fast in the rib, but moving in the framework. The ribs are in a parallel row of 54, ½ in. from each other, the wood being ½ in. thick, and nearly 1 in. deep. This is the clavier, and may be turned backward or forward by pushing the stop to the right or left. Under each rib-side of pianista, against the piano, is screwed a thin plate-iron arm indented above at outer end to receive the loop of a perpendicular wire guided downwards till it reaches a hook in the arm of each valve. These wires are slightly stretched only to allow the spring of each valve to act freely, and yet to pull them open when required. 9. The valves are circular, flat, 2 in. across, with a leather pad covering a round hole of an inch under the shelves, and directly under each note-bellows. They have a wire spring to press them against the hole, and an arm and hook to connect them to the wire leading to the ribs under table. There is also something, a pad or valve, inside hole—that is in the note-bellows, the construction of which I cannot see: perhaps to balance or counteract effect of outer valve. 10. The ribbed cylinder keeps the cards close to the place in spite of the pressure of the points. To do that a steel spring leans on the bearings at each end. The rollers have the same to keep them close together. Both are like carriage-springs screwed through their centres to the case. 11. The tails of levers under table are all one length, but the row of ribs make the wire diminish in proportion as they approach the cranks of the steel-points, so that their bearings slant along the ribs like the wires from bass to treble in the piano. The description given above as to the position of the wires shows how they lead to the valves. First, the horizontal wires of the clavier; second, the perpendicular wires to the valve-arms. 12. Now for the action. "W. R. H." seems to be experienced as a mechanic, as he has so well conceived what should be the mode of action; but, as I have just been observing the play of the instrument, I had better give exactly the result of my observations. The first leaf of card-volume is put against the rollers, a turn of the handle drags it through; then push the stop to the left, then the steel points tend to rise, but are stopped by the card, and all the outer valves of the note-bellows are open; the

continued turning brings the perforations over the points: they rise instantly in every place these perforations may be. This makes the little iron bracket fixed to rib to drop a quarter of an inch, and the spring of the valve being free to act, it closes. As a consequence, the reservoir being constantly inflated, immediately charges each note bellows that corresponds to the perforations or rising points. The note-bellows being charged, inflates, lifts the connecting-rod between bellows and levers that pass through the pianista on to the keys of piano. Of course, as this end of lever (side of handle) rises, the other dips on to the key, striking the note. According to the length of perforation, the key is pressed down, the note sounding as long as the vibration lasts. The returning card again presses the point; the valve opens. There is no action, as the air escapes, till a fresh perforation meets the points, when the action is repeated. When the clavier is turned off no action is possible, and this is wanted to allow of last leaf of card to be withdrawn without jerking the points. At the same time, you can hear the rush of air from the escape-valve, which has a wire spindle to govern it; a nut on this spindle may be screwed up or down if any given pressure is required. Further observation induces me to add that the middle plank of the air-reservoir alone rises the 3 in., the upper and lower plank being fixed to insure steady motion; but, in order to provide the continuous current over the upper plank in the reverse direction, is a single-acting bellows, with wire-springs over it to expel the air, and keep it closed when not in action. This arrangement is required for the expression-stop, fixed on an upright stem, then hinged to a horizontal arm. Connected to this arm is a branch and clamp to press on a large circular wire-spring. This enables the air to be compressed and to strike the keys with varying force. 13. The hinged cards are each 8½ in. by 4½ in., about 1-20 in. thick; should be white or grey cardboard, very firm, but not fibrous. The exit side of each perforation is black-leaded, to make the points slip out easily. I cannot speak of the system of notation here, not knowing the one pursued by the manufacturers. I have my own system, which is slow, and consists of a small T-square, divided along the edge like a 2 ft. rule, with divisions corresponding to those of the cylinder, and marked by the letters A to H, with the intervening sharps or flats, same as the piano. By sliding the T-square along the upper edge of the cards (these being cut true and already stringed with tape), the position of the notes may be pencilled, and afterwards punched out. The cards should be previously marked in sections regularly divided, as the bars in a piece of printed music, whatever may be the number of notes in each bar. This is to be ascertained by the revolution of the rollers, and the rate of movement required. It should be so arranged as to turn the handle without variation. If unacquainted entirely with music, as I am, it may be necessary to procure a primer of pianoforte instruction, and see how the notes are placed on the scale. I have some pieces of choice music noted by a lady who never knew a note, and they are the perfection of pianoforte playing as usually practised. 14. The space between first and last lever point is 7½ in., same as ribs on cylinder. The making of this instrument is by no means so difficult as a piano. There is no scale of notes to set, no framework of the same importance. The metal parts are exceptional, but need only be finished about the bearings, the cylinder being the most delicate portion. The rest of the work is analogous to that of a piano, but generally rougher; ordinary round-headed screws are used in every direction. This is the most comprehensive description that an amateur can give; but I may advise "W. R. H." to come and see the instrument, when all will be plain sailing; for that purpose (if desired), I have advertised my address in the "Sixerpenny Sale Column," under the head of "Pianista."—W. H. H., Brixton.

[46001].—**Thermometer Screens.**—I have never seen official dimensions given for a Stevenson screen, not even in the instructions issued by the Society and the Meteorological Office of the Board of Trade. My own Stevenson, which has been seen and passed by the assistant secretary of Society measures, inside 12 in. front to back; 22 in. side to side; and is 16½ in. high. The instruments should be placed in the centre, hung upon two upright strips of wood, about 2 in. wide, so that the air may circulate freely around them. I do not think the screen proposed by "F.M.S." would be efficient. When the sun shone the air within the umbrella would become heated, and being then lighter than the air outside, would not be able to escape. It would be worse than the Stevenson in the very point where the latter is faulty, the want of a free circulation of air.—EXEMPTUS.

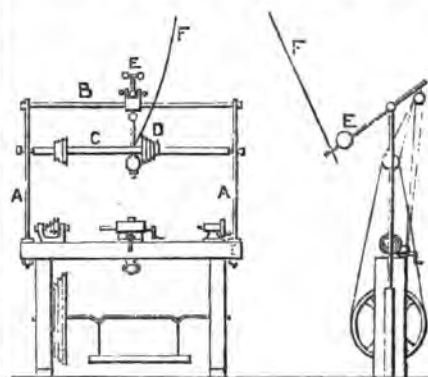
[46001 and 46054].—**Thermometer Screens.**—To "F.M.S." and "AMATEUR OBSERVER."—My Stevenson screen is made of good seasoned pine, dimensions as follows:—Length, 21 in.; depth, 11½ in.; height to eaves, 19 in.; to ridge, 25 in.;

length of ridge, 10½ in. The roof is hipped at each end, eaves projecting about an inch. The four uprights are 1½ in. square. I fixed up two upright strips 3 in. wide, reaching from bottom to ridge in side. On these I hang my thermometers, which are nearly in the middle of the box. Sides and ends are, of course, louver-boarded. I would send sketch, but it can be found in any elementary work on Meteorology. I copied mine from Mr. Scott's book.—C. R. T.

[46002].—**Feed-Water.**—On p. 576 it is stated that the feed-water gets up to a temperature of 204° Fahr. Now the exhaust steam in a condensing engine with 3 lb. of back-pressure would have a temperature of 142° Fahr. Does this steam raise the necessary amount of feed-water to a higher temperature than it has in itself? I should feel obliged if "Sunlight" would kindly explain my difficulty.—SAMOVAR.

[46011].—**Battery.**—The battery must be made up as directed. You cannot put the solution into the cell; if you did, the battery would work from 10 to 15 minutes only. The lampblack is necessary, so is the paraffin paper as an insulator between each couple. Local action will not take place if the flow is sufficiently rapid; and lastly, the zincs will require amalgamating. If you have not already begun the battery, I would advise you not to do so. The construction is not a good one, and would in action soon become choked and good-for-nothing.—W. J. LANCASTER.

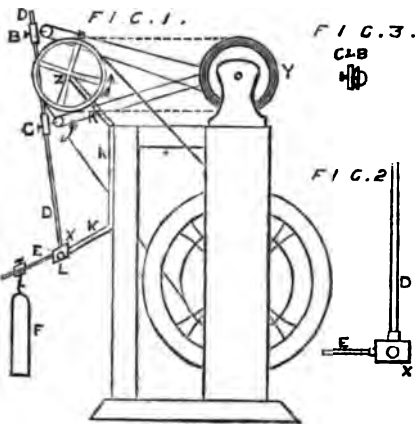
[46013].—**Overhead Motion.**—Perhaps it would be interesting to F. W. Mackenzie to insert the enclosed rough sketch of an overhead motion I fitted to a 5 in. lathe for wheel-cutting, drilling, and ornamental turning. It is very strong and simple, and I think it the best kind for general purposes. The bed of my lathe is teak, with planed wrought-iron plates, ½ in. thick on the top. A, iron uprights



carried by lathe-bed; B, square iron bar fixed with nuts on ends as a stay-bar, and used to carry counterpoise lever; C, driving bar (an old piston-rod) running on steel screws, the points hardened and with check-nuts; D, sliding pulley to work revolving cutters in slide-rest for ornamental turning, drilling, or wheel-cutting, fixed where required by a clamp screw; E, a lever with leaden weight to slide along stay-bar to any required position. This carries a pair of brass wheels at its extremity, over which the catgut band is taken from pulley D, and then to the slide-rest cutter. F, a slack piece of cord or gut attached to a hook in the wall or anywhere to catch the lever bar should the hook and eye of the band break or come off; otherwise it would probably do damage to the points on which the bar C revolves. I have also a simple plan of getting a very slow motion for turning iron.—G. H. H.

[46013].—**Overhead Motion.**—I observe that Mr. F. W. Mackenzie (query 46013) is labouring under some difficulty in putting up an overhead motion to his lathe "in a parlour," so I send a rough sketch of an overhead (not strictly so) motion which I have seen adapted by Messrs. Kennan, of Dublin, to their lathes, and which I have attached to my own at very little expense. It consists of two cast-iron brackets, K, bolted to back of stand of lathe. A shaft, slotted from end to end and same length as lathe-bed, running on two steel screws fixed at either end at the point Z. This shaft is level with the mandril and carries a pulley keyed to shaft, and which may be moved at pleasure to any point along the shaft. This pulley is not seen in drawing. A is the driving pulley with two speeds fixed at near-end of shaft, and is driven from the slow motion of wheel, or on a pulley on the crank-shaft of lathe. D is one of two iron rods 1, by 6 by ½, fixed in one of two brackets X. At right angles to the rod E this bracket is bored through to travel on a fixed bar (½ in.) (not seen in drawing), that is attached at either end at L to the brackets K. E is one of two iron rods, 8 in. by ½ in., attached to the bracket X, to hold the weight, F. This weight, of which

there are two, is so attached as to travel along the bar E. B and C are two of four pulleys, running in shields, and attached each to a sleeve which fits on to the rods D, and which permits of the pulley running up or down these rods, with a thumb-screw at back to fasten them to the rods D at any desired position. If desired, the lathe-pulley, Y,



can be driven from A, which is a convenience when having to shift the band during the progress of a piece of work. Of course, it will be understood from the above that there are a pair of these, Fig. 2, running on the lower shaft. When this motion is in use, the band passes round the pulley, which is keyed to the upper shaft, over the top pulley on rod D, then on to slide-rest over pulley on tool, and then under the lower pulley on the rod, D, and then joined; the weight keeping a strain upon it.—M.

[46014].—Rabbits.—To fatten, give lesser green food, more farinaceous food—bread, rice, &c., swelled with milk, are good. An authority in these matters says that rabbits, if properly fed, are in perfection for the table at the age of eleven to twelve weeks; but two-year-old rabbits are good eating, if nicely cooked.—H. O'B.

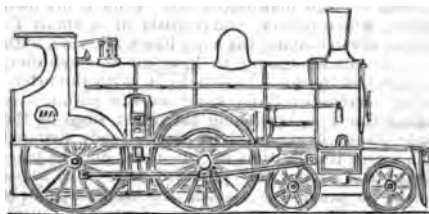
[46015].—Fowls.—Several reasons may be given for the scarcity of eggs. If too much, or unsuitable, food be given, the hens grow too fat to lay well; if not provided with a variety of cosy nests to lay in at home, they will stray, and leave their eggs behind them; if without access to proper materials for forming shell, the number of eggs will be very small. A good substantial meal of mashed food—oatmeal, potatoes, crumbs and scraps of bread, bits of meat, gristle, &c., &c., made warm, say, by being left in the oven all night, should be given to them first thing in the morning; all the bones from the table should be given them to pick before cat and dog get them; spice, notably a shake of cayenne pepper, as well as peppercorns, &c., left after soup, should be given in the food; eggshells must be pounded fine, and then mixed in also—if a few days old the shells will dry, and can easily be broken very small; the empty eggshells must not be thrown to the fowl, else they may acquire the vicious habit of breaking their own new-laid eggs (perhaps they do this now?). A pan of clean water must always be within their reach, renewed frequently during the day; the hen-house should be kept fresh and sweet by a regular and thorough weekly cleaning; it must be sheltered from cold and wet, to which fowls are very susceptible, and they do not recover the effects of a complete drenching rain on their feathers for 12 or 14 days after it. Hens often steal eggs, and must be watched for; and "mug" nest-eggs are more mischievous than useful, and, therefore, should be banished. One word more as to the nests for laying in: Hens are (like many other ladies) both fanciful and fastidious; they like to have a choice, and, therefore, it is a wise plan to provide a variety of boxes, baskets, little tubs turned sideways, &c., &c., in secret corners, or one behind another, each furnished with clean straw, or hay, or clean and dry withered leaves. I have seen two hens squabbling for possession of a favourite old butter-firkin; and the end of it was that the second hen walked over the other's back as she sat, and squeezed herself in at the end; and there she laid! And, finally, keep the hens in their house until after noontime, to secure all the eggs. Some days the hens lay early, other days later, even up to three p.m., after which hour it is very rarely an egg is dropped. A good feed of dry corn is necessary just before roosting time. I speak from successful personal experience.—H. O'B.

[46016].—Fowls.—The answer given "Hatch 'em" in this week's No. of the "E.M." that he need not complain at getting only one egg per day from his 15 or 16 birds will hardly satisfy him, but had he given some particulars as to how he keeps

and feeds them it would have been easier to advise him. Does "Hatch 'em" observe these golden rules of successful poultry-keeping? Have always plenty of clean water handy, variety of diet, table scraps, sharps or middlings, maize, barley, wheat, "sweepings," &c. Roosting-places warm and free from draughts. An open run—in the roads if possible; avoid over-feeding. From the middle of December I have been getting five to seven eggs per day from my score of birds (light Brahmas, most of them under nine months old) and they cost me from a penny to a penny farthing a week each for food. I mention this to point my remarks about over-feeding, and as I see, "Hatch 'em" says he keeps his birds "very well fed."—H. B. P.

[46016].—G.E.R. Locomotives.—I am afraid I cannot give many of the dimensions of the coupled bogie express engines, except cylinders and height of coupled wheels, which are as follows:—17in. by 24in., and 6ft. lin. I have a very good photo. of No. 160, which I obtained from a driver at Bury. The 7ft. 6in. single engines are not so satisfactory as they ought to be. They are too short in the stroke, and the position of the valves is a failure. On the other hand, they are very steady on the road, and are very fast on the level and down banks, but are bad climbers. I have travelled from Colchester to Liverpool-street behind one of them, 51½ miles in 68 minutes. The 7ft. singles do good work still. Last week, No. 298 ran from Liverpool-street to Colchester, with six coaches, in 1h. 5½ min. I ought to add we were almost brought to a stand at Stratford by signals, and ran the last 2½ miles without steam.—G. C. M. HALL.

[46016].—G.E.R. Locomotives.—Presuming "Tyre" means the coupled passenger bogies, with outside cylinders, the leading dimensions are:—Bogie wheels, 3ft.; coupled do., 6ft.; cylinders, 17in. by 24in. These engines are all rebuilds of the coupled mixed engines, and are twenty in number; dates are 1872, 1876, 1877, and 1878. Six



are fitted with Smith's vacuum brake, and eight with Westinghouse; the main brake-pipe is brought to leading end in all engines, except Nos. 342 and 370. As ten more 7ft. 6in. singles have just come out, of which I saw 602 this week, I presume they are satisfactory. All Mr. Sinclair's 7ft. singles are being rebuilt, and the Westinghouse brake fitted. The coupled engines, numbered from 307—415, are also being rebuilt, and the Westinghouse being fitted. If any more information is wished for, I shall be glad to give it, if possible, about G.E.R.—H. S. P.

[46020].—Lathe Matters.—The best way for short screws is to have a spring centre, which is a simple thing to make, and consists only of a piece of metal fitted into the poppet-head, into which another piece is fitted, and behind it a stiff spiral spring, so that when the mandril recedes the centre follows. This has been found to answer very well.—J. H. EVANS.

[46021].—Battery-Power.—You will be unable to make a bichromate to be equal to four Leclanchés. It may be equal to them when first tried; but then the Leclanché will run down in a few minutes, the bichromate keeping up for half an hour, but then is used up; whereas the Leclanché may be used over and over again, for a minute or two at a time, for two or three years. The one will not replace the other; but each is best for its own particular use.—W. J. LANCASTER.

[46024].—Cementing Silver to Polished Marble.—I once wanted to cement a silver plate on a presentation-clock. I tried everything that I knew, and everything that others told me of; but all to no purpose. I finally succeeded by first gluing a piece of paper on to the marble, and then gluing the plate on to the paper. This has remained on ever since, and shows no signs of moving.—W. J. LANCASTER.

[46027].—Broken Watch-Chains.—Place the female end in the vice, with end upwards, and slit it open with penknife. If the rivet does not come out of both sides, push one side of end, file the head of end, and the rivet will easily be knocked out with a small needle.—M. K. C. W.

[46030].—Optics.—"J. S. S." is quite correct; it should be 6·92 and not "6·33" as given in sections XII. and XIII., and I am obliged to him for pointing out the error. On page 497, in the line

preceding the one in which 6·33 occurs, the coefficient "2" ought to be expunged. In calculations of this nature, it is next to impossible to avoid slight errors, unless the work be done very leisurely and carefully revised. However, the example in question being a supposititious one, and the method being exact, any student can substitute the correct value 6·92, and thence find what the curves should be, without my taking up space for corrections. I fancy it will be found that when the crown is equi-convex and the flint plano-concave, the interior curves will be equal, or nearly so.—ORDERIO VITAL.

[46031].—Gun-Stock Chequering.—This part of the gun-trade, like other branches by the same craft, may be considered a trade of itself, inasmuch as it requires an expert to earn sufficient at it, the pay being low. In reference to the time it takes, that depends on circumstances, the class of work required, the number of superficial inches to be covered with it, the shape of the same, it also being tedious work to one not in full practice, to say nothing of an accidental slip. About 20 to 25 pistol-stocks per day requiring as much chequering as the Adams service revolver, and done as well, might be considered good work. I have known a good workman to be more than a day over a fowling-piece stock of the best make, and the same man, with an inferior one, about half a day, which, when finished, would look as well at first sight as the best, but would not bear comparison when placed side by side.—ARMOURER.

[46033].—Medical Coil.—To MR. LANCASTER.—The reason why a number of coils is used is to vary the current as much as possible. We sometimes put ten to twelve different layers, so that any amount of current may be obtained from a very weak to a very strong current. You can, if you like, use only one secondary wire; then you only have one current, its strength depending upon the number of layers of the wire. The coil with 18 and 36 wire should be joined up, as I described a similar coupling in my answer 45761, same number as your query appeared in. If not quite plain to you I will send drawings. I have been so very busy lately, besides having been called on assize jury, &c., my time has been used up from early morning till late at night. I have the first part of induction coil almost finished, and in a short time I hope to make up for all delays in articles for "ours." I only wish I had the time to spare of scores of people I am continually meeting who admire the MECHANIC, and who possess valuable knowledge which they could easily impart if it was not for the so-called trouble of writing.—W. J. LANCASTER.

[46034].—Amplifier.—A biconvex of crown of 8in. radius, cemented to a plano-concave same radius, will make up a good amplifier. You may use it midway between the object-lens and field-lens of eyepiece.—W. J. LANCASTER.

[46035].—Grinding Hard Mineral.—In order to reduce minerals to powder, recourse must be had to powerful machinery. In the cases of "emery" manufacture, and the grinding of "pyrites," in which I have had experience, the stone is first passed through a Blake's crusher, and from there between a pair of "chilled" rolls, set according to the size required, if required in powder, the broken material is passed through the rolls twice, the rolls being set closer the second time, and then over a set of machine sieves of various sizes. Edge-runners are no use.—FELLOW-WORKMAN.

[46038].—Solvent for Coagulated Albumen.—There is nothing that will do it like pepsine, although caustic potash or soda will dissolve it easily, yet they are too violent.—V.

[46040].—Electro-Magnet.—Why did you not buy a cheap book on electricity before you made your cells?—then you would not have blundered in their construction. You must have the copper outside, and the zinc, simply a rod, say lin. thick, inside a porous cell. The drain-pipe will be no use to you. Purchase the porous cells; they will cost you about 5d. each. Then make up copper cells about 7in. long by 4in. diameter; solder a plate in the bottom, so that it will hold the solution of sulphate of copper. Next make the rod of zinc to go into the porous cell. Dip the bottom of porous cell into melted paraffin for ½ in. up cell; then couple them together, putting sulphuric acid one part, water ten, in porous cell, and, in outer cell, a saturated solution of sulphate of copper. These batteries will work well, and make your magnets strong.—W. J. LANCASTER.

[46042].—Lathe Bearings.—You do not state what kind of work you turn, large or small; if large, I should recommend double bearings. According to description of spindle, it wants relapping, then grinding in with Turkey or flour emery.—YOUNG TURNER.

[46046].—Influence of Music on Snakes.—In the East, snake-charming is carried on by the natives with some kind of musical instrument.

I cannot give the *modus operandi*, as I never saw it performed. The snakes are evidently attracted by it, not frightened. From the description "Wallasey" gives of his Brazilian snake, I fancy he has got what I have heard called out there a "whip" snake; if that is so, the sooner he gets rid of it the better, as a friend of mine, an engineer, had several of his workmen killed from its bite when constructing a telegraph line through the woods in Brazil. I was told out there that the bite of the said snake always proved fatal.—R. H. H.

[46047].—*Speculum Working*.—Two causes are very likely to produce the result that "E. C. A." complains of. First, the use of too-coarse emery in first grinding the tools together. This may be remedied by using No. 4 emery, as described in my letters, working with a short, straight stroke for several hours; one-third the diameter is long enough for the stroke in that case. Second, the bottom tool may not be fixed rigidly enough; there should not be the slightest "give," and the support should be in the centre. Tools will never fit properly unless this is attended to. Should the tools be "spongy" towards the centre, they will never polish all over. There is, however, no need to condemn them on that account; examine with a magnifying-glass to ascertain this, and if it is seen that perfect contact has been obtained, the tools may be used without fear. I see "E. C. A." has his tools faceted; this is needless, nay, detrimental, and is only required in large surfaces, say, 16in. and upwards. Amateurs invariably adopt this theoretically correct and practically incorrect method of tool-making. Ignoring the fact that the polisher very quickly makes all this useless, —in fact, before the surface is half "up"—the original form is changed a dozen times, or more likely, a thousand times.—PRISMATIQUE.

[46048].—*Grove's Experiment*.—The tube should be 10in. long and 1in. diameter; glass tubing will do, but a thin brass tube with glass ends may be used with more success than a glass tube. The coils of wire in the helix should be four to six deep of No. 16 or 18 insulated wire.—W. J. LANCASTER.

[46049].—*Time by Electric Current*.—You will find particulars in the "Postal Guide"; the cost is in the form of an annual payment according to distance from nearest telegraph office. The 10 o'clock current is the cheapest; the 1 o'clock being used so much more through the country than the 10 o'clock, is charged more for.—W. J. LANCASTER.

[46054].—*Thermometer Screens*.—See my answer 46001, page 576. The screen I have given sizes for there is a very convenient one to use. Screens are not so important as to size as they are in construction. Stevenson's is an excellent screen, much better for an amateur than the Board of Trade screen. Better make your screen a little larger than you want it now, so that you can put other instruments in without having to enlarge it.—W. J. LANCASTER.

[46055].—*Bleaching Animal Grease*.—The question "Amateur Dyer" puts, is rather vague. There are different kinds of "animal grease." I presume he means brown bone-grease. If so, his efforts with oxide of manganese and sulphuric acid are useless, on account of salts of iron and other impurities which these sorts of grease contain. I do not think any process will thoroughly bleach this description of grease.—FELLOW-WORKMAN.

[46058].—*Faure's Secondary Battery*.—Use the red-lead very thick, with dilute sulphuric acid, laying on with a small flat brush. Roll the felt and lead sheets as loose as possible. The battery must then be placed in its cell filled with dilute acid. Two small cells, Bunsen's battery, will charge a pair of plates, 12in. by 6in., to keep a platinum wire, 1in. long, red-hot for ten minutes.—J. SUTCLIFFE.

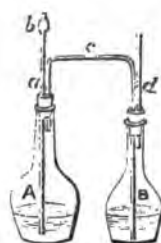
[46061].—*Model Engine*.—By the dimensions of the cylinder I should say the engine is one of the beam-engine class. Let me know if this is so. Also, if you want a vertical boiler with internal firebox or an externally fired horizontal one. With these particulars I will give you sizes. The class of engine will also enable me to give you size of wheel.—SUNLIGHT.

[46063].—*Carbon Bisulphide*.—Sunlight exerts no appreciable action on this liquid.—ANALYST.

[46063].—*Carbon Bisulphide*.—Chemically pure CS_2 does not change when exposed to sunlight, but it is very seldom obtained pure. The impure deposits a brown powder, which is carbon mono-sulphide, CS . This has a density of 1.66, is insoluble in water and benzene, and only slightly soluble in boiling carbon bisulphide and ether. When a mixture of carbon bisulphide and water is exposed to sunlight for some months, carbon sesquisulphide, C_2S_3 , is formed. This is an amorphous brown powder, insoluble in alcohol, ether, and carbonic bisulphide, and readily decomposed when heated to about $200^\circ C.$ ($392^\circ F.$).—F. BARKER COOK.

[46064].—*Estimation of Carbonic Anhydride*.—For the estimation of CO_2 , when present in small quantities, I would recommend the following process:—Weigh out 5 to 10 grams of the finely-powdered mineral into a small flask, closed by a perforated cork carrying a pipette charged with dilute hydrochloric acid, the upper end being closed for the time being with a caoutchouc cap; also a short glass tube, which serves to connect the flask with a U-shaped tube, one limb of which is filled with pumice, which has been saturated with copper sulphate solution, and strongly heated; the other with fused calcium chloride. This tube is connected with a second one filled with coarsely-powdered soda-lime, and accurately weighed. Everything being arranged, the dilute acid is allowed to flow into the flask, by removing the caoutchouc cap from the pipette. The carbonate contained in the mineral will be immediately decomposed, and the CO_2 evolved, after being deprived of HCl and aqueous vapour by the materials in the first U-tube, will be completely absorbed by the soda-lime in the second tube. When all action ceases, the contents of the flask are heated nearly to boiling, and a slow current of air drawn through the apparatus, so as to sweep every trace of CO_2 into the soda-lime tube, which is then detached and weighed. The increase in weight shows the quantity of CO_2 in the sample.—ANALYST.

[46064].—*Estimation of Carbonic Anhydride*.—To estimate the amount of CO_2 , an apparatus similar to the figure is used. The size of the



flasks depends on the capacity of the balance. B may be smaller than A. The tube *a* is closed at *b*, with a small piece of indiarubber tubing stopped with half an inch of solid glass rod. The other end of tube *a* is open, as are also both ends of *c* and *d*. The flask B is nearly half-filled with pure concentrated sulphuric acid. The tubes must fit air-tight in the corks, and the latter equally so in the flasks. The weighed substance (about 1grm. would be sufficient) is put into A. This flask is then filled about one-third with water, the cork properly inserted, and the apparatus weighed carefully. A few bubbles of air are now sucked out of *d*, by means of an indiarubber tube. This serves to rarefy the air in A also, and causes the sulphuric acid in B to ascend the tube *c*. The latter is watched for some time to ascertain whether the sulphuric acid in it remains stationary, which is a proof that the apparatus is air-tight. Air is then sucked out of *d*, which causes a portion of the sulphuric acid to flow over into A. The carbonate in A is decomposed by the acid, and the liberated carbonic acid, completely dried in its passage through the sulphuric acid in B, escapes through *d*. When the evolution of the gas slackens, a fresh portion of sulphuric acid is made to pass over into A, and so on until the whole of the carbonate is decomposed. A more vigorous suction is now applied, to make a large amount of sulphuric acid pass over into A, whereby the contents of that flask are considerably heated. When the apparatus is quite cold the stopper *b* is opened and suction applied to *d*, to draw out the remaining CO_2 , should there be any. The stopper is then replaced and the apparatus weighed; the weight obtained is subtracted from the weight of the apparatus when weighed before, and the loss is the amount of CO_2 in the quantity taken for analysis.—F. BARKER COOKE.

[46065].—*Rochelle Salt*.—The possibility of calculating the amount of potassium and sodium in a known quantity of their mixed chlorides, from the quantity of standard silver solution required to precipitate the chlorine, depends upon the considerable difference that exists between the molecular weights of the two chlorides. The method of calculation will be best explained by an example. Suppose, for instance, that by igniting a certain quantity of Rochelle salt, extracting the charred mass with water, adding excess of hydrochloric acid, and evaporating to dryness in a tared platinum dish, we obtain exactly 0.1331 gram of the mixed chlorides, which, when dissolved in water, are found to require 20 cc. of decinormal silver solution to complete the precipitation. This would indicate the presence of 0.071 gram of chlorine, a quantity which would be contained in 0.1492 gram of potassium chloride; but

the mixed chlorides only weighed 0.1331 gram. Now, the difference between these two numbers ($0.1492 - 0.1331 = 0.0161$) is proportional to the amount of sodium chloride, which is calculated as follows:—The difference between the molecular weights of KCl and NaCl ($74.6 - 58.5 = 16.1$) is to the molecular weight of NaCl (58.5) as the difference found (0.0161) is to the quantity of NaCl contained in the mixed chlorides—

$16.1 : 58.5 :: 0.0161 : x = 0.585.$
Hence the composition of the mixture is—
Sodium chloride 0.585
Potassium chloride 0.746
—1331

From which the quantities of sodium and potassium are readily calculated.—ANALYST.

[46067].—*Lifting-Press*.—What is the length of stroke of pump?—J. M. SROCKS.

[46069].—*Automatic Arrangement*.—To MR. LANCASTER.—Make a drum 15in. in diameter, divided into 12 spaces, each space will be nearly 4in. wide at the top and must have a funnel-shaped top, so that cheeks will slide down into the space; then this drum is to rotate once in three hours, and it is inclosed in a cylinder with hole in the top just large enough for checks to pass through. One space passes the aperture every 15 minutes, thus at six o'clock the drum is geared to clock, all checks dropped in before 15 minutes after six, will be found in first space, the next 15 minutes in second space and so on round for the three hours. One side may have a glass front, the other side will have a door, and each division being made separate can be lifted out and the checks removed before second division is touched, then second division, and so on all round. If you do not understand all the details I will make a drawing for you to work from. It is, as you will see, impossible for the men to tamper with the tell-tale, and quite as impossible to put checks into wrong space.—W. J. LANCASTER.

[46071].—*Mechanical Question*.—It is evident that you wish to increase the speed by two equal ratios whose product is two. That is, each pair of wheels increases the speed in the ratio of one to the square root of two. To do this approximately, let D and F be each 14, and E and G each 10 teeth. This will give you speeds in the proportion of 1 to 1.96. To do it exactly is impossible, for you would want the wheels in the proportion of 10 to 1.4142.... an endless decimal. Of course it is easy enough if the wheels, F and G, do not need to be the same as D and E; for instance, G may be 10, and all the rest 20 each.—PLOXT ALMONT.

[46071].—*Mechanical Question*.—The simplest way to make the shaft C turn twice as quickly as the shaft A is by cutting the same number of teeth on each of the bevel wheels, D, E, and F, and half the number on G.—ALFRED W. SOWARD.

[46072].—*Wheels and Pinions for Clock*.—I gave the number for a four-legged gravity regulator last week. See reply to 45452, p. 517.—A CLEKKENWELL CLOCKMAKER.

[46073].—*Chiming Clock*.—Gongs for the Westminster quarters are made of flat steel. About a 3in. by 3.32in. is (as far as my memory serves me) the usual size. The quarter gongs range from 3in. to 4in., and the hour gong about 7in. There are about 2½ to 3 turns in each, and the notes are got by shortening the inner end; it should be tapered down, not filed square; but in my opinion it would be much the cheaper plan for "A Novice" to buy them ready made. If he would like to do so, and will advertise his address, I will put him in communication with a wholesale manufacturer of gongs. The numbers for a quarter-chiming train are:—

Great wheel 144	pinion 12
Second " 80	" 8
Pallet " 72	" 8
Warning, 56	" 8

put on chime-barrel gearing into second wheel, 40. The barrel turns twice in the hour.—A CLEKKENWELL CLOCKMAKER.

[46074].—*Dark Slide*.—To MR. LANCASTER.—It would be difficult to fully explain the making of the double dark slide without having a series of drawings. You should get someone to lend you one of them, then you will be able to tell in a moment whether you could make one. They are very difficult things for an amateur to make; and as you can get one so very cheap, I should really advise you rather to make the camera than the slide. You will find full particulars about making camera in last volume. If the editor does not object to have the woodcuts made, on your sending another query, I will send drawings for you to work from.—W. J. LANCASTER.

[46075].—*Manganese in Steel*.—In reply to J. Edgar, manganese ores of varying strength and qualities are used in the manufacture of steel. It all depends upon the class of steel that is required

to be made, as, for instance, in some steels as low as 9 per cent. to 10 per cent. is used, and in others nearly a chemically pure manganese. If, however, J. Edgar will communicate with me direct, I shall be glad to place him in receipt of whatever information he stands in need of, as I supply 90 per cent. of the manganese consumed, and am, therefore, in a position to give him anything he wants.—GEO. G. BLACKWELL, 23, Chapel-street, Liverpool.

[46075].—**Manganese in Steel.**—The ore chiefly used for its manganese in making steel is spiegel-eisen or specular iron, which has the additional advantage of containing a large quantity of carbon. It is obtained by smelting in a blast furnace with charcoal, a spathic iron ore containing a large proportion of manganese, such as that from the Brendon Hills. The analysis of a sample of this material was—

Iron	82.86
Manganese	10.71
Silicon	1.00
Carbon	4.32

98.89

This is used for making Bessemer steel, being used in the proportion of about 1 part to 30 parts of pig-iron. In Heath's process the manganese is used in the form of carburet, which is formed by heating a mixture of black oxide of manganese and charcoal, or some other substance containing carbon, such as coal tar.—F. BARKER COOKE.

[46076].—**Governors.**—First decide upon the length you would like the arms to be, as this is often influenced by the space at command. Rule from "Templeton": Divide 375 by the square-root of the pendulum's length, and half the quotient will be the velocity required. The weight of the balls may be found by "the rule of thumb," as any weight sufficient to overcome the friction of the fixings is all that is requisite, any more than this being unnecessary and useless. There is only one form of throttle-valve which is of any value, and that is of oval section, closing at about an angle of 50°.—J. J. A., Liverpool.

[46080].—**Boring in the Lathe.**—The quickest way is to use an American self-centring chuck, such as are sold as the Victor drill-chuck and others of that class. Failing that, the next best plan is the one I use myself, which is to have a master-chuck fitting the mandril-screw. This is bored out, and carries liners of a standard size, which are in turn held with a set-screw. To fit the Morse drills, you need to turn down a piece of rod-iron to fit the master-chuck, and then with the drill it is intended to carry bore the hole so far down. The steel set-screw of the master-chuck comes through the iron liner and bites on the drill-shank, so that the whole is held firmly and with no loose parts. The only drawback is that it means a separate liner for each size of drill.—SUNLIGHT.

[46081].—**Engine Diagrams.**—You have omitted to say what your back pressure in the high and initial pressure in the low are. If you will forward me an exact copy of the diagrams, or, better still, the diagrams themselves, I can tell you what is at fault. One conspicuous fault seems to arise from the pipes between the two cylinders being too small, which the receiver does not remedy.—J. B. SHIPLEY, Gas Works, Burnley.

[46081].—**Engine Diagrams.**—You are right; there is too much lap on the low-pressure valve. You omitted to give the scale of diagrams, but, judging from appearances, I think you would do better to cut off at one-third stroke in the high pressure cylinder, and at half-stroke in the low-pressure cylinder. Let me have size of steam and exhaust ports, travel of valves, and whether worked direct or through a rocking shaft, also dimensions of valves, and I will tell you what I would do to get the best results.—LABOR OMNIA VINCIT.

[46082].—**Driving Smith's Fan.**—I fail to see how your fan can be "blown with a pole, bellows fashion," as you aver, as a 14in. fan would be a bleak, blasted blower, unless revolving at, say, 500 per minute; it is utter rubbish to hear speak of these little toy engines constantly mentioned in these pages, as about to be fitted to boats, pumps, fans, and so forth; make your cylinder at least 3in. diam. by 6in. stroke, or your 14in. fan will fail to force the fire sufficient for a heavy heat.—J. J. A., Liverpool.

[46082].—**Driving Smith's Fan.**—An engine 1½in. bore would be "nowhere" with a 14in. fan—surely you would never expect it to. You would need, at least, to have an engine 3in. bore and 4in. or 5in. stroke, and that would be none too large. The boiler for such an engine I should have about 3ft. long and 1ft. 6in. diameter. This, if set horizontally in brickwork, would be the simplest form. The plate should be ½in., and of the best boiler-plate. By the rule I use, rivet ½in. diam. would be the right size; the length under the head, 1½in.; distance apart from centre to centre of rivets, 1½in.; breadth of lap of plate, 2in.; the

ends to be flanged inside the cylindrical shell; man-hole, 8in. by 6in., with stiffening ring round the edge.—SUNLIGHT.

[46084].—**Boiler.**—Memo.—Just read, mark, and inwardly digest my reply to No. 46082 on this subject, and cease to expect boys or toys to be able to do men or machine work. Use coals for firing unless you have a superfluity of tin. Make your joints with red and white lead mixed together. When about to use it, screw up moderately and repeat; when engine is hot, use hemp gasket for packing.—J. J. A., Liverpool.

[46084].—**Boiler.**—Simplest form of boiler would be horizontal, set in brickwork. And I would not advise you to try to use gas except with a boiler of the vertical class, with special arrangements to use a gas fire. Horizontal boiler might be, say, 3ft. long, and 1ft. 3in. diam.; fire-grate, 1ft. square; plate should be ½in. thick (see also reply to No. 46082). I should carry from 30lb. to 40lb. of steam in such a boiler. But a 2in. bore engine is a little small, except it runs at a great speed, say, 280 revolutions a minute. I should strongly advise you, if possible, to use a coal fire with perhaps coke mixed after steam is up. Lag the cylinder first with felt, and then strips of mahogany overlaid in place with brass bands. For making the joints of cylinder covers and valve-chest, use thick drawing-paper soaked in boiled oil. This will, if the joints are properly faced, never leak. Pack the glands with lamp-cotton well soaked in tallow.—SUNLIGHT.

[46087].—**Air-Pump.**—I suppose you mean you have to put in new injection pipes to condenser. If so, let the pipes have a slight fall to the well. If I do not understand you right, say what the pipes are for, and I will help you with pleasure.—LABOR OMNIA VINCIT.

[46088].—**Solubility in Alcohol.**—Potassium and sodium carbonates are practically insoluble in alcohol.—ANALYST.

[46088].—**Solubility in Alcohol.**—Both carbonate of soda and carbonate of potash are insoluble in alcohol. Being, however, soluble in water, they are dissolved to a slight extent by commercial methylated spirit, as that substance is never anhydrous.—ALFRED W. SOWARD.

[46090].—**Spectroscope.**—Use a spirit-lamp with blowpipe: this gives a good heat, and will enable you to work almost as well as with a Bunsen burner. The blowpipe I mean is self-acting, and enables you to use both hands when experimenting. You can get Lockyer's 3s. 6d. book on the Spectroscope, and go through all the experiments in it; then examine any metal or ore that may come in your way, make a note of it, then, by-and-by, you will become proficient.—W. J. LANCASTER.

[46090].—**Spectroscope.**—If "C. R. T." has no gas, he should use a lamp burning methylated spirit. If purchased at an oil-shop, care should be taken to get spirit and not methylated finish. With such a lamp and a small direct-vision spectroscope, the spectra of the alkaline metals can be easily obtained. In the spectroscopic study of the heavy metals neither gas nor spirit is of use, the temperature produced by their combustion not being sufficiently high. Recourse must then be had to the induced electric current or to the electric arc. The following works may be read with advantage:—Proctor's "The Work of the Spectroscope," Lockyer's "Studies in Spectrum Analysis," and Browning's "How to Work with the Spectroscope."—ALFRED W. SOWARD.

[46091].—**Mechanical Law.**—That when a perfectly elastic fixed body (the table) is struck by a body (the top) moving in one direction and free to move in any direction, the motion is reflected, or its direction is reversed, as when a ball is thrown against a wall.—J. M. STOCKS.

[46094].—**Negatives.**—You can take a paper negative just as you would take a gelatine negative; but a paper negative will not be of much use to you; better take a gelatine negative, then print from that on to the paper. The development of the paper is done with either ferrous oxalate developer, or with pyro. Shall be pleased to give you full information how to go to work.—W. J. LANCASTER.

[46095].—**Preserving and Arranging Fossil Shells, &c.**—The state of preservation of fossils depends on the nature of the strata. Limestone fossils for the most part need no attention save cleaning, for which very weak sulphuric acid and water is as good as anything. For the others, gumming or glueing is the only way; or if the matrix be very soft and crumbling, it is as well to place it in a little plaster of Paris, which presently hardens and keeps the specimen from falling to pieces. For plant and fern impressions such as are found in the coal-measures, dip them in gum-water as soon as possible. This is better than gumming, as the objectionable shiny appearance is avoided. It is almost impossible to preserve impressions in very soft or wet clays, and great care and tender

handling would be necessary. The mode of arrangement usually adopted by scientific men is slips of glass covered with paper, and made to fit in the bottom of the drawer. The specimen may be fixed in the middle of the slip and the name of species, formation, owner's name, &c., written or printed at the bottom.—T. G. F.

[46097].—**Photography.**—One condenser can be used; but two are far better. Your negatives are, however, too large, they should be ½-plate only. I am unable to refer you to any work directly bearing on the enlarging lantern; but in the back numbers of this journal you will find a mass of information on the question. Put the points you want to know into the form of a query, and I will, if possible, tell you what you want.—SUNLIGHT.

[46098].—**N.B. Railway.**—Leaving Queen-street Station, there are first, 200 yards level line, then comes the incline proper, 1 mile 460 yards long, rising 1 in 45, and, lastly, 274 yards rising 1 in 1,285. Total distance between Queen-street Station and Cowairs is 1 mile 42 chains. Yes, a stationary engine is employed for working this incline, the train engine, of course, assisting. Locomotive power alone has been used with more or less success. Between 1844 and 1847 this was the case, and in 1847, Mr. Paton, of the E. and G. Railway, designed two powerful 6-coupled engines to assist trains up the incline. The wheels were 4ft. 9in. diameter. Of the diameter of cylinders I have no record, but should say they were about 16in. by 24in. They were placed outside, directly over the leading wheels, and inclined to an abnormal extent, 20° to 25°, I should say. A large, and not very handsome, dome and safety-valve were placed on the boiler length, also a safety-valve over the firebox. They weighed 27 tons, and stood on a wheel-base 14ft. They were named the "Samson" and the "Hercules." The former was No. 42 and the latter, I believe, No. 43. Owing, however, to the locomotives slipping and otherwise losing time, and probably for other reasons, the winding engines were again resorted to. The remaining 46 miles 60 chains are almost level, the steepest gradient being 333 yards of 1 in 600 falling, near Polmont Junction, and 800 yards falling 1 in 500, and 600 yards rising 1 in 300, both between Haymarket and Waverley-bridge Stations. Thus it will be seen that the formation of the rest of the line presents no particular obstacle to the locomotive. Like the Great Western Railway, this line was laid at a period when inclines of 1 in 70, and even steeper, were not deemed practicable, unless worked by auxiliary power. I trust that this will furnish "E. L. P." with all the details he requires.—CARSTAIRS.

[46103].—**Hard Steel.**—Get diamond-point tools used for this purpose. Often advertised in these pages.—J. J. A., Liverpool.

[46104].—**Fairlie Engines.**—Mr. J. W. Barney will find a great deal of information, and several articles, on the Fairlie engines, in Vol. XXXIX., page 651; Vol. XXX., pages 107 (illustrated), 118, and 579; Vol. XXXI., page 477; Vol. XXXII., page 353; and Vol. XXXIII., page 89.—T. R. SAXTON.

[46106].—**To "Sunlight."**—I am sorry to be obliged to tell you that the size of engine you name will not drive a fret saw, that is, to do any work. It would be quite insufficient in power. The steam-pressure being so low, would still further increase the disability. You would want at least a 2in. bore engine with a suitable boiler to do any good. If you still desire to make a boiler to drive your ½in.-bore engine, I would tell you size, &c., or would you get a larger engine and proportionate boiler?—SUNLIGHT.

[46108].—**Object-Glasses—Dialytes.**—I would advise you, as being mechanically easier, to make a new eyetube, two or three feet long, and put the flint concave in the end near the o.g., and the eyepiece in the other end, and let it all slide together to adjust it, and it then works as a very long eyepiece tube, and will, perhaps add about one foot to the length when drawn out and focussed. Query 2. The length depends on the position and the focal length together, and I generally placed mine so as to make the total length from 11ft. to about 12ft. Query 3. Three inches stopped down to 1½in. The concave 1½in. diameter. Query 4. No; and I do not think it could be expected to show these objects; sometimes it has shown the shadow of Saturn's ring upon the planet. Query 5. Several methods have been described of ascertaining the power of telescopes in back numbers of "E. M." Query 6. Whichever on trial gives the best definition. Try the flat to the eye first.—ARTHUR HINDE.

[46109].—**Hardness of Water.**—"Dyer" should get at a chemist's a small flask known as a "miniature gallon," and a pipette tube graduated in cubic centimetres. These can be purchased for a few pence. A few ounces of soap solution (Castile soap dissolved in spirit) and a stoppered bottle containing about 12oz. will complete his apparatus. Measure a miniature gallon of the water, and put it into the stoppered bottle. Now add

1 cc. of soap solution, shake well. Result—no lather; add another cc.; shake as before. Keep adding soap in the same way until a good fixed lather is produced, and the number of cubic centimetres of soap added to produce lather is the number of degrees of hardness of the water. If under five or six it may be classed as soft; if over that it is hard. Some that I have tried going up as high as 30 and 35 degrees.—ROBERT GODFREY.

[46109.]—**Hardness of Water.**—The best method for determining the degree of hardness of water is that proposed by Dr. Clark; it is conducted as follows:—70cc. of the water are put into a stoppered bottle, and a standard solution of soap in dilute alcohol added from a burette until a permanent lather is obtained. The contents of the bottle must be vigorously shaken after each addition of the soap solution. The soap solution is prepared by dissolving curd soap in proof spirit. It is standardised by means of a standard solution of calcium chloride, made by dissolving 0.1 gram. of Iceland spar in dilute hydrochloric acid, evaporating to dryness and dissolving the residue in 100cc. of distilled water. To 16cc. of this solution diluted with 54cc. of distilled water, the soap solution is added, and the quantity required to form a permanent lather noted. The remainder of the soap solution is then diluted until 17cc. are required to produce a permanent lather with 16cc. of the standard calcium chloride solution. It is then a standard solution, and when used to 70cc. of a sample of water as above described, each cc. consumed indicates 1 grain of calcium carbonate (or its equivalent) in one gallon of the water.—ANALYST.

[46109.]—**Hardness of Water.**—This is generally estimated by Clark's method, which is based upon the fact that when pure water is mixed with a very small quantity of alcoholic solution of soap and shaken for a few minutes, a froth is produced, which is persistent for some minutes, while, on the contrary, when the water contains calcic salts in solution, no such froth is produced until a sufficient quantity of soap-solution has been added to decompose these salts. The quantity of soap-solution requisite to produce the froth in water containing such salts is to such an extent proportionate to the amount of these salts in the water, that, with a soap-solution of known volumetric value, the degree of hardness is indicated by the quantity requisite to produce the froth in a given quantity of water. The hardness of water is expressed in degrees, each of which represents .01gm. of calcic carbonate in a litre (1,000cc.) of water. The soap-solution is made by dissolving white curd-soap in alcohol (sp. g. .92), and its strength is adjusted so that 100cc. suffice to produce the froth with 100cc. of a solution having 20° of hardness. This solution is prepared by dissolving .20gm. of pure calcic carbonate in hydrochloric acid, evaporating the solution to dryness, so as to remove all excess of acid, then redissolving it in pure water and making up the volume to exactly one litre. This standard calcium-solution of 20° of hardness is kept in a well-stoppered bottle. A series of other calcium-standards, varying from one degree upwards, may be made by diluting that solution in due proportions with pure water. 100cc. of the water to be examined is measured into a stoppered bottle of double that capacity, and the soap-solution is added to it from a graduated burette in small successive portions, the water being well-shaken in the bottle after each addition. This is continued until a persistent froth appears on the surface of the water. A second experiment is then made comparatively, with the water and the standard solution to which it approximates most closely in hardness. Should the hardness of the water exceed 20°, then it must be diluted with such a volume of pure distilled water, that its hardness is reduced to within 20°, and 100cc. of the mixture tested. The degree of hardness found for the mixture is then multiplied by 2, 3, or 4, according to the extent to which the water has been diluted.—F. BARKER COOKE.

[46111.]—**Cutting Tiles.**—Mark a line across the face where you want to cut the tiles. Take a small, sharp, cold chisel—say, about 3in. long, and about $\frac{1}{4}$ in. or $\frac{1}{2}$ in. wide; hold it to the line, and give it light, smart taps with a light hammer all along the line (be careful to be exact to line). When you have done this all across, reverse the tile; lay it flat on your hand (slightly hollowed), and tap the back of it with the hammer behind the line, when it will divide. A couple of rubs (or more, according to your care and skill) on a flag or flat sandstone will make the edge smooth and true, so that when laid it cannot be seen that it is a "cut" edge—i.e., if done skilfully.—KANT.

[46113.]—**Secondary Battery.**—If you can charge one secondary cell having the same E.M.F. as the cell of Bunsen used in charging it, then you will have stored energy without loss; but if you cannot only charge it, but get a "greater quantity" from it, then either you will have stored energy which never existed, or you will have

created energy. In either case, the problem of perpetual motion will be solved at last. But, unfortunately, the E.M.F. of a battery does not depend upon "reasoning" (however unreasonable); and in a secondary battery, the E.M.F. is not changed by changing the number of cells of the charging-battery, but (as in any battery) it simply depends upon the electrochemical nature of the materials composing it. Let E = the E.M.F. of a battery, R = the resistance in circuit, and C = the strength of current in circuit; then $C = E/R$. In your method of charging call E of Bunsen positive, and E' of secondary negative, because they act in opposite directions. Then, since they act in the same circuit of resistance R , the strength of current in charging will be $C = E/R - E'/R$; whence, if E and E' are equal, no current will pass, and therefore the secondary cannot be charged by Bunsen. In charging any secondary battery the total E.M.F. in circuit must be positive; or, in other words, the E.M.F. of charging-battery must always be greater than that of secondary. You could charge secondary of unit E.M.F. by two Bunsen cells (each of unit E.M.F.), joined in series, because then, $C = 2E/R - E'/R$, (R) being, as before, the total resistance of circuit. But you cannot, even in theory, get more electricity out of secondary than charging-battery puts in, and in practice you always get less.—J. M. STOKES.

[46114.]—**The Analysis of Ointments, &c.**—Treat a portion of the ointment with ether, which will dissolve the fats, and leave the mineral constituents, which may then be examined by the ordinary methods of qualitative analysis. Another portion may be boiled with water, allowed to stand until cold, the upper layer of fat removed, and the aqueous solution tested for mercuric chloride, this salt being soluble in ether.—ANALYST.

[46114.]—**The Analysis of Ointments, &c.**—To test this for Hg, Bi, and Zn dissolve in nitric acid, and to the solution add a considerable excess of pure potash solution. The Zn will be precipitated, but re-dissolves in the excess of potash; whereas the Hg will be precipitated—the protosalt as a black, the per-salt as a yellow, and the Bi also as a white precipitate. Filter, and to the filtrate add sulphide of ammonium; if Zn is present, it will be thrown down as a white precipitate. Redissolve the precipitated Hg and Bi in nitric acid, nearly neutralised with ammonia, and add chloride of ammonium and hydrochloric acid, then a large quantity of water. The Bi will be precipitated as chloride, whereas the Hg will remain in solution. For testing beer for iron and alumina, evaporate one or two litres of the sample to dryness, and incinerate the residue. If iron be present, the ash will be of a reddish colour, whereas in genuine beer it is always white or greyish white. Take a portion of the ash and boil in strong hydrochloric acid, with a little nitric; filter, and to the filtrate add ferrocyanide of potassium, which will give a blue precipitate of Prussian blue if iron be present. Take the rest of the ash, boil it in strong HCl, and evaporate to dryness on the water-bath, in order to render insoluble any silica which might have been in solution. The dried mass is then moistened and heated with a few drops of strong hydrochloric acid. About 50cc. of water are added and the solution filtered. The filtrate which contains all the alumina as chloride of aluminum, is made strongly alkaline with a solution of pure potash. The potash precipitates the phosphates of lime and magnesia (if any be present), while the alumina is kept in solution. The alkaline solution is boiled, and after filtration, is slightly acidulated with pure hydrochloric acid, and then ammonia is added until the reaction of the liquid is decidedly alkaline. If any precipitate be thrown down it consists of alumina. It is of the highest importance to use pure reagents. The ammonia and HCl never contain any alumina; but the caustic potash (or soda) is liable to be largely contaminated with it. Care must, therefore, be taken to use only pure potash. The solution must be freshly prepared and not allowed to stand for any length of time in a glass flask or bottle, from which it would be sure to dissolve alumina. For this reason, the alkaline solution must not be boiled in glass or porcelain vessels, but platinum.—F. BARKER COOKE.

[46115.]—**Packing for Small Air-Pump.**—Lamp cotton (not woven wick) will be found to answer as well as anything.—LABOR OMNIA VINCIT.

[46115.]—**Packing for Air-Pump.**—Nothing would be better than a leather cup-shaped collar. This would be best to keep tight and yet work as easily as possible.—SUNLIGHT.

[46116.]—**Private Telegraph Wires.**—It is impossible to answer this question without understanding how the telegraph wire came to its present position. By whose authority or consent were the posts fixed, for there must have been some consent given. When wires have been lawfully put up, I do not know by what authority they can be pulled down again, unless they are

proved to be a nuisance.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[46118.]—**Slide-valve and Piston.**—An unsteady vacuum may arise from other causes than leaky valves and piston. If your engine cylinder is fitted with indicator cocks at each end, then put the crank on dead centre, and open the cock at opposite end of cylinder to where piston is. Now turn on the steam, and if any rushes out of the open cock you may reckon that the piston is leaky. Again, take off one of cylinder covers, put the piston at opposite end of cylinder, turn on the steam, and you will see whether it is the piston or valve that is leaky. Be careful the crank is on the dead centre.—LABOR OMNIA VINCIT.

[46118.]—**Slide-Valve and Piston.**—A simple test would be to try the slide-valve for leakage first. To do this, take out the pin of the slide-rod joint, and place the valve in the middle position; now open the cylinder cocks and turn on full steam. As the valve would cover both ports, any steam passing out of the cylinder cocks would show leakage, and would also demonstrate which end of the valve was in fault. To test the piston, let the engine stand on the one dead centre, then turn on steam behind the piston, and if any leakage occurs, it will also show in the cylinder cocks.—SUNLIGHT.

[46119.]—**Daniell's Battery.**—If "Young Beginner" were to put a few drops of sulphuric acid into the solution of sulphate of copper, and a larger quantity of sulphuric acid into the water, I don't think he will have cause to complain of the action of the battery, provided also that the cells are coupled one to another, and not each cell to itself.—GEO. G. BLACKWELL, 26, Chapel-street, Liverpool.

[46122.]—**Hydraulic Ram or Waterwheel.**—Under the circumstances, I think one of the small American pattern hydraulic rams will do all you want at a very small cost. If you advertise your address, I could put you in communication with a firm who make these things a speciality.—LABOR OMNIA VINCIT.

[46125.]—**Carbolic Acid.**—When this substance is agitated with water it dissolves to a limited extent in the water; but no chemical action takes place. It is known to act destructively on living germs, to which property, its power as a disinfectant is no doubt due. The odour of carbolic acid, although offensive to some persons, is to me, rather refreshing than otherwise; at any rate, it is infinitely preferable to the odour of sewer-gas. I am not aware that it increases the appetite, but on the other hand, sewer-gas would be very likely to spoil it.—ANALYST.

[46126.]—**Laws in Regard to Telephone Wires.**—I am not sufficiently versed in the various statutes to answer completely this question, but I do not think wires can be put up without the consent of the proper local authorities, as well as of the landlords concerned. As to crossing private property, here again the rights of the companies depend upon the power given them by their own statutes, which must be consulted.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[46128.]—**Engine Query.**—To "SUNLIGHT."—You have not taken into account the action of the lead, and that, I fancy, would explain the discrepancy probably. I should advise you to make a full size card model of the valve and face, and so get the matter right. I have not time, I am sorry to say, at the present, to give the matter consideration, and so definitely deal with it. But I think that the omission of the lead is where you are at fault. If you have correctly taken your theoretical dimensions and travel, it should correspond with the actual, of course. And I always prefer to make the theoretical and practical agree; and I strongly deprecate having to make any deductions from the theoretical calculations to make them agree with the facts, as shown in actual fact.—SUNLIGHT.

[46129.]—**Adhesive Weight of Locomotives.**—To "GUIDE-YOKE."—The subject of tractive force and adhesive weight of locomotives was very fully discussed in Vol. XXVI., to which I will refer your correspondent. In the example given in the query, "Guide-Yoke" bases part of his calculation upon the erroneous supposition that "the resistance at a speed of 60 miles an hour is 30lb. per ton." To find the total resistance of an engine, tender, and train, on a level line in every-day working, the formula $x = v^2 / 114 + 12$ is used, and I may state that in practice I have found it to be most correct. Applying this rule in the present instance, we have $60^2 / 114 = 31.57$ lb. per ton, "variable" resistance, which, added to the "constant" 12lb., gives the total resistance at a speed of 60 miles an hour on the level as 43.57lb. per ton. Your correspondent has taken the effective pressure at 100lb. per square inch, which, under the circumstances, is rather too high; but dealing with the example, it will be found that an engine having a total tractive force of 10,028lb.,

will be able to draw a maximum load (including itself) of 230.1 tons at a speed of 60 miles an hour, providing, of course, that it also possesses the necessary adhesion. In all calculations, care must be taken that the tractive force of the engine does not exceed the co-efficient of adhesion between the wheels and the rails; this co-efficient is found in practice to be about 1-6th of the weight resting upon them, or 373.3lb. per ton; or, as it is now usually expressed, an adhesion of 16.66 per cent. The concentration of excessive weight upon any one pair of wheels must be avoided as far as possible. Some "single engines" have 16 tons, or 35,840lb. placed upon the driving wheels, and taking the co-efficient as one-sixth, the adhesion is as follows:—

(6) 35840
5973.33

Now it will at once be seen that it is immaterial how much nominal tractive force such an engine may have, because here we have the fact that the wheels will "slip" if a power exceeding 5973.33lb. be applied to them. To convey a load of 230.1 tons at a speed of 60 miles an hour, requires a tractive force of 10,028lb.; the co-efficient being one-sixth, it follows that to exert such a force without slipping, no less than 60,168, or 26.8 tons would have to be placed upon a "single" pair of driving-wheels. This would be a perfect impossibility; therefore, as we cannot place the required weight upon one pair of wheels, we must distribute it, and use coupled wheels. I trust this explanation of the plain facts will furnish "Guide-Yoke" with the desired information.—CLEMENT E. STRETTON, Saxe Coburg-street, Leicester, Feb. 18.

[46136.]—Concert-Pitch.—If the querist will consult Mr. A. J. Ellis's paper, read before the Society of Arts, and published in their *Journal* for May 25, 1877, he will find that "concert-pitch" is an indefinite quantity. I cannot attempt to quote many instances, but the following will suffice:—Chappell's concert-pitch fork gave, in 1877, 455.4 for A, or 546.3 for C. Crystal Palace Band fork gave 458 A; Training School, Kneller-hall, 456.6 A; army regulation pitch, 455.6; Westminster organ principal, measured by Dr. Stone in 1877, 442 A; Handel's fork, 426.4 A. The Philharmonic pitch was found to be 544.3 C. I believe Brinsmeads sell a set of forks Philharmonic, medium, and vocal, which correspond to the majority of existing pitches. Nothing satisfactory will be arrived at until C 512 has been accepted as a definite and unalterable standard pitch.—S. R.

[46136.]—Concert Pitch.—To "VULCANITE."—I copy a few pitches from Ellis's "History of Musical Pitch":—

1860 Society of Arts' fork, A.....	441
1877 Glasgow Public Hall's organ A.....	450
1877 Willis's Concert Standard, Albert Hall organ, and Alexandra Palace organ.....	453
1878 Her Majesty's Band.....	445
1877 Crystal Palace Band.....	454
1879 Broadwood's pitch.....	446 to 454
Collard's pitch.....	449
Erard's pitch.....	455
Steinway pitch.....	455
Chappell and Co. pitch.....	455
Kneller-hall pitch.....	452

—V.

[46136.]—Concert Pitch.—In 1859, a normal pitch of A = 435 was established in Paris, to which the querist probably refers; but in England the pitch has been steadily rising for more than a hundred years, and is probably still doing so. A tuning-fork belonging to Handel in 1751 corresponds to treble C = 510; and in 1859, the treble C of the Italian opera, London, was 546, being fully one semitone higher than the Handel fork. The probable cause of the rise is doubtless the "brilliance" of an instrument slightly sharper than one to which we have been accustomed. The difference between two pianos, equal in other respects, but tuned to different pitches, is very apparent; hence, manufacturers are apt to tune their instruments a trifle above the ordinary pitch, which, in time, gradually rises. In comparing the compass of the voices of modern with those of past singers, the rise in pitch should be carefully allowed for, it being, of course, more difficult for a soprano to take a high note now than it was when the pitch was lower.—WM. JOHN GRAY, Elswick Science School.

THE following has been given as a material for fireproofing for wood by the *Chemist and Druggist*:—Take alum, three parts; green vitriol, one part; make a strong, hot solution with water; make another weak solution with green vitriol in which pipe-clay has been mixed to the consistence of a paint. Apply two coats of the first, dry, and then finish with one coat of the last.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, Chime has replied to 45415; A. W. Soward, 45685.

- 45525. Injectors, p. 361.
- 45526. Bicycle Route, 361.
- 45529. Bone Mill, 361.
- 45547. Legacy, 361.
- 45556. Russian Vapour Bath, 361.
- 45564. Speed Indicator, 361.
- 45741. Civil Service Strictures, p. 450.
- 45745. Artificial Limbs, 459.
- 45762. Boat Tabernacle, 459.
- 45765. Watch Jobbing, 459.
- 45768. Watch Fuses Chain, 460.
- 45787. "D. H. G.'s" Overhead, 460.
- 45789. Sulphurous Anhydride from Vitriol Chambers, 460.

QUERIES.

[46137.]—Silvering Glass.—Will some of the readers of our valuable paper kindly give a receipt how to silver looking-glasses or wall-mirrors by what is known as the patent French process? I have tried nearly all the receipts given in this paper for some considerable time past, but with even less success than Mr. Hughes. Of course, the process being for wall-mirrors, I had to pour the liquid when made up on the glass, but I never, in any single instance, got a film until I tried the process with glucose fully described in this paper three weeks since; but strange to say, it was of three different shades of blue on one sheet of glass, and on another there was a film on one corner about 6in. diameter, and all the rest of the glass was rippled just like the sand on the seashore at ebb-tide. The film was very thin, and the silver not thrown down on the glass. The solution, after standing for about an hour, became quite black, and there seemed to be more silver on top of the solution than in contact with the glass. I allowed it to stand four hours, and the film was so thin that it nearly all came off when I washed it. At first I attributed my failures to not having distilled water, so I got a still made, but was none the better. I was in the habit of mixing the solutions with a silver spoon. I discarded that, and got crystal vessels and rods, but was none the better, so now I have come to the conclusion that those receipts are not adapted to looking-glasses or wall-mirrors at all.—P. DONALD.

[46138.]—Storage Battery.—I have made one of these on the principle of the Sutton cell, and find that in charging it, the resistance at first is very small and gradually increases as the solution gets exhausted until it requires three Bunsens in series to finish it, and even that is not enough in my case to take all the blue colour out of solution. Will someone well acquainted with these things say how such a cell is to be charged by a dynamo-machine? I have always understood that dynamos require a regular external resistance to balance the internal resistance. If this is so, this form of storage cell could not be charged by a dynamo unless they were put in series first until the resistance became too much, and then work them singly or in shorter series, and even then the resistance would be far from regular.—E. F. C.

[46139.]—To Mr. Wetherfield.—A. sells goods to B. on board ship at Rotterdam for cash at 60 days on receipt of bill of lading. He agrees afterwards to deliver in London for an increased price, and on B.'s proposal to pay cash on delivery he agrees to allow 2½ per cent. A. instructs carman, when sending goods, not to take any portion out of his van until he is paid, nor allow the goods to be touched. Payment before delivery is refused, carman being told to deliver his goods, or at least get them out of his van, and he would at once be paid. Carman refuses this, and drives off. During the negotiations goods have risen considerably in price, and B. has to purchase at a loss. He gives A. notice at once of his offer to pay on delivery to carman as agreed, and that he insists upon the completion of contract, but A. says the goods have been tendered, and refused, and declines completion. A. has previously sent invoice, which specifies upon it 2½ per cent. for cash on delivery, and B. sues him for the money out of pocket through having to pay a higher price. County-court judge decides that the goods were legally delivered when handed over to bonded carman, and verdict is for A. Is this according to law? Does cash on delivery mean cash before delivery? B. contends A. was not entitled to cash until he performs his part of contract.—E. H.

[46140.]—Gas for Heating Iron Hoops 2½in. wide, ½in. thick, and 4ft. diameter.—Could some of our readers give some information how gas could be used with economy for the above use, and to heat the iron to a bright red heat. I have a large quantity of hoops to heat in the space of twelve months, and have, up to the present time, used old wood; but it is very scarce and dear, which involves great loss of time and money. I have been informed that it is used in large forges.—J. W. SMITH.

[46141.]—Tubes to hold Mercury.—I am anxious to know if brass tubes, soldered with ordinary tinmiths' solder, will do to contain mercury? If not, please say what kind of metal tubes and solder will do.—C. O. N.

[46142.]—Heat for Horticultural Purposes from Waterfall.—I have a fall of water, and am desirous of converting its force into heat for horticultural purposes. Is there any practical manner of doing so? The idea of the friction of two discs one upon the other, the heat thus generated being imparted to water for circulation has occurred to me.—H. B.

[46143.]—Fusing Copper.—What heat is required to fuse copper? I have a number of old copper coins, and wish to convert them into small castings. Can I do

so with an open coal fire without blowpipe or crucible? Also, what should I use for moulds—will plaster of Paris do?—MANSLER.

[46144.]—Drilling.—Would "Sunlight," or Mr. Evans, kindly say how I am to fix any article, say a piece of brass, so as to drill a straight hole with a chuck-drill? Mine is only a common lathe, and I want some plan to hold the work up to drill without turning round. Any help will be gratefully received.—C. E. T.

[46145.]—2in. Telescope.—To "ALDEBARAN."—I was thinking of making same as follows:—1. Get a good 2in. object-glass with cell and flange screwed outside; then get 3ft. of 2in. brass tubing (2in. internal dia.) screwed inside at both ends; then get a small cap, such as a small oil-cup lid, screwed outside, and have a hole 1½in. dia. bored in its centre. This, I believe, would complete the large tube; then get 6in. of 1½in. brass tubing 1½in. (outside dia. or internal dia. f) with a flange 2in. dia. on one end: this would slide in the large tube, and the hole in the centre of the oil-cup cap would keep it steady. Now would it require an eye-glass? I expect it will, and if so, what size glass does it require for the cell of the same glass to fit into a 1½in. tube? This flange I should have screwed. I shall be glad if you will also state the technical terms for ordering such parts as above. Also, what would be the thickness of the tubing required, and, if an eye-glass is required, what is the use of such glass?—B. EASON.

[46146.]—Caustic Potash.—Having been using this for removing varnish from bottom, &c., of canoes, I find on righting it that the liquid has run down on to the mahogany, which was new and unpolished, and has left some nasty brown stains. Will someone kindly say if there are any means of removing same, and whether spirit polish will take and look all right over those places, or whether the marks will show through?—W. F. M.

[46147.]—Boiler Power.—I have a horizontal engine mounted on boiler, size of cylinder 7½in. by 4in., but cannot keep enough steam in boiler, which is a saddle boiler fixed in brickwork, with return flues 6in. deep; the chimney being on front of boiler over end of return flues; length of chimney 15ft. by 5in. pipe; size of boiler 6ft. 6in. long, 1ft. 6in. dia.; heating flue 12in. by 9in.; fire-bars level with bottom of water-legs or side. A job to get fire to draw when I first light or when engine is stopped. I have exhaust in chimney, and top of boiler covered, where exposed to air, with composition, and there is no steam dome. Is it that the boiler is too small, or would slide-valve make a difference if not correct?—F. C.

[46148.]—Fret-Saws and the Lathe.—Will Mr. Hoskin (letter 19559) kindly say what size the small pulley on crank should be, so that the belt may take a firm grip and the saw go at a moderate pace. Will advertise my address if he will let me know where he obtains his saws.—J.

[46149.]—Oil for Lathe.—Will Mr. Evans or any other reader kindly tell me what is the best oil to use for above? I am able to use my machine only about once a week, and I find, unless constantly cleaned—that is, about every time it is worked—the oil clogs and becomes brown in colour. I am using at present sweet oil and paraffin.—CLOUTER.

[46150.]—Engine Query.—I wish to make an upright engine of about 4 h.p. Would any of "ours" be good enough to give me a sketch of the best and neatest design for same? I wish it to have a bent crank, with bearings on each side, and long enough at both ends to take on pulleys and fly-wheel, and to have foundation sole-plate, so that it would hold water to pump out of for boiler supply; also the best kind of governor to suit same, not patent, like "Tangye's."—C. W. MILLWRIGHT.

[46151.]—Hot-Air Engine.—I should like to make a hot-air engine of about 1 or 2 h.p., and have seen Bailey's one. Can I make anything like it without infringing his patent, or how should I proceed to make one of a different design? I wish it to drive a small churn, &c.—C. W. MILLWRIGHT.

[46152.]—Clock Repair.—Thanks to "Woodleigh" for his reply. I have followed his instructions, but the pulley is cast in one piece—i.e., not held together by rivets. I could put fresh spikes in, but how to point them is the rub.—H. H.

[46153.]—Induction Coil.—To Mr. LANCASTER.—I want to make an induction coil to give a 1in. spark. I have 1lb. of 36-gauge silk-covered wire, and 2lb. of 10-gauge silk-covered wire; what quantity of primary, and how many layers, should it be wound with? Should it be wound along from one end to the other and back again, and so on, insulating between each layer; what are the best materials to use for insulating; please state size of iron wire for the core, and the length of coil, and how to make the condenser; would there be any more power by using a large quantity of primary wire, without increasing the secondary wire. Would some thin sheet india-rubber or American fibre do to place between the primary wire and secondary wire in the place of ebonite, as I find it very difficult to get thin sheet ebonite?—J. A. W.

[46154.]—Potash Carbonate.—Can potash carbonate be made from its sulphate, similar to soda carbonate from its sulphate—viz., the Leblanc process? An answer will oblige.—PEARLASH.

[46155.]—Dowson's Water-Gas.—I should be greatly obliged if any correspondent or reader of the *ENGLISH MECHANIC* could give me particulars of the principle and details of manufacture of Dowson's water-gas, or place me in the right channel for obtaining such information?—C. J. O. CORLEY, Victoria Villa, Dunstable, Beds.

[46156.]—Pendulum Spring.—Will a watch-making subscriber tell me how to rectify a spring that touches the sides of curb-pins—viz., the two outside coils?—PIVOTER.

[46157.]—Secondary Batteries.—To Mr. W. J. LANCASTER.—I should be glad if you can give me any information as to the best of the above kind of batteries, which can be used for lighting with such lamps as your incandescent one, and if a secondary battery could be easily constructed to keep one lamp lighted

for five or six hours! What kind of dynamo-electric machine would be the least expensive to buy; which could charge such a battery?—A. S. R.

[46158].—**Ginger-Ale**.—Could any reader be good enough to give me a receipt for what is called aromatic ginger ale?—W. W. W.

[46159].—**To Mr. Evans**.—Will you please give instructions how to make a cutter to feed a soft wood column with 16 clustered seeds, to work in a lathe with slide-rest and overhead motion! The column is 1in. dia.—**IGNORANT WOOD TURNER**.

[46160].—**Collodion**.—Required to know the relative values, in decimale of an inch, of the numbers of "B. W. G." or the name of any cheap publication treating of the above?—**COLLODION**.

[46161].—**Pumping to Pressure**.—I have three 7in. deep well pumps with 6in. suction and 6in. delivery pipe to the reservoir. When I am pumping low pressure to the reservoir only, my gauge (a mercury one) stands at 20lb. to the sq. in., and by partially closing a valve in the main or delivery pipe, I pump to several houses from a 3in. main 1,000 yards from my engine house. I cannot supply them until my gauge stands at 60lb. to the sq. in. Will "Sunlight" or "Labor Omnia Vincit" kindly say what pressure ought to force the water there? The houses in question are 30ft. higher than the reservoir.—**WATER MOTOR**.

[46162].—**Nascent Oxygen**.—The recent correspondence relating to the danger of making oxygen gas prompts me to ask some chemist to kindly inform me under what conditions (if any) it may be dangerous to decompose chlorate of potash with manganese by using for the purpose sulphuric acid. And what he would recommend as the most effective and economical process for liberating the largest amount of oxygen in its nascent state from the materials named.—**JOHN PICKERING**.

[46163].—**Coin or Token?**—I shall be glad if any of "ours" can give me any information about a coin which I found passing as a shilling the other day. Size of a shilling, on one side usual head surrounded by scroll "Georgius Dei Gratia"; other side very much rubbed, can only faintly make out (we think)—Bank—To—P.—I—1805. I was not aware that silver tokens were permitted at the beginning of the century. Does Bank stand for Bank of England, or some unknown Provincial Bank. And if for the former, will the Bank redeem at par? It appears to be about standard silver, and nearly equal to a well-worn shilling. I found a demi-crown of Louis XV. the other day. Has it any value beyond old silver—also a franc of the First Napoleon?—**C. C. C.**

[46164].—**Painting Hoop-Iron**.—Can any readers give me any information as to the way the red paint is mixed that is used for painting the hoop-iron used for shipping bales? It is orange lead with something that makes it dry quick and bright. I have used boiled oil and turpentine, but not knowing the proper proportions, &c., have not been successful so far in attaining the drying property.—**A FELLOW WORKMAN**.

[46165].—**Double Dry Slide**.—To Mr. LANCASTER. I have a portable camera, but it is minus the dark slide. You said in a previous number you would tell a correspondent how to make a double dry slide; can you oblige me with the dimensions and a sketch showing the thickness of material and the arrangements of the working parts to suit quarter-plate?—**CARINET MAKER**.

[46166].—**Rangoon Oil**.—Will Mr. Allen or any of "ours" kindly inform what this is, or ought to be; with simple means to detect adulteration? When first introduced it was purely a mineral oil, with a peculiar smell, of a bluish amber colour, and would lie on bright steel articles for a length of time without clogging. But what is now in the market, when laid on becomes like glue in six months; if left about a year, like a hard varnish; especially if exposed to sunlight, requiring the application of scratch-card to remove it. I have been told it formerly was obtained from Rangoon, where it oozed from the earth, but is now a manufactured article from the refuse in candle-factories. Whatever it is composed of, it is quite different to what it used to be, decidedly smelling of tallow, and also being much thicker in cold weather.—**ARMOURER**.

[46167].—**Block Signalling**.—Will anybody oblige by giving a sketch of the block instruments as now used by the L.B. and S.C.R., same as shown at Crystal Palace, showing interior and method of working?—**LISWAL-TER**.

[46168].—**How to Make a 2in. Astro. Telescope**.—Will "Aldebaran" kindly say where the 2in. o.g. Paris make, can be had; also, what would be requisite focus for a 4in. o.g., and the price? For the benefit of those amateurs who require brass castings of any kind, I may here say that Messrs. W. and T. Jackson, brass founders, Harding-street, Leicester, are useful people to know. They are in a large way of business, and their charges are most reasonable—in fact the trade price, at so much per lb. They cast for me the other day six difficult pieces, weighing together about 2lb. 3oz., and charged 2s. 8d., and from most abominable patterns, made larger in parts by gumming paper on and stuck together with wax. There is no need to employ a pattern maker—a wife will do all that is needed, if sand-papered off and covered with hellac varnish, although the latter is not necessary.—**ISOKRYT**.

[46169].—**Vulcanised Rubber for Gas-Stoves**.—Will a kind fellow-reader who really knows, tell me how to prepare these pipes so that they do not smell of gas after having been used some little time! I have tried both white, black, and red rubber, and even pipe of extra thick-ness; but am sure to become impregnated with gas after a time.—**ERRATUM**.

[46170].—**Bending Wood**.—Will some of "ours" be kind enough if they know, and if not, to try several ways, the best way to bend wood, such as beech or birch? I have been in the furniture trade all my life, and I never saw the proper way or heard of it. Look at the Austrians—they are taking all the best of our work away.—**H. B.**

[46171].—**Electric Reader**.—Will some of the electric current of Rushbridge used on East Railway? and

[46172].—**Phial of the Four Elements**.—In two books I have seen it stated that mercury, salt water, alcohol (coloured red), and an essential oil, although shaken up, will separate again. I find the alcohol mix with the water, as I should expect; and thus I can only get three separate fluids instead of four. What is the best way to colour alcohol? Any help will oblige.—**EXPERIMENTALIST**.

[46173].—**China Painting**.—Will any of your correspondents kindly inform me could I construct an apparatus or kiln for firing my own work in the above?—**EXPERIMENTER**.

[46174].—**Ferric Oxide and the Magnet**.—Why is it that ferric oxide (Fe_2O_3) is not acted upon by the magnet ("Fowles' Chemistry"), although containing, according to Percy on Iron and Steel = 69.10 per cent. of iron, and yet the black iron oxide (Fe_3O_4) only containing 57.01 per cent. of iron, is readily acted upon by the magnet. None of the chemistries give any explanation of this. A solution will greatly oblige.—**ESQUIRRE**.

[46175].—**Legal**.—To Mr. WERNERFIELD.—With reference to jeweller's plate licence, I wish to know if it is the amount of gold or silver contained in an article sold, or is it the quantity kept in stock for sale, which renders one lawfully bound to pay the above licence?—**JEWELLER**.

[46176].—**Burnishing Ink for Edges of Boots**.—I want a receipt for a burnishing ink for the edges of boots and shoes? what I use is this, and takes too long to dry. A receipt for a stamping ink for cotton, &c., would also oblige.—**W. R.**

[46177].—**Tinning Bicycle Spokes**.—Would any reader tell me how to tin bicycle spokes: does the wheel have to be taken to pieces, and is it a difficult thing for a novice to do?—**BIZIN BICYCLIST**.

[46178].—**Boring**.—I want to bore (perfectly smooth and true) a brass tube about 1-16in. thick, 1 1/2in. dia., by 14in. long. Would "Sunlight" or some other reader kindly inform me the simplest method? I have a good screw-cutting lathe.—**BRASS FINISHER**.

[46179].—**Boiler Pressure**.—What pressure of steam to the square inch will steam-jacketed cooking boilers stand made of 3in. cast-iron?—**STEAM**.

[46180].—**English and Norwegian Fish Guano**.—Can any of your readers inform the public how this substance is made? I have a friend from N.W. British Columbia, who boils down a vast quantity of herrings, and a fish called the candle-fish, for oil, and he wants to treat the residue and make into guano. There is a vast quantity of offal fish wasted in England. I know a firm of chemical manure merchants in the city, if they could be informed where it could be had in paying quantities, they would set up works, converting what is generally considered a nuisance into wealth. Now is the time for fishermen and gentlemen interested in the welfare of the State to inform the public the parts of the coast where large quantities of such fish as dog-fish, star-fish, &c., can be got cheaply.—**JAMES D. CURRIE, Captain R.A., Twickenham**.

[46181].—**Planing with the Lathe**.—Has it not been noticed that if a job is fastened to the face-plate, and a tool laid on its side in the toolholder of rest, it will, when traversed by the screw, cut a shallow groove across the face of the work? Now all that is wanting is some plan to give the work an up-and-down motion, and we should have a planing machine; very handy for small jobs; slow, of course; but to many this would be no objection.—**E. H. ALCOCK**.

[46182].—**Medical**.—Will Dr. Edmunds, or any other kind medical reader of the "E. M.," tell me what he thinks of the following case? I am troubled greatly with internal pain, the greatest and most constant being in the region of the umbilicus. This pain extends to that part of the spinal column on the same level with the umbilicus. This is accompanied by cold shivering, sensations down the back, and sometimes all over the extremities, especially the hands, being cold, and having a numbness sort of feeling. To this I may add that the external surface of the abdomen is so sore that my clothes touching it cause considerable pain. I have no appetite, or next to none. Is the internal pain I am most anxious about, as it distresses me so greatly.—**AN ANXIOUS ONE**.

[46183].—**Opals**.—A friend of mine, now in Australia, wishes for information regarding the opals found in his locality, the Riverina district. After my reading a description of the different varieties, and suggesting that it is probably the wood opal which is found in N.W. South Wales, he writes: "It is certainly not the wood opal; it is found in the interior of a stony incrustation, and, when polished, displays the beautiful play of colours you speak of in one of your descriptions. I have seen some which appeared as if they were flashing out of them quite vividly. They are eagerly sought after out here, and are scarce." This description seems to indicate the noble opal. I do not find this described as a native of Australia, nor do I know anything about the stony incrustation. Perhaps some reader will kindly supply the information sought, giving some hints respecting the probable value of the stones.—**W. G. TUX**.

[46184].—**Wringing-Machine Rollers**.—Can "Sunlight" tell me the best way to fix the spindles in wringing-machine rollers? What is the best wood to make new rollers of, as they want them cheap, as competition is so great.—**A. M. B.**

[46185].—**To Dr. Edmunds**.—My son, who is now eleven years of age, when about a month old had inflammation of lungs, within a few months after, whooping-cough for more than twelve months, bringing him down to a shadow, mere skin and bone, since which he has had measles, followed by severe inflammation of lungs, which left him with a hacking and violent cough. When pretty well, a short dry cough, and shortness of breath. About three years ago he had scarlatina very bad. Every winter he suffers, apparently, from bronchitis or inflammation. He lies now very ill after one of the above attacks, having heavy fits of coughing; his face much swollen. Medical man says dropsy. Is there any cure, or can you advise for relief of a great sufferer, and greatly oblige.—**A POOR MOTHER**.

[46186].—**Intensity Coils**.—What is the rule as regards the proportions of core, primary and secondary,

&c., &c., in constructing these coils? For instance: Suppose I make a coil with a core 7in. long by 1in. diameter; primary, two layers of No. 17; secondary, half a mile of No. 36, and use four Hunsens to work it, and I then want twice the power; would doubling all the lengths and battery-power do this? I have several volumes of our friend, the "E. M.," and there are many specimens of coils to be constructed, but no general rule to be observed as regards size. There is also a list, a volume or so back, of the sizes of some dozen coils and their performances; but that is not what I want. I am told different makers will make their coils of different proportions; but there must surely be some one made of construction which gives the best results? I have been, I see with several others, awaiting Mr. Lancaster's promised papers on coils; but they are still absent from our pages.—**B. H.**

[46187].—**Watch and Clock Repairing**.—To "ALFOJEE".—Please accept best thanks for replies to former queries. I have had a few troublesome jobs, and have managed to get all to go except one. This is an old fashioned English eight-day clock. I shall feel thankful for a little advice on it. The scape wheel teeth are worn uneven; should I have them recut? The face of pallets where the scape wheel teeth drop are dented. I thought of refacing them with some pieces of watch-spring steel, or would it be better to grind and polish? Would the latter cause too much drop?—if so, how should I alter it? The pendulum spring is very stiff; would a thinner one do better? How can I find the proper centre of pinion of scape wheel, so as to put a new pivot? Is there any special tool for it? I have put a hair-spring, also a mainspring, in an ordinary Geneva watch, but am puzzled with one that has a suspended barrel. In taking out the broken one, must I unpin the stop-work, or how should it be done? And now, as there's a gap in the columns in the "E. M.," caused by the death of "Second's Practical Watchmaker," could not "Alfojee" step in and fill it? Some articles on "Watch and Clock Repairing," with names of necessary tools, would be very acceptable to many amateurs, and I am sure our obliging editor would insert.—**HOPKINTL**.

[Gladly and we quite agree with "Hopeful" in his estimation of "Alfojee's" ability.—**ED.**]

[46188].—**Hexagon Patterns**.—When two pieces of perforated zinc (circular holes) are moved across each other, hexagonal patterns of varying size appear. Would some reader be kind enough to explain the cause? They must be held up to the light.—**B. H.**

The pieces sent by "B. H." are pivoted so as to move across one another circularly. The hexagonal patterns are best seen by looking through the zinc, held at normal distance at a piece of white paper on which the light shines.—**ED.**

[46189].—**Muffle for Firing Painted Glass**.—Would any correspondent kindly give drawings and details of above, and say whether metal ordinarily used in foundries would answer? Also particulars as to setting, height of chimney, and most suitable fuel. Largest sheet to be fired about 10in. by 10in. Any information will be thankfully received.—**VIRGUS**.

[46190].—**Beat in Violoncello**.—I have got my lad a youth's violoncello, which I have had strung an octave to violin—i.e., strings G D A E instead of G D G A. There is a strong beat on the F of the D string, and also same note (F), if sounded on G string. What is the cause and how is it to be remedied? Other notes clear and good.—**KANET**.

[46191].—**Air Absorbed by Water**.—Will some kind reader tell me the relation that exists between the pressure of air on the surface of water; proportion of surface exposed; the time of exposure, and the quantity of air absorbed? I want to know about how much air would be absorbed by 1 c. ft. water at 60° F., having a surface of 1 sq. ft. exposed for a quarter of a minute to a pressure of 30lb. per sq. in. above atmospheric pressure, and quantity absorbed when exposed to 20lb. for same time. If a general law is known it would be of use to those interested in air-vessels for pumps, &c.—**H. SCORROR**.

[46192].—**Sugar Refining**.—Which is the most economical method of using steam in the vacuum-pan if used at a pressure of, say, 30lb. ? To take it, having 75lb. on the boiler, at that pressure through a reduction-valve, or to have the exhaust-steam loaded to this pressure. Is there a rule, having the number of boilers and steam-pressure known, for determining the diameter of main steam-pipe. Also in boiling by steam, what is the rule for determining the heating-surface in relation to the capacity of the pan?—**W. D.**

[46193].—**Staining Floors**.—Having stained some deal boards with chrome mixed with size, and varnished with two coats of spirit varnish, putting it on with a brush, I find they dry rather white and dull in some places. Is it the room that is too cold?—**A WORKING LAD**.

[46194].—**Fistula**.—Would Dr. Edmunds please state what his opinion is with regard to fistula in a person of consumptive tendency and of thin habit? Ought it to be cured, or regarded as a necessary evil?—**V.**

[46195].—**Photo. Washing Machines**.—Wanted a description of the most efficient machine for washing photo. prints—with working drawings, if possible.—**MEKK**.

[46196].—**Siemens New Armature**.—I want a description of Siemens new armature, especially as regards winding and commutator. The principle is what I most require.—**DOO TAY**.

[46197].—**Cold Feet**.—Will Dr. Edmunds kindly give me advice? I am quite a sufferer from coldness in the left foot (winter and summer alike); it is warm enough while in bed; the veins of the leg are much distended; sometimes while walking I feel a sharp crampy feeling in the leg? Warm socks have no beneficial effect.—**CHILL**.

[46198].—**Hydrometer Scales**.—Please state how glass hydrometer scales are proportioned? One I have showing the specific gravities from 1,000 to 1,060 has the divisions larger at the top than the bottom. Another one for specific gravities from 1,900 to 1,900; has its divisions all equal. I want (if possible to do so accurately)

to print the scales, and have the instruments adapted to them.—**ARHOL JEAM.**

[46199].—**Impurities in Acids.**—What are the commercial impurities in the following: Oxalic, tartaric, sulphuric, nitric and hydrochloric acids? How may the impurities be detected?—**MICRO.**

[46200].—**Photographic Transparencies.**—What is the best process of printing transparencies on glass, and can they be transferred from the glass to gelatine films so as to be more portable, or printed direct on gelatine?—**S.**

[46201].—**Largest Gasometer.**—What are the dimensions of the South Metropolitan Gas Co.'s new gasometer in the Kent-road, and is it the largest in the world?—**S.**

[46202].—**Pattern Making and Casting.**—Could any of our able friends be prevailed upon to give us a few articles on pattern making and casting? I believe they would be of infinite value to many of us.—**E. C.**

[46203].—**Legal.**—My wife's marriage settlement, dated October, 1887, conveys the legal estate of house property, and 3 per cent. consols, the whole bringing about £300 a year, to two trustees, one of whom, a solicitor of high standing, has always allowed me to manage the estate; but we have now appointed my two brothers as trustees, and they begin by pushing me aside, and have ordered that a firm of solicitors do manage, collect the rents, and hand the money to me after deducting 5 per cent. for their commission = £14. I occupy warehouse, £20, and dwelling house, £20; belong to our estate, for which they demand rent of me. Am I obliged to submit to this loss and interference after managing it for 21 years? and there being evident reasons why no one can manage it so profitably as myself.—**G. B.**

[46204].—**Geometrical.**—Find the area of a segment whose arc contains 215° 45'; the diameter of the circle being 49 ft. 9 in.—**G. PENNELL.**

[46205].—**Induction Coil.**—Should the secondary coil be made with double-covered silk wire, or will single do if well insulated? Should double or single-covered be used for primary? Would the size of the coil make any difference?—**L. L. J.**

[46206].—**Oval Chuck.**—How can I make a simple oval chuck for a 4 in. back-geared lathe, as the shape of headstock will not allow of one like that illustrated in the "Lathe and Its Uses"? I do not want one for ornamental purposes, but to turn handles, &c.—**E. H. ALCOCK.**

[46207].—**Weight of Cattle.**—Could any reader kindly let me know if there is any way for finding the weight of cattle by measuring them? If there is, directions would greatly oblige.—**X. Z.**

[46208].—**Electric Clock Dials to Beat Minutes.**—Will Mr. Janssen or some other correspondent oblige with a sketch of the best arrangement of electro-magnet, pawl wheels and locking motion, &c., suitable to drive a dial from the regulator which beats seconds? and oblige.—**VORTEX.**

ANSWERS TO CORRESPONDENTS.

* * All communications should be addressed to the Editor of the ENGLISH MECHANIC, 31, Tavistock-street, Covent Garden, W. C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

* * Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 22, and unacknowledged elsewhere:

C. Wood.—Selig, Sonenthal and Co.—J. Wolstenholme.—W. Stanley.—T. Wheeler.—G. Calver.—Trouble.—W. H. Davies.—W. M.—T.—E. Gobert.—Jack of All Trades.—J. Hezmalhulch.—G. H.—A. Manook.—J. B.—Scotch Wo King Mechanic.—B.—A. Machine Tenter. Lancashire Ltd.—Clirionet.—E. J. B.—G. J. H.—J. Perry.—W. E. K.—Elisha.—Amateur.—Number and Angle.—E. B. Fennessy.—J. C. King.—A. E. Morris.—A. Progham.—G. Fryer.—T. R. Saxt.—J. T. Orne.—A. Down Reader.—Stone Lathe.—H. S.—Robur.—Black Vic.—W. F. C.—Tom.—A. K.—Amateur Electrician.—W. H.—W. F.—On Guard.—K. L. E.—Photo Beginner.—Etcher.—J. R. Y.—W. F.—R. N. H.

A NEW VOLUME.

THE next number is the last of volume XXXIV. Readers willing to oblige us by recommending "ours" to new subscribers should do so now, when a new volume is commencing. The index to Vol. XXXIV will be published in the number dated March 24, and cases and bound volumes will be on sale shortly after. Readers desirous of making up their sets for binding the present volume are recommended to do so at once, as the back numbers soon run out of print.

P. Vincent. (Much depends on the wording of the agreement. You might sue the agent in the County Court for the return of the deposit, or for the loss you

have sustained by the non-delivery of the machine or work. If he defends the action successfully, you can then sue the principal. You would probably save time and money by consulting a respectable solicitor personally, and showing him the agreement before taking any steps.)—**YELLOW JACKET.** (No. A well-known physician once said that a couple of oranges eaten before breakfast three times a week during the time the fruit is in season would keep many of his richer patients from his sick-list. We cannot tell what language your signature is meant to be written in.)—**TRIO.**

(Try yourself the preparation of a tin, and if you make anything of it, we think you will not again ask the question. In object-glass making, as in everything else, good work must be paid well for.)—**A SUBSCRIBER.** (We think not; but a letter to the Secretary of the Board of Trade would settle the matter at once.)—**L. A. P.** (There is only one way—by taking out a patent. The first stage, obtaining provisional protection, will cost you from £5 to £10. Write to any of the patent agents advertising in these pages for a copy of their instructions to inventors.)—**R. M.** (It is impossible to say "what he ought to know"; but if his guardians are of opinion that his master is neglecting his part of the contract, they have their legal remedy, which any solicitor will indicate.)—**SEWING-MACHINE.** (The duties are simple; but can only be acquired by actual practice. The salary varies according to the character of the office, from £2 to £5 per week.)—**SEWING-MACHINE.** (Try a Turkish bath.)—**DIPLOMATIST.** (Apply to any of the patent agents advertising in this paper.)—**INVALID.**

(1. Your only remedy is removal to a milder climate. You suffer as all persons whose lungs are affected suffer. 2. The application of one of the many damp-proof compositions outside may stop the evil. Read an article which appears in the *Building News* of Feb. 3, p. 156, on "Watertight Brick Walls," or you might try a coating of thin sheet lead inside the wall under the paper.)—**A. KRAUS.** (1. Only a medical man could safely prescribe. 2. We cannot say.)—**M. C. H.** (Read subsequent replies to the same query. The shellac is melted by heat, preferably by means of a blowpipe.)—**Y. VAN GASTON.** (The grubs referred to are various species of Anthomyia, a genus of flies, and the only remedy seems to be the use of strong-smelling and pungent odours, which will drive away the insects when they approach to deposit their eggs. 3. Sinking the ground with gas liquor before digging is one remedy, and the abundant use of soot round the young seedlings is another. All affected plants should be destroyed as soon as detected.)—**L. VAN POOL.** (We never heard of such a book. It is easily overcome by practice. Put the tongue against the upper teeth and drive the air past it. In a short time you will be able to produce a splendid rolling.)—**R. S. R.** (See a reply on p. 576, last week. The instrument you have is not of much value in taking observations.)—**R. T.** (Most of the text-books contain questions; but we do not know of one which gives the answers, except in the body of the book. If you wish to pass you will avoid such help.)—**J. T. M.** (See p. 562, No. 732, for two recipes.)—**J. A. L.** (The Praxinoscope was illustrated and described on p. 81, No. 732. See also p. 487, No. 747.)—**A. CHAP. I. KERR.** (Strong potash will remove it; or rubbing with turpentine. Or you can try the preparation advertised on p. iii.)—**MAZZERO.** (A 1 per cent. solution contains 1 part of the substance and 99 parts of the diluent. It is only the additional atom of oxygen that is "effluviolous.")—**F. W. B.** (We never heard that the town you mention is a bad place for people having a tendency to biliousness, and you give no information on which Dr. Edmunds or any other medical man could give advice. Discontinue taking the compound you mention, and instead, take a wine-glassful of Frederick's water twice a week before breakfast. It is quite possible that you are one of those persons who should abstain altogether from tobacco.)—**TRY IT.**—**S. H., Glasgow.** (See for the amount in the County Court of the district in which the matter resides. That is your only remedy.)—**POBATE AND DIVORCE.**

("X" cannot marry the lady; she is still the wife of "W," and will remain so until her husband obtains a divorce from her. If she left her husband to live with another man, who has since discarded her, she has not much prospect of relief at the hands of the Divorce Court.)—**X. Z.** (We do not know the address. Better advertise for it in the "Sale Column." Send to the office of the paper named, enclosing stamp for postage.)—**J. CHAMBERLAIN.** (Is it the Luxograph? We never heard of the name you give.)—**T. A. H.** (Thanks; but the statements made are scarcely sufficiently definite, and savour too much of American imagination.)—**A. NEW SUBSCRIBER, Waterford.** (Details have been given; but how do you propose to work the motor by means of batteries, or have you steam or water-power? The batteries would be very costly, and if you have either of the other motive forces at hand, it would be more economical to use them direct.)—**BRASS-CLIP.** (Use printer's ink thinned with turpentine. It is made of lampblack and linseed oil, the latter being boiled until it catches sight, when it is allowed to burn for some time. Or use ordinary ink thickened with a little lampblack or "ink bottoms," and add some gum.)—**G. H.** (For incubators, see p. 311, No. 793, and p. 485, No. 773; p. 536, No. 567, and several other back numbers.)—**BOGGERMAN.** ("Civil Engineering," by Law and Hurrell, Lockwood and Co.; or, perhaps, "Railway Construction," by Stephenson and Nugent, same publishers, &c., would suit best. Collins Sons and Co., have an "Applied Mechanics" at 1s. 6d.)—**AMATEUR ELECTRICIAN.** (You have not enough secondary wire. See p. 150, No. 760; and p. 342, No. 768, for instructions. See a table given on p. 410, No. 797, where you will find references to the number of coils described in our columns.)—**J. R. C.** (Such an appliance was described on p. 509, in our notice of the Crystal Palace Electric Exhibition. You can make a thermometer do by having one made with a platinum wire let in at the part of the scale required, and another at the bulb. When the mercury rises with the increase of temperature, the circuit is completed, and the bell is made to ring in the ordinary way.)—**WOLFELE ELECTRICIAN.** (If you want an electric light for a few minutes at a time, the bichromate is the cheapest; but if a good, steady one is wanted for an hour or more, use the Bunsen. Have you any idea of the cost?)—**J. W. G.** (Many papers on micro-staining in back volumes. See, for instance, p. 476, No. 774. The anti-

line dyes are very handy for the purpose. 2. It depends on the intensity of the incandescence required; but not less than a dozen, we should say.)—**L. W. E.** (Certainly; it is simply a question of light. As large as you please, but 6 ft. by 6 ft. would do.)—**QUIDNUNC.** (If you have the book you will see it illustrated in Fig. 4. It means that a beam of light is reflected at the same angle as it strikes the reflecting surface.)—**E. H. BARLOW.** (See No. 735, pp. 157 and 168. You must be between 16 and 18, and compete for an entrance to the Royal Military Academy, Woolwich. At the final examination, after 2½ years' instruction, you must come out near the top of the list to obtain a commission in the Engineers.)—**A POOR CARPENTER.** (See p. 455, No. 861; but we are afraid that not much can be done now.)—**AMATEUR.** (We have published the rules many times. See p. 361, ante. Procure Calvert's "Mechanic's Almanac." We believe he publishes cards containing tables calculated for all pitches of guide screw.)—**E. R. DALL.** (Better have been given several times; besides, the details are wanting.)—**AMATEUR, Coleraine.** (It is impossible to say upon such a datum; but presumably it is mercury.)—**AMATEUR.** (Do you not see that speed of revolution has a great deal to do with the actual wind-supply. Six inch fans will be large enough, unless you require a very powerful blast in the shape of quantity.)—**ALBERT HALL.** (See pp. 73, 95, 329, this volume, and the preceding answer.)—**E. DICKENS.** (Watch replies to queries now appearing.)—**P. W. J.** (Your query is a puzzle. There is no examination, except for officers; and as to the reserve, any seaman or resident at a seaport can join, provided he is physically capable.)—**X. O. B.** (Use fresh acid and try again. Did you think the one lot would do any quantity?)—**F. F. C.** (For the inhaler, see pp. 477, 526, Vol. XXXIII, and p. 98, present volume. For salicine of soda, see pp. 504, 525, 546, Vol. XXXIII.)—**GAMMA.** (We believe that a wipe with ordinary paraffin oil is the best thing.)—**NOVICK.** (Added in the form of a phosphate, we believe. The manganese is the black oxide.)—**T. RAWLINSON.** (The phenomenon is what are known as parhelia, with or without mock suns, due probably to mist and almost perfect stillness of the air. See the index to Vol. XIX. for some remarks about them.)—**ELECTRA.** (Impossible to understand from your description.)—**I-PICATOR.** (See p. 452, No. 825, for an idea; but it will be as expensive to make as to buy.)—**WOLFELE BOTANIST.** (Collins, Sons, and Co. publish a good manual of elementary botany. See p. 576, No. 684, for a method of preparing specimens for an herb-arium.)—**G. FAYNE.** (Indigo and starch made into a dough with starch paste; blue carmine, artificial ultramarine, ceruleo-sulphate of potash are substitutes for the indigo. The moist condition is preserved by means of a little glycerine. 2. You must have a coil or a plate machine and a Leyden jar.)—**F. R. S.** (Practically there is no appeal, because you must go to prison on the conditional order if you do not pay. We do not believe any judge would make the order if he had not satisfactory evidence as to means of payment. If they err at all, County Court judges err the other way.)—**J. J. GILBERT.** (The *American Mechanic* is published weekly, and can probably be had through Tribune, or Sampson Low and Co. It is a good paper. Use a "Dictionary of Arts, Sciences, and Manufactures," published by Longmans, would probably suit you.)—**CHARLES WICK.** (No.)—**G. M. S.** (See reply 4677, p. 523, No. 850, for directions to dress rabbit and other skins.)—**A. SERRAVALLO.** (Probably what is called pyrosis, or water-brash; but you had better see a medical man at once.)—**RANCHO LINDEN.** (You will have to sue him in Glasgow, and employ a Scotch lawyer. The English County Courts have no jurisdiction.)—**T. TOWLEY.** (We certainly prefer the "Cyclops" for several reasons.)

BRASS BEADING.—Hibernica.—Your queries can only appear in the "Sixpenny Sale Column."

THE LATE "SECONDS' PRACTICAL WATCH-MAKER"

WE have received several sums of money for the benefit of the widow of "Seconds' Practical Watchmaker," "Gimel," who says he should be happy to add his mite, asks:—"Could not some one in or near Leicester or Mrs. Coates advise what would be best done with the money for it to be of permanent benefit to her? Perhaps storing a small shop, if the widow would be able to manage it; or, this not being suitable, perhaps some of the readers of the ENGLISH MECHANIC could get the widow admitted into some almshouse. If something of a permanent character is not done, the money would soon be exhausted in rent and living, as I have known to be the case in other instances."

We append a list of the amounts received, to which we will add any others that may reach us. We will ascertain Mrs. Coates's position and wishes, and report further next week.

"J. K. P."	5 0 0
G. Calver	2 6
W. H. Davies	10 0
T. Wheeler	1 0
Jas. Robertson	10 0
	£3 3 6

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden, London, W. C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lots of Orders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade; to write to the Editor if he has any suggestions to make; and to advertise in the paper when he wants work.

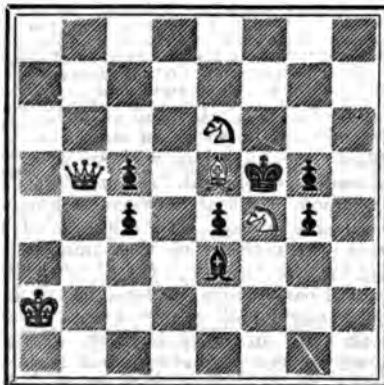
The charge for Advertisements for Situations is One Shilling for Twenty Words, and Sixpence for every Eight Words after.

Holloway's Ointment.—A Cure for all.—This ointment may be rubbed into the system, so as to reach any internal complaint. By this means it cures sores or ulcers in the throat, stomach, liver, spleen, or other parts. It is an infallible remedy for bed-legs, bad humors, contracted or stiff joints, gout, rheumatism, and all skin diseases.

CHESS.

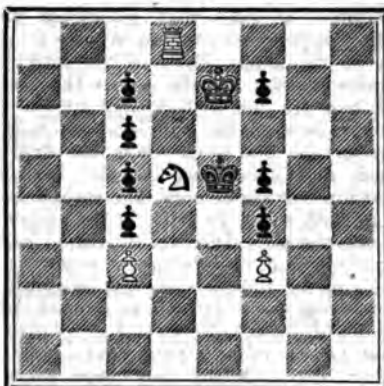
All Communications for this department must be addressed Chess Editor, 22, Chancery-lane, W.C.

PROBLEM DCCXXXVI.—By C. PLANCH.
Black.



White.
White to play and mate in three moves.

PROBLEM DCCXXXVII.—By D. FAWCETT.
From the Leeds Mercury.
Black.



White.
White to play and mate in three moves.

CHESS ITEMS.

At Brighton Chess is flourishing. A Sussex Chess Association is under consideration, when Brighton would be the head-quarters. Arrangements are being made for a Brighton Challenge Cup, which suggested the idea of having a county organisation. Several matches are being conducted between the Brighton players, and their play gradually improving will make them a most formidable Chess circle. A great deal of the enthusiasm created is due to the exertions of Mr. H. W. Butler, Chess Editor of the *Brighton Guardian*, to which paper we are indebted for the following items:—On the 6th inst., Mr. G. R. Downer, of the Chichester Chess Club, played simultaneously against Mr. H. Erskine eight games, winning seven games and losing one to the Brightonian. During the progress of this match Mr. Butler played simultaneously (blindfold) against Messrs. Scott, Street, and G. Downer, sen., all of the Chichester Chess Club. This is, we believe, the first attempt Mr. Butler has made at a semi-public blindfold encounter, and considering the strength of his opponents, his performance is highly creditable. He lost to Messrs. Scott and Downer, and won of Mr. Street.

The *Croydon Guardian* Solution Tourney resulted in favour of Mr. P. S. Shenale; 2nd, Mr. W. Jay; 3rd, Mr. G. J. Slater; 4th, Mr. W. Ives. The winner owes his success to the unsoundness of a problem in the Competition, which contained 28 solutions. Mr. Shenale discovered 21, scoring 127½ points. No other solver had the good fortune of turning so bad a problem to so good account as Mr. Shenale.

The *Weekly Irish Times* offers for the best-contributed three-move problem during 1882 a copy of Mr. Bland's forthcoming work. For the best two-mover, the *Weekly Irish Times* for six months. For the best solutions and criticisms, a copy of Mr. Bland's "Annual," presented by Miss F. F. Beechey, will be given. Address, the office of the *Weekly Irish Times*.

As interesting match was played on Saturday, the 18th, between the Fourth Class, City of London Chess Club, and the Oxford University. The contest came off at Wadham College, Oxford, and proved to be a very interesting struggle, the visiting team winning by only one game. The following is the score: City Club—B. G. Laws, 1; Ed. Ridpath, 1; J. Foster, ½; J. A. Manning, 0; Rev. J. J. Scargill, ½; Rev. Ed. Wel's, ½; J. E. Rab-beth, 0; H. D. Long, 1; J. F. Lovelock, 0; M. D. Blunt, 0; M. Beyfus, 1; G. Adamson, 1. Oxford University—G. E. Wainwright (Un.), 0; W. H. Heaton (B.N.C.), 0; W. P. Emerton, ½; E. A. Crosse (Exeter), 1; C. D. Looock (Un.), ½; W. N. Beebie (Trin.), ½; J. Moultrie (New), 1; J. T. Lawrence (Merton), 1; S. Weale (St. John), 1; Rev.

H. A. Pickard (Ch. Ch.), 1; A. Ackerley (C.C.C.), 0; G. F. Leatherdale, 0. The return match will be played a few days prior to the Annual University Match—Oxford v. Cambridge—and will probably take place at the City Club's quarters, Moultrie's Hotel, Newgate-street.

The Annual Meeting of the City of London Chess Club took place on Wednesday, the 22nd inst.

The Annual Handicap that is now being played is making fair progress, and it is hoped to be finished for the distribution of prizes at the annual dinner which takes place in March.

Solutions will be given next week—also acknowledgements.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

£s. 6d. for Six Months and 11s. for Twelve Months, Post-free to any part of the United Kingdom. For the United States, 12s., or 3 dols. 25c. gold, to France or Belgium, 12s., or 16f. 50c.; to India (via Brindisi), 12s. 3d. to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 12s.

The remittance should be made by Post-office order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 3d. each to cover extra postage.

Messrs. JAMES W. QUINN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the *ENGLISH MECHANIC*, at the rate of 3 dols. 25c. gold, or 12s. 3d. in sterling, post-free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes they must be paid for at the rate of 4d. each copy, to cover extra postage.

Vols. XXIV., XXV., XXVI., XXVII., XXVIII., XXIX., XXX., XXXI., XXXII., and XXXIII., bound in cloth, 7s. each.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in March and September, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 3d. each, through any bookseller or newsgate, or 2d. each, post-free from the office (except index numbers, which are 3d. each, or post-free, 3d.).

Indexes for each half-yearly volume up to Vol. X. (except Vols. II., III., IV., V., and X.) inclusive, 2d. each. Post-free 3d. each. Indexes to subsequent vols., 3d. each, or post-free, 3d. Cases for binding, 1s. 6d. each.

* Subscribers are requested to order Cases and Vols. through their booksellers, and not to send direct. The regulations of the post-office prevent their transmission through the Post.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a *Free Wrapper*, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

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Sixteen Words		3	6
For every succeeding eight words		0	6

* It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O's.

The address is included as part of the advertisement and charged for.

Advertisements must reach the office by 3 p.m. on Wednesday to insure insertion in the following Friday's number.

Throat Irritation.—Soreness and dryness, tickling and irritation, inducing cough and affecting the voice. For these symptoms use Epps's Glycerine Jujubes. Glycerine, in these agreeable confections, being in proximity to the glands at the moment they are excited by the act of sucking, becomes actively healing. Sold only in boxes, 7½d. and 1½d. labelled "JAMES EPPS and Co., Homoeopathic Chemists, London." A letter received:—"Gentlemen,—It may, perhaps, interest you to know that, after an extended trial, I have found your Glycerine Jujubes of considerable benefit (with or without medical treatment) in almost all forms of throat disease. They soften and clear the voice.—Yours faithfully, GORDON HOLMES, L.R.C.P.E., Senior Physician to the Municipal Throat and Ear Infirmary."

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 5 words.

Tinsmith's Circular Cutting Machine. by Rhoads and sons, cost £14. diameter, with 1 pair of extra cutters (good as new), cost £3, for good 10in. bottom-closing machine or cash £2; approval.—JON BLAIN, Albert-square, Carlisle.

All sorts of Instruments and Apparatus exchanged for others. Good value allowed.—Dr. CAPLATZ, Science Depot, Chancery-street, Tottenham Court-road. Established 1862.

Wanted, good Gold Albert, not less than 15 carat, in exchange for "Penny Cyclopaedia," bound in 27 vols, cost £5.—W. FELTON, Sandwich, Kent.

Marine Chronometer (Arnold, maker), gold cylindrical spring, goes within three seconds a week in present condition. Wanted, 32in. Bicycle, Piano, Harmonium, or others in cash.—ROWLAND, 8, Brayard's-road, Peckham Rye.

Bateman's Horizontal Engine Castings, 1in. bore, 2in. stroke; all parts turned and fitted. Exchange for Induction Coil, or others.—J. F., 103, Castle-street, Reading.

Medical Works (list sent), for works on Geology, Conchology, Mineralogy, or specimens, or anything useful.—Wm. SMITH, 78, Lower Ford-street, Coventry.

Newtonian Telescope, 5in. aperture, 8ft. focus; also Vols. XII. to XXXI. *ENGLISH MECHANIC*, two numbers wanting in Vols. XIV. and XV., all others complete, for combined Lathe and Press Saw, Britannia Co's, in good order; or others.—J. COLLINS, 8, North Gildry-street, Eglon.

Photographic Burnisher (Cabinet). Exchange for Cabinet Rolling Press, and give balance arranged.—T. CORNUS, Photographer, Innes-street, Aberdeen.

Edison's Electric Pen Apparatus, complete, in full working order, with about five reams of printing paper, and other plant in proportion, for back-gear lathe in good condition; gap preferred.—E. F. C., 11, Great New-street, Fetter-lane, E.C.

For Sale, 4ft. planed iron and steel, mechanic's Lathe, 5in. centre. Offers in Bicycles or Tricycles.—G. J. BRASS, 10, Queen-street, Colchester.

Kelly and Co.'s "Directory of the Iron and Metal Trade," price twenty-five shillings, last edition, for large Spring Balance, Office Books, or Stock and Dies.—Address, K. E. B., 4, Frederick street, Lark-hill, Stockport.

Fret Saw Attachment for Lathe, Saws, Files, &c., quite new, in exchange for good Metal-turning Tools or Turkey Boxwood to the value of £1.—W. H. B., Rufford House, Charlton Kings, Cheltenham.

Wanted, good Sewing-Machine or 50in. Bicycle. Give handsome Organ Accordion on stand, blown by foot, worth £5 10s.—W. SHACKLETON, Dower-street, Accrington.

"**Cassell's Old and New London**," 3 volumes (one bound), cost 32s. 6d. Exchange Turning or Electrical.—F. C., 33, Essex-street, Reading.

Lavate's complete works on "Physiognomy," 4 vols., several hundred illustrations, well bound; for 4-plate Bellows Camera, with Portrait and Landscape Lens and double dark slide.—THOS. HOWARTH, Manchester-road, Blackrod, Cheshire.

Strong treadle Howe Machine, wheel feed, in good condition. Any reasonable offer.—BETA, Belbroughton, Shropshire.

Large Handsome Coil, with Electric Bell, baize-covered table, &c., suitable for public exhibition. What offers?—BETA, Belbroughton, Shropshire.

Brass Milk Kettle, 7 gallons, 15lb., good condition. Exchange for Birds, or others.—LINDFIELD, Loughton, Hawk-hurst.

Fans.—A few 9in. Wheels (one brass), suitable for Fans, as described on page 339 of E.M., with brackets. Will take any useful exchange in Electrics or others.—G. FENDELL, 21, Victoria-terrace, Bolton-road, Bradford, Yorks.

Powerful Shocking Coil wanted. Will give a number of 3-vol. Novels in good condition. Send stamp for list. M. A. SALTER, Cromer, Norfolk.

Lathe, 3in. back-gear, gap-bed, slide-rest, &c., complete, quite new. Exchange Drawing Instruments.—S. CHAMBERS, 4, Coulson's-terrace, Penzance.

Exchange Stereo Camera and Lens for pair of 5in. Lantern Condensers, or others.—O. LARSEN, 23, Newstead road, Liverpool.

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WORLD OF SCIENCE AND ART.

FRIDAY, MARCH 3, 1882.

SPECIMEN OF IVORY-TURNING.

By J. H. EVANS.

THE piece of turning now illustrated is of a more complicated nature than those hitherto described, and will require a deal of care in its production. It will be seen at once that it embodies more than one description of work, and that most of it is of an extremely delicate nature. It is a difficult task to engrave work of this kind to do it justice, as some of the parts cannot be so distinctly shown as they appear in the original. I will endeavour to overcome this in the details of making it. In making such an ornament as this, one of the principal things to attend to will be the chucking of the various parts, and as there are eighteen separate pieces this is no slight matter. All the thin parts that are cut through must be well fitted to a chuck made of boxwood, and the external shape of the chuck must be a counterpart of the internal form of the work that is to be held, and when fitted, a thin solution of glue, quite clean, must be applied to the wood, and the ivory then fixed on to it. I will point out that it is absolutely necessary that the ivory should touch the wood all over; if it does not, where it is free the points will most assuredly break when being cut, and as this is a very disappointing thing to happen, it is better to save the time by giving the attention to the fitting of the work on to the chuck. In the first instance, in making a specimen of this kind many odd pieces of ivory may be worked up that would be, so to speak, useless for other purposes.

Having now given a few hints necessary to attend to, I will proceed to give directions, and the settings for the various parts, and the tools used.

Starting with the extreme base, it is simply a ring of ivory, and the pedestal is of African blackwood; the diameter of the ivory ring is 2½ in. and ½ in. in thickness; the diameter of the blackwood pedestal is 1½ in. and 2½ in. deep. This done, the ivory piece that is fitted over the top of pedestal and drilled out into points must be fitted to its place, and when this has been done, a chuck in boxwood to correspond must be made and the ivory glued to it. It will not take a very long time before it can be worked, but it is better, if possible, to leave it all night to set and dry well. As a rule, I find it better to get out the different parts, and make one job of chucking those parts that require glue; but this cannot always be done, as the proportions cannot be got at nicely except by building up as you go on; and here a little difficulty presents itself: because the bare forms may take the eye at once and satisfy the taste; but when the ivory is fitted over it, it may possibly look too heavy, and I don't think anything but experience will overcome such obstacles as these.

To proceed, we will assume that those parts chucked are ready to turn; the depth of the ivory overhanging is 5-16ths of an inch, and the external diameter is 1½ in. bare, which will leave the ivory a little less than 1-16 thick. This is not particularly delicate, being near the base. Now, to cut this out to the shape seen, a drill, No. 18, eighteen

hundredths in diameter, was used in the first place; the lathe-head set at the starting-point of the 96 division, and cut at every



SPECIMEN OF IVORY TURNING.

fourth hole, which will make 24 points. The drill must be so adjusted that it cuts only half its diameter into the ivory, which

brings the parts uncut to a point. When this drill has been carried round, another of smaller diameter, No. 10, must be used, and the slide-rest moved, so that it will bring the points as seen. It will be seen that five drills in all were used in the first series of holes, and when this is completed, those holes which are drilled in the part that is left must be done. Here four more drills are used. I say four more, but they are the same as used before, except the largest one, and it will be seen that they run in the reverse direction. On the edge, at the top of this piece, a series of small beads are drilled; these are done with an astragal or flat-ended bead-drill, in order that the superfluous material between each one may be cleared away. There are 60 of these beads, the division of that number being used for the purpose. On the top of this a small barley-corn pattern is cut with a double-angle tool of 45° in the eccentric cutter; this, in all probability, will not be shown in the engraving, but as it adds much to the appearance of the work, I should recommend its being done, especially as it takes such a short time to cut a pattern of this description; the next piece will be that which is fitted into it, the points resting upon the eccentric pattern just mentioned; this piece, when roughed out, looks very much like an old hat, but when cut and mounted it loses that somewhat undignified appearance; this must also be glued on to its chuck, both in the fitting and against the face, as the points that rest on the base are cut with a drill in the same way, only with the slide-rest set round to the surface, and to cut them the drill 18 is used, and every second hole of the 60 division leaving 30 cuts, the second hole is done with a No. 10 drill; in the upper part of this the same drill No. 10 is used, and the same division, only being so much smaller in diameter, the holes are naturally brought closer together. It will be seen that three circles of these holes have been drilled, and that between each of the centre parts another drill, No. 6, has been used, the division being set back to the hole between those previously used. It is always an advantage, in doing this class of work, to choose a division that can be divided by an even number, as it is more easy to obtain the half of it; it can be overcome, however, by the compensating index peg, should an odd number be chosen.

We now come to the plain curve of ivory, which must be turned to a nice curve. The foot or largest part is 1½ in. diameter, or rather smaller than the top of the piece, underneath, with the three circles of holes which is 1 3-16 in. diameter. The depth of the curve is full ½ in., and the diameter of the top or smallest part is 3-10 in.; by using these measurements the curve to correspond with the original can easily be obtained. The next piece, it will be seen, is more drill-work; this is simply a small dish as it were, the concave curve turned out first, and fitted on to a boxwood chuck, to fit it in the same manner as before; when chucked, the outside must be turned as thin as possible to match the inside, as near as possible, so that when cut it shall show the same thickness all over; this is not an easy matter, and will tax the patience very much. When turned, the same drill, No. 18, is used, and the sixty division, advancing four holes for each cut, there being fifteen in all, arranged as before, so that the parts left come up to points; another series of smaller size drill adjusted so that the complete circle is left, the next drilled in a like manner, and the fourth also; and to finish this part, on the largest space at the top a small drill is used. This piece is not a difficult or delicate part, and is only a question of patience to complete it.

And now we arrive at a totally different class of work—that is, the slender stem;

this is what is commonly termed the geometric staircase, and is executed by aid of the eccentric chuck and slide-rest only; at a first glance it would lead one to suppose that it was spiral work, but that appearance is caused by the repetition of the movements of the eccentric chuck. It will be seen that the stem is slightly taper, consequently the slide-rest must be set to the proper angle; the work must be mounted on the eccentric chuck, and the slide screwed out one half-turn. The tool must be a fixed one, No. 5, and the depth of cut set so that the circle is made true after the eccentricity is given to the chuck; the dividing wheel of the chuck must be moved eight turns of the screw or divisions in wheel for each cut. A difficulty arises with regard to supporting such a slender piece of work while being turned. The slender guide will not help on account of the eccentric motion of the work. The only way is to support the small end by means of the poppet-head centre, and being so small, it must have a false piece fitted of larger diameter with a perfectly flat end, and for each cut a fresh centre is made. This will necessitate twelve different centres.

Thus, the eccentricity being given to the chuck, and the tool fixed, bring the centre of the poppet-head to bear upon the end, and make the first cut; this done, the slide-rest must be moved along the exact width of the tool, the front wheel of the chuck turned round eight divisions or turns of the tangent screw. But, before moving any one of the arrangements, great care must be taken to withdraw the poppet-head centre. If this should be forgotten, the work will be probably broken, and have to be gone over again; and, when the operation of moving the wheel has been completed in its entirety, it will be seen that the end of the work has twelve consecutive centres, and it will only remain to remove the slide-rest the width of the tool each time, and continue till whatever length of ivory you are doing is completed. The poppet-head centre must be adjusted each cut. The stem of specimen illustrated is very delicate, the small end being only about one-eighth of an inch in diameter; and, to cut such a piece, the utmost delicacy of touch will be required. I had better mention that the ivory from which such a piece of work is to be made must be much larger than it is required when finished, as the eccentricity of the chuck being thrown out, one side of the material is removed until the complete circle is again obtained.

The stem finished, we come to some more delicate work, and the piece which projects at the top of the stem will be the next part to do. This is of a slight curve, and has fifteen cuts round it, the largest being cut with the No. 18 drill, and then the No. 10 used three times round. This piece must be also glued on to the chuck with great care. We now come to the part which covers the lower part of the body, which is first fitted to the shape, and then on to chuck, in the same manner as before. There are fifteen drill cuts in the length, and thirty in the circumference, making, in this one piece, 450 cuts. At the lower extremity it is very slender; and, when fitting such a piece of ivory as this, care must be taken to fit it, of the two, rather closer at the top, and it will then spring to the form on to which it is to go. I mention this because I have found by experience that the ivory is more likely to expand a little after it leaves the chuck on to which it has been glued. The body itself of this particular piece is made from a small cocoanut, the smallest I ever saw, and it was this that first gave me the idea of mounting it, but I fear it will prove a somewhat difficult matter to get another so small, so it may be made of blackwood. In case anyone should prefer to make it of cocoanut, if one is to be had, I will give a hint as to the best way to

work it up. One of the great difficulties with such material is the imperfect shape that they generally are. Should one, however, be procured, it should be chucked by the body, and the mouth of the interior be turned true, then rechucked by the part turned, and centred with the poppet-head centre; and if pretty true, it may be turned all over, as this one was. But, as I have said, it may be made from any other material. The next piece will be the ivory that descends; this has 30 cuts in its circumference, and three in its length, the No. 18 drill being used in the first instance to make the points, and then the No. 10 drill, of which there are two, the slide-rest being so adjusted that the drill will leave a point between each cut. This done, it will be seen that there are three smaller holes drilled in the centre of each part left by the other cuts. We now come to the edge of this piece, which is in the solid with it, and is cut out in steps with a step-drill having four steps; the same division of 60, taking each alternate hole, must be used, there being 30 cuts. In using a drill of this character, it is always more effective if the depth of the cuts can be arranged so that the part left at the top of the steps will be the same width as the steps are. In the centre of each piece left, another hole is drilled, which makes it more delicate and in character with the other parts.

The lower part and the body may now be looked upon as finished, and the cover will form the next subject for our consideration, although this is a portion of a sphere. There will be no need of a spherical slide-rest or dome-chuck, the shape being turned inside and polished, it must take the same course as all the other parts, and be fixed to a chuck with glue, and then turned as thin and true to the inside form as possible. When the ivory has to be turned so thin as in this case, it is not a very difficult matter to get it true, as the colour will show through, and it will be easily seen where it is not equal. Of course, if the spherical slide-rest was used, the same curve could be obtained absolutely without difficulty; in the absence of it, however, it can be very well turned by hand; and in cutting or drilling the holes in it, the slide-rest must be so arranged at an angle that the point of the drill is as near the centre of the radius of the curve as possible, and as the actual centre is neared, the rest will be almost at a right angle to what it was when doing the first series. In working up such a thin piece of work as we are now doing, the greatest accuracy with the settings of the rest will not be absolutely necessary, because, by way of example, if the rest is not set to the centre as described, the only result would be that the hole would have a slight angle on one side or the other, which, in work of so slight a substance, would not be seen. To cut the first series of holes, of which there are 15, a drill No. 45 was used; this is a size that is not always made with a set of drills, unless a set of 12 dozen are ordered. And in case anyone should care to copy this work, I may as well point out that it can be done with the eccentric cutter; and by the latter, holes of any size may be cut by having a narrow cutter, with a square end, placed in the instrument, about No. 8; and the diameter that is required may be obtained by setting out the eccentricity of the cutter to the desired amount. This operation, it will be seen, has been repeated three times, reducing slightly the diameter of each series of holes, and between the portions left another hole has been drilled, also in three circles.

We now come to another piece, which is again fitted to this convex top, and it forms a kind of frill, and is also very delicate. This is a part that will tax the patience; it has 24 drill-holes round its circumference, and six throughout the curve; it must be turned very thin, especially as we are get-

ting towards the top of the whole thing, and must be careful not to have any part in the least degree heavier than the lower portions. The next piece will be the last curve, and should be also very delicate; more so, in fact, than any other part. It has six holes in the curve and eight in its circumference. I will again mention the importance of highly polishing the ivory before attempting in any way to cut it, as it cannot be done then. Underneath this top piece, a thin, circular plate, cut out with a drill till there is scarcely any of it left, also there is another piece like it under the cover, the whole being cut away to a mere shell. There is, perhaps, no use in this; but when looked at from the top, the confusion of circles, intersecting one another, as it appears, is very effective. The top piece of all is simply a small piece of ivory turned to the shape seen, and then cut into four with the universal cutter; the long piece descending into the body is only intended for a finish. The top of this piece being so thin, and the stem so extremely delicate, I was compelled to just cement the cover on, as it could not be moved without its shaking off. The engraving is cut short of the lower portion of the base for the convenience of the size of the paper; but as I have given the dimensions of it in the first part of this paper, it will not matter. As there are considerably over one thousand cuts and drill holes, it is rather a difficult matter to make the instructions very concise; but I trust the few given will help any one desirous of so doing, to copy it, and should any further instructions be required, the original can always be seen or had to copy by application. I am glad to note that several amateurs have been able to do some very excellent work indeed from previous articles, so that I feel a deeper interest in doing my best than ever.

I will just hint that for such a slender piece of work it is safer to fix the base to the stand upon which it is placed under the glass, as it will not stand rough usage.

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.*

By JOHN WATSON WARMAN,

Associate of the College of Organists, London.

q. I will now have been understood (noting from 87, c) that the treatment of the Cross-Bead will often have to be modified to suit the Projection, whichever form of the latter is chosen. To this it is necessary to add that whenever the Cross-bead is made to enter the Key (see 87, f), the lateral extent of the Cutting which furnishes the Projection should be lessened by a corresponding amount,—such precise amount being simply that of the Bead thickness horizontal, added to the space always necessary to leave between Bead and Key-End.

r. Instances of all the three Forms now described are easily to be met with. The Curved Projection is at present constantly used by Hill (though often with a Flat Bead, see again 87, f); his large Organ erected about 1875 in Worcester Cathedral Nave-Transept may be mentioned: see also *Devington's* fine Instrument in the Church of St. Martin-in-Fields, London. The Notched form (as described at oo, ante) is now, and I believe always has been, regularly employed by Willis; the Organ, completed in 1865, for Hoddesdon Church, may yet once again be cited. The Sloped is the kind formerly used by Hill; his excellent Instrument, built in 1861 for St. Alban's Abbey, affords a specimen. Other Builders than the above-named also employ one or more of the foregoing Forms of Key Projection.

s. The relative Merits of the three kinds must be considered to depend to some extent upon circumstances, thus:—

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The *Curved Projection* presents decidedly the best appearance, and it also insures a good amount of vertical room beneath it; but it is somewhat expensive, owing to the advisability of the Curve itself's being Veneered or otherwise ornamentally faced, especially if the Cross-Bead be set so as to enter the Key (see 87, *f*); and this last treatment, or, as an alternative, the *Cambering* of the Bead (see again 87, *f*), will still further add to the cost. It should be observed that the advisability of having the Bead to so enter will here arise only when it is desired to secure a considerable amount of Projection (Overhang),—as when the Manuals are as many as *Four* in number; and that such advisability is caused by the impossibility of giving to the Curve a convenient and graceful form if it have to commence far back from the Key-end. On the whole, we may say that the *Curved model* may be freely adopted for all Organs in which its small additional cost can be borne, provided that the vertical distance from Manual to Manual be not less than 2½ in. (see 92, *n*).

The *Notched Form* will be found decidedly the simplest, cheapest, and most generally useful of all: it gives a fair amount of finger room beneath it; and we have already seen that it calls for no special treatment of either the Cutting itself or of the Bead. Its disadvantage is that the slight increase of thickness in its extreme Tip diminishes the clear [vertical] finger-space so beneath it. For this last reason we may say that this Form also should not be used when the vertical distance between the Manuals is less than 2½ in. (see preceding parag.).

The *Sloped model* is decidedly displeasing in appearance, and it has (as already seen) the additional disadvantages of requiring the Cutting to be made sightable throughout, and of compelling the top boundary of the Cross-Bead to be kept much down. As a set-off to these drawbacks, the *Sloped form* possesses the merits of securing the largest practicable amount of both vertical and lateral finger-space beneath it,—owing to the permissibility of making the extreme Projection-Tip quite thin, and to the fact that a considerable extent of lateral cutting does not spoil the appearance of this particular model, nor bring about the instability which might result from a *Curved Nose* much cut-in laterally. For these reasons we may consider that the employment of the *Sloped Projection* will be generally advisable in all cases where the vertical distance from Manual to Manual is less than the 2½ in., or in Manuals for which a considerable amount of Projection (Overhang) is desired (see here at 93, *a* and on).

It should be here observed that, whatever be the particular form of Projection used, it will always be advisable to make the Cross-Bead, if present at all (see 87, *gy*), an Entering one (see 87, *f*), whenever it is wished to secure the largest possible amount of Finger-space beneath such Projection. It is hardly necessary to add that the Treatment adopted should be of exactly one same Type in all the Manuals of any single Organ, with the exception of the lowermost Manual, and that even this also should, by preference, be so correspondent (see at *n*, ante).

t. Regulating Tail.—By this is meant the Treatment bestowed upon the Tails of the *Upper* of two Manuals which are to admit of Coupling [together] by means of an Action set between them, the object being the obtaining of a Regulation of the contacts of such Action. The actual point of the application is made to exactly, or almost exactly, correspond with the point of contact of the Coupler, when in working. At this point see *Department COUPLING-ACTIONS*: also what is said at *nm*, next; at *s*, next and on; and at 90, *r* to *nnn*.

There are here also three representative Types or Forms of Treatment,—viz., the *Button*, the *Split Key*, and the *Spring*; a little must be said on each:—

u. The Button form of Regulator consists chiefly (1) of a small non-rustable *Screw-Eye* (see with *BOTTOM PORTIONS*, at 33, *e*; also the future *Department SCREWS*) or other similar screwing Fitting capable of being turned by the Fingers, or by a suitable Spanner, and (2) of an accurately shaped pad or *Button* of hard Leather, which is firmly attached to the lower end of the Screw, and receives under it the Sticker or Drumstick Head of the Coupling-Action (see again *Department* of latter), all the while such Coupler is in working. In the applying, the

Screw-eye is first screwed downwards through the [upper] Key, so as to protrude below latter, and then the Button is firmly screwed on to such protruding end; and thus on turning the Screw-eye the Button will obviously be carried round with it, and its level, and consequently the reach of contact of the Coupling action, will be altered accordingly,—as may be required for adjustment.

But in order to ensure the smooth passing of the Drumstick or Sticker-head under the Button (especially if any Key of the Lower Manual be depressed at such moment), and at same time to provide an *Off-Clearing*—that is, a vacant space for the Drumstick Head to pass into when the Lower Key is so depressed but the Coupler is not in action,—either (3) a *Block* or an *Under-sinking* must form part of the Treatment. The first-named is, as its name implies, a small block; this is affixed to the under face of the Key at a point just inside—that is, nearer to the Key-nose than—the Button, and is set as close to latter as is possible without the risk of the latter's touching it at any time. The forward part of the block is *Sloped* in such a way as to present an under-face running upwards towards the Playing Part of the same Key; and along this face, therefore, should the Lower Key be depressed as just said, the Drumstick or Sticker Head will smoothly travel until it reaches its proper point under the Button. And the vertical thickness of the Block must be such that the under-face of the Button, when correctly adjusted, extends a trifle—say a little over 1-16 of in.—below the under-face of the Block. The alternative of the Block—the *Under-sinking*—consists merely of a *centre-bill Hole*, of a diameter of about a full ¼ of in. larger than the Button diameter, and bored into the under-face of the Key at a point exactly vertically beneath the Screw-eye point: thus when the Button is attached it lies almost entirely within the Hole,—extending only a little below the Key under-face, precisely as if the latter were a Block. It is necessary also that the Key itself be cut away, so as to form a slope commencing a little distance inside the Button,—such cutting being, in fact, of just the same size, shape, and posit as is the Block of the other Variety, and its object being the provision of the *Off-Clearing*, as with that treatment. Note, that both in the present and the two remaining Forms of Regulating Tail it will usually be best for the Buffing not to be applied to the Key but to the Drumstick Head: see further what is said on this point in connection with the *Wedge* (at *z*, next). For the reasons why the Upper Key is preferable for the receiving of such *Off-Clearing* see under Head of *Selection* (at *y*, next). For the determination of the *Slope Angle*, whether of the Block or of the Cutting, look again at Head of *Wedge* (*z*, next, middle of parag.). For the relative merits of the Block and the Under-sunk treatments, also see a little on (at *y*, next).

It is hardly necessary to add that the Button must always be perfectly free to rotate clear of everything; for if its periphery were to touch the Block or the Hole, and so be prevented from turning along with the screw, the entire Regulation would manifestly be at once destroyed.

In order to prevent the chance of the Coupler, when it has been drawn on, gradually getting itself out of action by the Drumstick-head's slowly working from under the Button, it is necessary to so have the structure that such Drumstick or Sticker Head shall, just before it arrives at its final point of contact in action, pass over or under a slight projecting *Ridge-lump*, or its equivalent, of such a nature as to effectually prevent the Coupler's ever of itself getting out of contact. This "Lump" is, in the present case, most easily furnished by forming, on the Lowermost Key, at a point exactly beneath the Screw-eye, a small *Catch-sinking*, of the shape of the segment of a cylinder: in this sinking the Drumstick-head will lie whilst in action.

uu. It may here be mentioned that the Bevil-headed Sticker Coupler figured by *Hopkins* on p. 53 of his 1st Edition is absolutely worthless for so confined a space as that between two Manuals of an Organ; besides which, any *Sticker* form of Coupler is, for such location, inferior to that of the Drumstick (see fully in *Department COUPLING-ACTIONS*).

[For the reason why the foregoing Forms of Regulator cannot well be applied at the fore

or descending part of the Key see again in *Department COUPLING-ACTIONS*.]

nnn. At this point see what is said, at 90, *r*, 10th parag., with reference to sometimes setting the Regulating-Screw in a *Slanting* direction.

v. The Split-Key form of Regulator possesses the *Screwing-eye* or its equivalent just as does the preceding form; but now, instead of employing a Button, the Key receives a horizontal *Saw-cut*, about 3 in. long, made in such a way that the under part of the Key is formed into a slightly elastic *Tongue*, about 3-16 of in. thick,—the position of the Cut being such that the Tongue has its fixed end or root turned towards the Player, and its nose or free end directly beneath the Screw-Eye. It will now be manifest, that by screwing the Eye vertically downwards till its nose comes in contact with the free end of the Tongue, the latter can be compelled to descend, or be permitted to rise, and so the requisite regulation of the contact be secured,—the elasticity of the Tongue being sufficient to allow of and ensure the only small amount of movement necessary. The Action will, in the constructing, be adjusted with the Tongue pressed a little downward.

It will, of course, be necessary to provide—as in the previous Form—a proper vacant space or *Off-Clearing*. It is equally obvious that neither the Cutting nor the Slope-Block can now be permitted to form part of the *upper* Key, for in such case the Regulating Tongue would become useless; the only alternative, therefore, is the having of the *Off-Clearing* at the [upper] face of the *Lower* Key. The shape of the Clearing, if a Cutting, will be the same as with the preceding Form (see *v*, ante), except that the Slope is now to be reversed,—that is to say, to run *downwards* towards the Playing Part of its Key. The Block also, if adopted instead of the Cutting, will be similar to the former one (see again *v*, ante), with the exception of the reversal just mentioned, and that the Block-crown must now come beneath the Drumstick-head and point of Regulation. The *Angle* of the Slope will be exactly as before (see *z*, next). For the relative merits of the Block and the Cutting, see also as before (at *y*, next).

The *Ridge-lump* already spoken of (at *u*, ante) is of course as necessary here as with the Button type of Regulator. Such Lump is, with the present kind, best formed by simply Beveling away the under face of the Tongue-end at the point just beneath or a little beyond the Screw-eye, so as to make the said face to slope rather sharply upwards towards the extreme tail-end of its Key. The Drumstick-head, when in position for action, will thus be in contact with, and actuate by means of, the said Slope.

w. The Spring form of Regulator differs from the Split-Key only in that the wooden Tongue is now replaced by a similar one of some sufficiently elastic *Metal*,—generally Brass. This metal Tongue is firmly attached to the under face of the Key by a couple of suitable Screws. The *Ridge-lump* is furnished by giving the Tongue a slight but sudden bend upwards at the desired point.

(To be continued.)

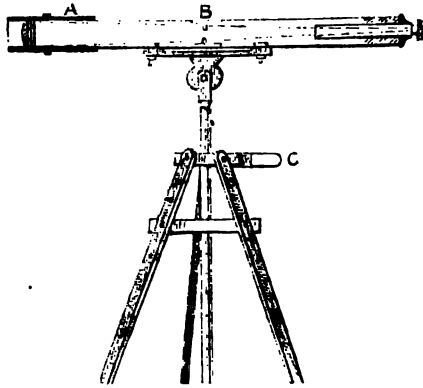
HOW TO MAKE A 2 IN. ASTRONOMICAL TELESCOPE.

(Concluded from page 535.)

THE length of the telescope must be regulated by the solar focus of the object-glass, which we will take at 30 in.; this, after allowing for the eye-tube socket and a fair margin for focussing, will give a length of 26 in. for the body-tube. It will, of course, be understood that these are merely proportional measurements, because object-glasses differ so much in focus that special directions are impossible. Each glass must, therefore, be tested for the tube it is to be fitted to. The testing may be proceeded with as before directed, except that the sun will be substituted for the gas-flame. Some little difficulty will most likely be experienced in getting an exact focus, because, even when held at the right distance, the image will be liable to distortion by the slightest tilting of the object-glass. This tendency and the reason of it convey a valuable lesson in tele-

scope construction, since it demonstrates the importance of bedding the object-glass square to the axis of its tube, and of fixing the eyepiece-lenses centrally in their cells, so that their axes may be in a line, not only with each other, but with that of the object-glass as well, for unless this be the case, anything like perfect definition can hardly be expected. For this purpose the use of a lathe to cut off the ends of the body-tube and to fit the eyepiece-lenses in their mountings is absolutely essential.

Having cut the principal tube of the telescope to its correct length, the 6in. piece of 2½in. tube may be slipped over one end to the extent of 4in. (see A in section), and kept in that position either by running in some solder (having previously cleaned and moistened the parts with a little chloride of zinc or Burnett's fluid) whilst the tubes are held over a Bunsen flame, or by drilling three or four holes and screwing the two tubes firmly together. I may here mention that should any difficulty occur in getting tubes of just the right diameter, to fit one within the other—and this, in out-of-the-way districts, is,



I am afraid, far from an unlikely contingency—an excellent substitute may be found by pasting several turns of brown paper round the 2in. tube until it forms a roll of substantial thickness. This should be moved along until it projects about 2in. beyond the end, in which position it may be left till dry, when it will be found to grip the tube so tightly that no other fastening will be necessary. The object-glass may then be passed down until it rests upon the trued end of the tube, and a spare piece of the same tube placed upon it. The eye-tube socket can then be adjusted, so that its shoulder beds fairly against the outer tube, and fastened as directed for the cap-tube.

The form of eyepiece generally adopted is that known as the "negative" or "Huyghenian" eyepiece. This combination consists of two plano-convex lenses, whose foci are as 1 to 3—say ½in. for the field-lens and ⅓in. for the lens nearest the eye; they should be placed at a distance from each other of one-half the sum of their combined focal length, which, in plain English, means—in this instance, at least—exactly ⅓in. apart. Ordinary plano-convex lenses may be bought at any optician's from about 4d. each; but these would not be at all suitable for our present purpose, since they would not, in all probability, have been centred, as will be plainly seen from their chipped and unground edges. For properly-centred lenses, suitable for a celestial eyepiece, 1s. each will not be an unreasonable charge. These lenses may be mounted, with their convex sides towards the object-glass, in a wooden tube, which should be made to fit the eyepiece tube in such a manner, that while it may be easily slipped in, it will be sufficiently tight to prevent any side motion. The same rule will apply to the fitting of the lenses, and, indeed, to all the movable parts of a telescope, without exception.

The eyepiece lenses may be kept from shifting by springing brass wire rings closely against them. A diaphragm should be placed midway between the lenses, with an aperture rather smaller than the diameter of the cone of rays formed at that position by the field-lens. This, in the present instance, would be ⅓in. Its object is to cut off the extreme rays, and to give a flat field of view. A diaphragm of 1in. aperture may also be placed, with advantage at half the focal length of the object-

glass (B); this may be fixed in a cardboard or other tube, for the convenience of movement to suit the cone of rays from the object-glass (see dotted lines). The interior of the telescope may now be painted to a dull black, with a mixture of thin French-polish and lampblack, when it will be ready for putting together.

The amateur having proceeded thus far, will no doubt be impatient to test the power and definition of his telescope; he will, however, speedily discover that the simplest observation cannot be made in comfort unless the telescope is conveniently mounted upon a stand. For a combined horizontal and vertical motion he cannot, perhaps, do better than adopt the plan recommended in the last article (see illustration, Figs. 2 and 3, page 535), but in fixing this mounting to the tube it should not be placed, as it is too often done, at the centre of gravity for a horizontal position, but rather at that part where the telescope is evenly balanced when it is pointed at an angle of about 45°. By this means the telescope will maintain its equilibrium at all convenient altitudes, and the nuisance of a stiff centre or a sliding balance weight be dispensed with.

A stand for the telescope is now all that is necessary to complete the undertaking, or of the different kinds usually employed; a folding garden-tripod is certainly the most handy, but unless the amateur is fairly versed in cabinet work, I am afraid his first attempt would be liable to fold up at very inconvenient seasons. I have, therefore, suggested in the sketch the much easier plan of simply screwing the legs to two discs of wood of different sizes, each disc being perforated for the pillar. The telescope may be kept at any desired elevation by tightening the screw C, or by such other means as his ingenuity may suggest.

Aldebaran.

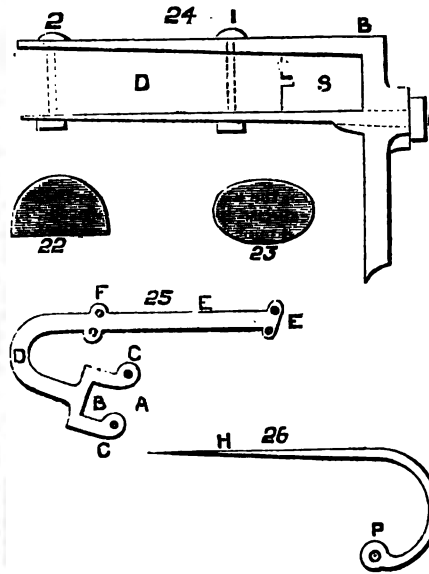
CART AND WHEEL-MAKING.—XIV.

(Continued from p. 416.)

By J. CHARLES KING.

IN dressing up shafts to the particular rounding sectional form wanted, a learner is apt to forget the framing and ironwork bearings; even with some experience, it is done inadvertently sometimes.

The diagram, Fig. 22, shows a section of shafts rounded off at the top and slightly at the lower



angles, and also in form like an ellipse Fig. 23. Fig. 22 is the more common, and for some reasons the best. For either shape, flat-bearings must be left at bottom, and edges for about 3in. long at the bar, and 12in. at the scroll-iron bearings both back and front, and on the undersides of the points for the tug bearings about 20in. Much depends upon these bearings being perfectly true and level; other parts of the shafts may be warped, but these may not be out of truth, if you would have an accurately framed and ironed carriage.

The tug-plates which protect the bent points

of shafts are simply pieces of half-round iron 20in. long, tapering from 1½in. wide to ½in. wide at the tips, 3-8in. thick at the widest part, tapering to 1-8in. thick at tips, where they are drawn quite flat. A metal cap called a shaft-tip, which is driven tightly over both wood and iron, forms a finish. Tug-stops are mostly screwed into the iron, to form checks for the harness fixing at this part. It is now becoming common for plates with tug-stops to be fixed outside instead of under the shafts. They are rather more effective than underneath.

The framing of the step-bar to the shafts of a cart is by a small stud-tenon on the bar. In no case must it be so wide as the bar by ½in. and only ½in. thick, and bare ½in. long. It is made thus small so as not to need a large or deep mortise in each shaft, which would cause weakness likely to lead to a fracture of the shaft at this spot.

The steps, after the tug-plates, are the next ironwork fitted to a dog-cart carriage. If these are bought at the coach ironmonger's, the proportion of parts will be generally correct, and but little setting will be required. Well-proportioned steps, with safe treads, have already been described.

The technical terms for the parts of a step are the "head," the "strap-bolt," the "stem," and the "treads."

The head is the part which secures the bar to the shafts, and the strap-bolt, by its nut, serves the shaft tightly up to the shoulder of the bar.

The annexed sketch of a step-head, B, Fig. 24, will show the action of this strap-bolt: when the nut A is screwed up, it draws the bar D forcibly on to the shaft S (shown in section). This is further aided by giving what is termed "draft" to the bolts 1 and 2: this is done by marking the place on the bar D, where the bolt-holes are in the step-head, and boring them about ½in. further away from the shoulder of the framing; do not attempt to drive in the bolts, but use what are termed "draw-bore pins." These are of smooth round steel, tapering from a point to a notched head. Any bolts will do for temporary use, if small enough to go easily through after the draw-bore pins, while you are framing and fitting the parts together, as you will have to screw and unscrew these bolts several times, before final fixing with bolts that fit tightly in both wood and iron of step-head and bar.

Measure your carriage for widths according to the chart, page 344, cross-line for diagonal accuracy, and try the levels of the shafts, especially where the body will bear on the carriage part.

The scroll-irons are the next ironwork to fit and fix to your shafts. These can be bought ready made, though it is always best to have them made specially for your dog-cart. The front scroll-irons should be made with butterfly flaps, to receive the bolting of clips, which pass over the shafts to fix the scroll-irons in front; by this fixing, no holes have to be made in the shafts to fix them on. Diagram 25 shows a front scroll-iron, viewed as if looking down obliquely on to it in position as fixed to the carriage.

The technical terms for the parts of this scroll-iron are—A, the head; B, the fork; C, the ears; D, the stem or scroll; E, the flap; F, the wings of the flap, with holes slightly closer together than the widths of the shaft. The wings nearest the stem are called the root wings, the others the point wings. I mention these terms in case a learner has to order such scroll-irons of a smith. The order would run thus:—Scroll-irons for 2in. springs, ½in. oval shafts, butterfly flaps for 2in. wide shafts, flaps 1½in. long; scroll to turn short from root flap and 1½in. side cant; bottom of ears to be ½in. from top of flap. Shaft clips with 5-16in. bolts, pipe-eye of spring 7-16 bolt (this gives size of hole in the ears). Hind scroll-iron, Fig. 26, would be described as a pipe scroll-iron—P is the pipe, H the flap. The pipe for a 2in. spring with 7-16 bolt, stem full ½ oval iron, flap 1½in. long, with three ½ round holes, distance between bottom of pipe and top flap 8in., 1½in. side cant. A smith would make correctly to these dimensions, but a drawing in chalk of side elevation would in all cases be useful. For the ironwork, the cartmaker's work is handed to the smith to carry out this process of manufacture, and order should be precise, as they are invariably followed closely by the smith, so that only what is called a slight twist is requisite to set true.

make the four scroll-irons fit the spring-heads, and bolting into the "pipe-eyes" or "spring-couplings" quite true every way. I have described the simplest forms of scroll-irons to fix to the shafts, suitable for a village-cart or shooting-cart. Some scroll-irons are made with corner-plate flaps to fix under the body instead of the shafts; others have the stems to turn out at right angles to the line of the flaps. The uses of these will be explained.

(To be continued.)

THE CRYSTAL PALACE ELECTRIC EXHIBITION.

ALTHOUGH the exhibition at the Crystal Palace is not yet complete, so far as some of the stalls are concerned, the most attractive feature—the electric light—is now in full working order. To those interested in the latter subject, the display of the various systems on view affords an excellent opportunity for making comparisons, and for gathering information that is not to be obtained elsewhere. The principal dynamo and magneto-electric machines are shown at work, occasionally with duplicates at rest; and we have also the best known and most successful regulators, with excellent exhibits of incandescent lamps—the chief attraction for the general public, as the system available for use in dwelling-houses. Besides machines and lamps, however, there are many details connected with the installation of the electric light which can be seen at the Palace as carried out by rival firms; for not only is there considerable variety in the steam-motors used to drive the generators of electricity, but the arrangements of shafting, sizes of pulleys and belts, and sundry other matters connected with the successful erection of electric-lighting plant, render this portion of the exhibition unique. The Anglo-American Brush Light Corporation have, in some respects, the best position of all for showing their exhibits, for while they supply the tropical and with arc-lights and the Alhambra Court with incandescent Lane-Fox lamps, the steam-engines and dynamos are located in a new shed almost adjoining, which is erected on what is known as the North Lawn. This shed—a tolerably large one—is at least clean and sweet-smelling, comparatively speaking, and a gallery or platform which runs round three sides affords visitors every opportunity of examining the exhibit. The machines are arranged along what may be termed the front line; and the engines, five of Robey's well-known semi-portables, occupy the back line, their furnace-ends being the only part to which the public have not access. The engines drive a counter-shaft running across the shed, and the machines are driven from that, only a comparatively few dynamos in the exhibition being driven direct. One of the exceptions, however, is found in this exhibit; for on the western side is a Hodson's rotary engine, driven by a launch boiler and working a small dynamo direct, for which purpose such an engine is specially adapted. The Robey engines are of various sizes, and one has a firebox specially suited for burning wood; and the counter-shafting, though driven in sections, is so arranged with friction-clutches that any engine can be cut out, or one can be used to drive the whole. Turning to the lights, we find in the office of the company a couple of 15-candle incandescent lamps; while, pendent from the roof of the Alhambra Court, are some pretty incandescent lamps of 50-candle power. The "fountain" in the tropical department has an "electroliner" of Lane-Fox lamps, while in the water of the basin some are shown floating or submerged. In the case of the Anglo-American Brush Light Co. one can pass so easily from the machinery-room to the spots where the lights are exhibited, that this part of the show naturally forms one of its most attractive features. Passing southwards down the nave, a number of arc-lights are found, worked by the Weston and Maxm machines, and the crystal electroliner by Messrs. Defries illuminated by Maxim incandescent lamps naturally attracts great attention from its beauty and the excellent effects produced. Still further south are more arc lights, and in the theatre the Jablockhoff candles, which at the time we saw them were scarcely calculated to impress the observer in their favour. Here we may appropriately observe that arc-lights, regarded as lights only, are incomparable, for all arcs are alike, and it is only by taking notes of the relative steadiness or freedom from flickering that any comparison is to be made. Their respective merits depend more on their cost, both as regards production of current and the attention needed for their proper working, and though the older forms of regulator, with their "clockwork" gearing, are beaten in simplicity by sundry modern forms, it may turn out that after all they really work better than their young rivals. The Crompton and the Pilsen arc-lights, shown in the orchestra and in the space between that and

the stage, are both good specimens, and the Pilsen lamps driven by Schuckert's machines, shown in the west corridor, where they serve to light their own dynamos, are certainly remarkably steady, and are almost the perfection of simplicity. The Crompton lights, which seem to have a better claim to their alleged candle-power than some others, are worked by Bürgin machines, which for compactness vie with the Siemens and the Gramme. We have previously referred (page 509) to the splendid effect produced by the Edison incandescent lamps in the concert-room; but the exhibit in the entertainment-court is certainly the chief attraction, so far as the general public are concerned, of the whole exhibition. Here, suspended from the roof, we find a magnificent "electroliner" composed of coloured glass and brass worked into the shape of flowers—350, we understand—the incandescent lamps being placed, to the number of 99, in the corollas of the "flowers." These lamps are on three circuits, either of which can be cut out as desired. Arranged on tables in the court are instruments representing some of the most useful of Mr. Edison's many inventions, while on the walls, and suspended from the roof, are various practical illustrations of the application of his system of incandescent lighting to domestic purposes. Thus we have bracket-lamps, pendent lamps for illuminating billiard-tables, and "portable" lamps, which are portable to the extent of the slack wire connections, but which are exhibited apparently for the purpose of showing the public how easily the light can be cut out or brought into the circuit, which is effected by simply turning a tap similar to that found in gasfittings. On one of the tables in the court is the Edison vebometer, which consists of a couple of little cisterns attached to a beam, the oscillations of which, produced by the electro-deposition of copper in the cisterns, are made to register the "quantity" of current supplied. This instrument is to be what the gas-meter is nowadays, and is to be affixed in each house supplied with electric light, as the basis for calculating the charge to the consumer. It is exhibited without any explanatory ticket, and, apparently, is not at work, though it would seem that if it had been connected to the "electroliner" in such a manner that the public could see for themselves what amount of current was consumed by the 99 lamps, an item of much-wanted information would have been afforded. Here we may mention that Edison's machines and their engines (like the Brush Co.'s, of Robey's make) are in the basement or "tunnel" near the entrance from the garden terrace. The dynamos are twelve in number, so arranged that any two can be cut out without stopping by means of a clutch arrangement on the shaft. It is noticeable that all the Edison machines are connected to one circuit or line wire, and each carries an incandescent lamp on the top, which lights up the machines and engines. The remainder of the nave is, or will be, illuminated by the Mackenzie lamp (Strode and Co.), the Gravier (the only one missing at our visit), the Gérard, the Crompton, and the Siemens arc-lights. The Swan incandescent lamp is shown in several parts of the building, and may be inspected all day long in a little temporary house erected near the north end of the Crystal Fountain. Should the visitor look in towards evening he will find that incandescent lamps can warm the atmosphere of an apartment, though they exercise little effect compared to gas, and, of course, do not vitiate the atmosphere. We have not attempted to notice each electric lamp, nor to give a list of the firms exhibiting; it must suffice to say that such a display of the new means of illumination has never before been exhibited anywhere, and certainly the public have never before had such an opportunity of examining all the details of the various systems. We have referred above to the engines used in driving the machines of Edison and Brush, and we should also mention that Ransomes, Sims, and Head, and Marshall and Sons also have engines supplying motive power to other machines. The machines in the west corridor are driven by the large compound Galloway, where they have not separate motors of their own; but one of the most interesting groups of engines and machines will be found in this portion of the building in the shape of Siemens' machines driven by engines made by Messrs. Gwynne, of Hammersmith, being adaptations of types they use with centrifugal pumps. One of these engines (vertical) runs at 700 revolutions, and another at 800, driving direct—the dynamos being fixed on the same base-plate. Near the railway is a horizontal engine working an exciter and an alternate current machine—the chief novelty in connection with which exhibit is one of the belts, which is made up of a number of "links" of leather held together by steel pins. Belts, in fact, are shown in considerable variety, for the White House Mills Co., of Hoosac, New York, who exhibit the Arago disc dynamo and Ball's arc-lights, use cotton belting, which appears to answer well, while other exhibitors have rubber belts and different makes of leather and cotton. In the west corridor the visitor

will find an application of an electro-motor, for driving a band-saw, and will probably wonder what advantage is gained. A Hodson rotary engine is used to drive a Gramme, which in turn drives another connected to the pulley of the saw. Several Hodson rotaries are to be seen about this part, and at the end is the exhibit of the Turner gas-engines, included in which is a magnetic motor shown by Mr. F. Penn, of Lewisham. Close by, Messrs. Chubb show Holmes's electric time lock, which can be so set as to open at any given time on the next day. It is a highly ingenious, but rather complicated piece of mechanism, involving the use of two chronometer movements and an electrical attachment in the event of their failing. Several Otto gas-engines are shown driving dynamos, and in the passage at the end of the Chinese court, Mr. Elmore exhibits the Otto driving his dynamos and supplying current for electro-plating purposes. The Clerk gas-engine is also shown in the west corridor. Two useful exhibits must not be overlooked in the shape of portable electric lighting plant. One is shown by Mr. E. S. Hindley, of Bourton, in the west corridor, in the shape of a steam-engine and dynamo mounted on a wheeled platform, while in the basement Messrs. Ransomes exhibit one of their small portables, which has a small Gramme fixed on a shelf projecting from the smoke-box, and a single but powerful arc-light, intended for the use of contractors. We have not mentioned all the machines and engines employed in this unique installation of the electric light, for our space is limited; but we must now pass to other exhibits. At the Post Office stall will be found one of Professor Hughes's induction balances, which is explained at intervals during the day; another can be seen in a glass case near where Mr. Ladd shows the original letter received from P. Reis, in 1863, describing his telephone. A number of telephones are erected in different parts of the building, but we regret to find that some are disconnected in consequence of damage. The Consolidated Telephone Construction Company have a variety of instruments fitted up, but they are so far apart (the southern gallery to the end of the north nave) that few persons care to make the necessary arrangements to try them, and those who try them on chance generally find that at the other end there is some one whose sole idea of using them is to perpetually ring the bell, or to shout so loud that all the other instruments in use also convey the message. Probably when the exhibition begins to attract public attention, the Company will see that an attendant is placed at each end of the line. Two specimens of that wonderfully ingenious instrument the siphon recorder are shown, one by the School of Submarine Telegraphy working through a long artificial cable, the other by the Eastern Telegraph Company, in the south nave. Close to the latter will be found the exhibit of Dr. Gladstone and Mr. Tribe, who show the decomposition of water by the copper-zinc couple; the preparation of aniline from nitro-benzene, and of ethyl-hydride, also by the copper-zinc couple. Mr. C. F. Varley's exhibit is now located, in which he shows a 1,000 cell gravity battery connected to multiplier for converting dynamic into static electricity, also his rotary machine—one of the fore-runners of the present dynamos, which was patented in 1860. A number of railway signalling appliances are exhibited by the London and Brighton, the London and South-Western, and the South-Eastern Railway Companies; Sykes's combined electric lock and block, and some novelties which we must notice at a future date.

THE OBSERVATORY ON MOUNT ETNA.

THE following account of the observatory on Mount Etna is given by Signor V. Tedeschi: "The astronomical observatory on Etna has just been finished, and is doubtless one of the most interesting of its kind, both on account of the valuable instruments which it contains and its exceptionally favourable position for astronomical and spectroscopic observations at that great elevation, and, thanks to the extraordinary transparency of the atmosphere in these southern regions, the sky is of a perfectly pure blue, the stars shine in all their splendour, and distinct spectroscopic lines can be obtained which are invisible at all other European observatories. These advantages induced the municipality of Catania, at whose expense the observatory was constructed, to aim at its being an international station, and so they added to the observatory three large bedrooms, a dining-room, and kitchen for the use of such foreign men of science as desire to remain there for some time, and the telescope is finished with a moveable iron tube, the length and aperture of which can be modified at pleasure, so that foreign astronomers can apply the instruments they bring with them. The observatory is built on a little eminence on the side of the central crater of Etna, a position which makes it almost certain that should a stream

of lava issue on that side, it would divide into two streams and flow harmlessly on each side of the little hill. The building consists of two storeys, the joint height of which is nine metres, and the base of the edifice occupies a superficial area of 200 square metres. In each story there is a large circular room surrounded by other chambers destined for different uses. In the centre of the circular room in the lower storey there is a solid pillar to support the great refractors. All the instruments, as well as a fine collection of seismographic and meteorological apparatus, are in the upper storey, in the large circular room of which are the telescope and chronometrical apparatus. This room is roofed with a moveable iron cupola. In this story are also the rooms for foreign visitors, and a little terrace from which there is a view of half Sicily, Malta, the Lipari Islands, and part of Calabria. The observatory on Etna is the highest building in Europe. The observatory on Vesuvius is 619 metres above the level of the sea, the Hospice of the Gotthardt 2,075 metres, and that of St. Bernard 2,401; while the Etna observatory is at a height of 2,942 metres. At this great elevation there is no fear, in taking astronomical and spectroscopic observations, of the perturbations proceeding from the variable density of the different atmospheric strata, so that this observatory will probably render invaluable service to astronomical science and terrestrial physics."

IMPROVED CARBONS FOR ELECTRICAL PURPOSES.

FOR electric lighting purposes it is well known that it is of the first importance to procure good carbons—such as are comparatively pure and as homogeneous as possible. Mr. J. G. Lorrain, of Victoria Chambers, S.W., has recently obtained letters patent for an improved method of preparing carbons for all purposes, whether in the shape of filaments, rods, pencils, plates, masses, or electrodes employed in electric lighting. In carrying out the invention, the carbons are impregnated with a substance in which carbon exists, and this is acted upon by another chemical reagent, so that the carbon is separated and precipitated or deposited in the pores and on the surface of the filaments, rods, pencils, &c. The patentee describes two processes by which the invention may be carried into effect, and which have been found to give good results in practice, but the invention is not limited to the substances, compounds, or chemical reagents referred to, as any hydrocarbon or carbonaceous substance may be used, which, in the presence of chlorine gas or of an acid, or of any equivalent agent, will be decomposed and deposit carbon upon the body under treatment.

Carbons in any form used for electric lighting in galvanic batteries, and in microphones or telephonic transmitters, or for other purposes already prepared by some known process, are boiled in turpentine, say, for about half an hour, or until occluded water ceases to be evolved from the carbon. They are then submitted to the action of gaseous chlorine, first at the ordinary temperature, say, for example, for about five minutes, and then to a gradually increasing temperature, until bright redness is attained. In the treatment of the smaller description of carbons, such as filaments, pencils, and small rods, the patentee employs a cylindrical or other conveniently shaped vessel made of glass or other material. In this vessel the carbons to be operated upon (already saturated with turpentine), are placed in such a manner as to complete an electric circuit. The vessel also contains water, provision being made so that the water may be drawn off and replaced by fresh water when desirable. The vessel is next exhausted of air by means of an air pump or otherwise, and is then filled with chlorine, or the chlorine may be introduced without first exhausting the air, which is then expelled by displacement. An electric current is then passed through the carbons, and their temperature very gradually raised until they reach bright redness by gradually increasing the current. By this means complete union of the hydrogen of the hydrocarbon with the chlorine will take place, the hydrochloric acid produced being absorbed by the water, and a large part of the carbon liberated will be deposited in the pores and interstices of the carbons.

For the treatment of larger carbons a porcelain or earthenware tub capable of being heated by means of a furnace is by preference used, and the chlorine gas is caused to pass through such tube which contains the carbons previously saturated with turpentine. The tube is very gradually raised in temperature to bright redness by means of the furnace, in place of being heated by the electric current. This process of saturating the carbons with turpentine and gradually heating in presence of chlorine, is repeated until the carbons are of the required quality.

According to another mode the carbons are boiled in strong sugar syrup, say, for about an hour, or until they are free from occluded gases.

They are then soaked, say, for a period of two or three days in dilute sulphuric acid (preferably a mixture of four volumes concentrated acid to one of water), and subsequently for a like period in concentrated sulphuric acid. By this means the elements of water contained in the sugar are abstracted, and much of the carbon is deposited in the pores and upon the surface of the carbons; after having been well washed the carbons are heated to redness out of contact with the air. This process may be reversed—that is to say, the carbons may be steeped first in sulphuric acid and afterwards in syrup, and then washed and heated out of contact with the air, whereby a similar result will be obtained.

SCIENTIFIC NEWS.

AN observatory is to be erected at Durban by the generosity of some colonists, at the instance of Mr. D. Gill, the Astronomer Royal at the Cape. It appears that Mr. Gill was on a visit to Durban, and noticed that it was a favourable place for observing the Transit of Venus, a fact he mentioned to Mr. H. Escombe, who at once offered to provide a first-class equatorial, costing £450. The town council granted a site for an observatory, and two merchants in Durban, Mr. W. Randles and Mr. Greenacre, have undertaken to defray the cost of the building between them.

At the meeting of the Royal Dublin Society last week, Mr. Howard Grubb described some novel heliometers he is constructing from the designs of Prof. Houzeau, the Belgian astronomer royal. They are for use at the coming Transit of Venus. In Professor Houzeau's arrangement the two half-objectives are of very different foci, one of about 14 ft., the other 6 in. only, but so placed that both form their images on same plane. As the apparent diameters of Venus and the sun are about as 28 to 1, it follows that the image of Venus, as formed by the large objective, will be about the same size as that of the sun formed by the small objective, and consequently coincidences can be made, not by bringing the limb of Venus to touch that of the sun or a micrometer line, but by superposing the image of the sun as formed by the small objective on the very slightly larger image of Venus as formed by the large objective, and thus it is hoped that all the inconvenient and perplexing phenomena of irradiation, "black drop," &c., will be completely eliminated.

Prof. Tyndall's course of lectures at the Royal Institution on Thursday, March 16, 23, and 30, will be on "Resemblances of Sound, Light, and Heat." On Saturday, March 18, 25, and April 1, Prof. H. G. Seeley will lecture upon "Volcanoes."

The *Times* announces that an improved storage-battery has been devised, which possesses five times the durability and two and a quarter times the capacity of the Faure accumulator. Each cell is capable of containing 400 amperes, and of delivering a current of 50 for eight hours. A public demonstration is to be made very shortly, probably at the Crystal Palace; but as such an improvement is doubtless patented, why all this mystery? What is the new storage battery, and who is the inventor?

The collection of fossil fish belonging to the British Museum has been enlarged by the collection of the Earl of Enniskillen, and in the course of a few weeks it will be enriched by the addition of the collections made by Sir P. G. Egerton. It will then be an altogether unique and unrivalled exhibit. The collections will be located in the new museum in the Cromwell-road.

At the meeting of the Society of Telegraph Engineers and Electricians last week, a paper was read by Mr. Treuenfeldt on the Siemens railway gongularm used in France and other countries. The paper led to a discussion, in which some of the authorities in this country pointed out that the gong was not well adapted for crowded lines, but might be found useful in the colonies. Reference was made to the advisability of adopting a uniform code of signals throughout the country, and Prof. Ayrton advocated the revival of magneto-electric generators instead of batteries.

At Hatfield Park, the seat of the Marquis of Salisbury, the piles to support a coffer dam

across the River Lea have just been successfully driven by the power of a water-wheel situated at a distance, which power was transmitted by two dynamo machines to the gearing connected with a pile-driver of ordinary construction erected on a barge floating in the river. The machinery worked well, lifting a monkey weighing about four hundred-weight with ease and regularity.

At a meeting of the Balloon Society last week a paper was read by Mr. C. E. Kelway on his electric log, which can be easily fitted to ships, and which indicates in the captain's cabin or elsewhere the speed at which the ship is travelling or the actual distance run. The appliance can also be used for "naval range-finding." One of the instruments, with fittings complete, is shown in the West Corridor, Crystal Palace, near Elmore's electro-plating stand.

The various expeditions for the observation of meteorological phenomena in the Arctic regions are getting ready to start in the spring. The Dutch Government has already subscribed 30,000 florins, and the German and Russian committees are completing their arrangements as speedily as possible.

The second lecture at the Crystal Palace by Prof. S. P. Thompson, was delivered on Wednesday. The mechanical production of electric currents, said the lecturer, was the great discovery of Faraday's life; and the modern magneto-electric and dynamo-electric generators were the instruments in which this discovery was embodied and employed. The old glass frictional electric machine was now quite out of date, and the modern dynamo-electric machine had nothing to do with friction, but worked upon a self-sustaining magneto-electric principle. Sturgeon, Arago, and Henry had shown how to apply currents of electricity in making bars of iron into magnets by the simple process of winding the wire that carried the current in a spiral coil round the iron bar, which became a magnet so long as the current flowed. Faraday made the converse discovery that the motion of a magnet relatively to a coil of wire generated, or, as he termed it, "induced," a current of electricity in the coil, the current being a momentary one only, and lasting only while the magnet and coil were moving toward or from one another. Great steadiness in the driving-engine was indispensable for electric lighting, and probably gas-engines would in the future be found to supersede steam-engines. One of Crossley's gas-engines, driving a Gramme generator, was shown in action on the stage, and the lecturer referred to the extraordinary efficiency of the newer patterns of large gas-engines, one of which, nominally of 16 horse-power, actually worked at 40 horse-power (indicated), with a consumption of only 17 cubic feet of gas per hour per horse-power. The new heating-gas invented by Dowson was even more economical, effecting, even when interest on the somewhat higher prime cost of the gas-engine was taken into account, a saving of 40 per cent. in the cost of driving-power. Where water-power or tide-power was available, the cost of producing electric currents by dynamo-electric generators might be still further reduced.

In consequence of the success of the astronomical branch of the Liverpool English Mechanic Association, the management have been encouraged to form a microscopical section. The objects of this section are to promote excursions for the practical study of microscopy, and to encourage a liking for the investigation of minute forms of life ordinarily to be met with during a summer-day's ramble. For this purpose members will be expected to provide themselves with at least an inexpensive form of microscope. A preliminary meeting will be held on Monday next, the 6th March. Further particulars may be obtained of Mr. Edward Carter, Sec. *pro tem.*, 3, Lord Nelson-street, Liverpool; or of the President, Mr. S. Leigh Gregson, Slater-court, 5, Castle-street, Liverpool.

There is some evidence that the repeated production of hypnotism is not without danger. Prof. Harting, of Utrecht, has lately stated that he made a number of experiments in hypnotism on fowls, pigeons, rabbits, &c. In one case six hens were repeatedly hypnotised at intervals of two to three days for some time: in about three weeks one of them began to limp, became paralysed on one side, and died. The same occurred to the others at different times,

and in three months all were dead. M. H. Milne-Edwards considers the fact that hysterical persons, brought frequently into the hypnotic state, gradually improve as subjects of demonstration, to indicate a deterioration of the nervous system, and it is advisable not to hypnotise such persons often. M. Charcot, from a study of hypnotism, distinguishes three nervous states comprised in it—(1), a cataleptic; (2), a lethargic; (3), a somnambulant state. Each may occur at first and persist alone, and they may also be produced successively, at the will of the operator. (The symptoms of each state are described in a note to the Paris Academy, Feb. 13.)

According to the *Chemiker Zeitung*, a highly-successful experiment, the first of its kind, in electric lighting of trains by incandescence, has been made on the line between Frankfurt and Hanau. Whereas on the Brighton line the accumulators are charged beforehand, in the present instance the charging took place during the journey, through the agency of a dynamo-electric machine driven by the motion of the train. The apparatus (including a very ingenious commutator) was supplied by Möhring, of Frankfurt.

The application of a spring or suspended weight to shutting a door makes that shutting noisy. To remedy the evil, Herren Handke and Kraus have devised a pneumatic arrangement (described in *Dingler's Journal*), wherein the act of opening the door moves a piston away from a suction-valve, causing air to be drawn freely through the latter. As the door is closed the piston returns and the air has to escape, but can only do so by an aperture much finer than that through which it entered; hence a brake-like action on the door.

A recent report by M. Cappa on the mining and extractive industry of Italy (*Rev. Ind.*) states among other things, that the celebrated marble quarries of Massa, Carrara, and Serravezza, in the Apuan Alps, yield 150,000 tons annually, valued at about 13 million francs; two thirds of the quantity are exported. The arrangements necessary for working and utilising minerals in Italy are still very inadequate. Thus, the production of cast-iron is only 26,000 tons, worth four million francs, and the manufacture of iron (in great part from the casting of old materials) is about 50,000 tons, worth 26 million francs, whereas, the importation of iron in different forms, amounts to at least 150,000 tons, worth 46 million francs. Most of the important iron ore of Elba, and of that from the 65 iron mines worked in Italy, is exported.

An interesting telephonic experiment was recently made in the French Senate; two apparatuses being placed right and left of the tribune, and speeches transmitted to the Petit Luxembourg, to the room of the President of the Senate, where they were distinctly heard and taken down in shorthand.

A large passenger steamer, *La Provence*, sank last month in the Port of Constantinople, after a collision. An improved diver's dress has been sent to the place from Marseilles; one of the windows of the casque is replaced by a copper plate, in which a telephone is fitted. The diver has merely to turn his head a little, to receive communications or to speak; thus he carries on conversation from the sunken ship.

In a fully illustrated article in *La Lumière Electrique* of Feb. 4, Count du Moncel discusses the discovery of the telephone.

Last year, mad dogs did great mischief in France. From Nov. 1, 1880, to Nov. 1, 1881, there were 611 cases of rabies, 153 persons bitten, and 21 deaths (four times more deaths than the previous year). The council of Public Hygiene and Salubrity of the Seine appointed a commission to consider the question, and after full discussion, it has recommended the Prefect of Police to print, publish, and post up a paper of instructions to the following effect:—Any part bitten should at once be made to bleed freely, and washed with a jet of water, or other liquid (even urine) till cauterisation is practicable; and a ligature placed immediately at the base of the limb. Cauterisation may be done with Vienna caustic, chloride of zinc, butter of antimony, but a red hot iron is best; any small piece of iron will do, and all parts of the wound should be reached. Success depends on promptitude, and any one can cauterise. Cauterisation with ammonia

(volatile alkali), tincture of arnica, or carbolic solution is wholly useless. The Prefect of Police is advised also to ordain that every dog on the public thoroughfares must be either held with a leash or accompanied, the only exceptions being dogs after cattle, or engaged in the hunt. Vagrant dogs should be taken to the pound, and those without a collar (required by an order in 1878) killed at once, those having a proper collar only if not reclaimed within 48 hours.

The experiments hitherto made in electric transmission of force were always with short distances (up to about three miles), and it has been affirmed that transport to great distances is impossible. M. Deprez now states, that with small Gramme machines, weighing about 100 kilogrammes, modified according to principles which he has indicated (*Comptes Rendus*, 13th Feb.), he has obtained a useful work of 37 kilogrammetres, with an interposed resistance of 786ohms, which corresponds to 78·6km. (say 49 miles) of ordinary telegraph wire. This took place without there being any sparks at the brushes, heating, or necessity for special precautions in insulation of conductors. The yield was 0·25. M. Deprez shows by figures the superiority of this result to an experiment by M. Fontaine with larger machines, and a small resistance (4·65ohms).

The vigorous movements of some insects offer a difficulty to microscopical examination and preparation. Signor Stefanelli overcomes this by applying to the insect's mouth a small drop of chloroform, which immediately renders it motionless.

In a recent lecture Dr. Werner Siemens says: "It has certainly been proved by direct comparison of sunlight with electric light, that a white object electrically illuminated, compared with one illuminated by sunlight, appears yellowish, whereas illuminated by gas-light it looks red. The illusion arises from our being accustomed to see the earth redly illuminated after sunset, and on this basis forming a different scale of colours for ourselves. Daylight would accordingly by night appear still bluer than the electric light. This false idea would disappear if electric illumination became general." He considers, however, that meanwhile the objection to lighting theatre stages with the arc-light is reasonable.

Paper made from strong fibres (as linen), can now be compressed into such a hard substance that it cannot be scratched with anything but a diamond. In view of this fact, the *Papier Zeitung* considers that, before long, a great variety of house furniture will be made of paper instead of wood.

At the silver-plating works of MM. Christofle, in Paris, there is annually deposited more than 6,000kilogs. of silver; and since 1812, when the works were started, no less than 169,000kilogs. of silver has been used, being deposited on an enormous variety of objects, in thicknesses suitable to their nature. The mean thickness adopted is that which corresponds to 3 grammes per square decimetre, or 300 grammes per square metre of surface. The surface covered with silver at these works alone is equal to more than 56 hectares—i.e., about 138 acres. The total quantity of silver used in Paris for electroplating is estimated at about 25,000 kilogrammes a year; and in Europe and America altogether, nearly 125,000kilogs., worth 25 million francs.

USEFUL AND SCIENTIFIC NOTES.

RECENT experimental results give the tensile strength of glass at from 2,590lb. to 9,000lb. per square inch, which is higher than Fairbairn's results; crushing strength, 6,000lb. to 10,000lb. per square inch. According to Mr. Traulson, of Millville, New Jersey, flooring glass 1in. square and 1ft. between the end supports, breaks under a load of about 170lb., presumably concentrated.

At a recent meeting of the Newcastle-on-Tyne Photographic Association, a paper was read by Mr. John P. Gibson, chemist and druggist, of Hexham, in which the author described his successful photography of a flash of lightning on the night of the last July 5th by means of Swan's plates of ten times the rapidity of wet collodion, and backed with red paper to prevent halation. The lens used was a $\frac{1}{2}$ in. Ross rapid symmetrical with the largest stop but one.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 81, Tavistock-street, Covent-garden, W.C.

All Cheques and Post-office Orders to be made Payable to J. PASSEMORE EDWARDS.

* * * In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pitance of his, will undertake to write the whole body of physics: a vice from whence great inconveniences derive their original."
—Montaigne's Essays.

THE SPECTROSCOPE AND METEOROLOG.

[19766.]—WITH reference to the remarks of "A Fellow of the Royal Astronomical Society" in your to-day's issue (19741), will you permit me to observe that while a wet and dry bulb hygrometer can only indicate the amount of moisture about and closely around it, the spectroscopic claims to search the higher and more distant regions of the atmosphere for this result.

The advantage of this in cases where earth vapour is comparatively nil, and cloud condensation heavy, is obvious; and even in those of a persistent layer of moisture near to the earth's surface, some idea of its density and thickness may be obtained by a spectroscopic examination of it in vertical and horizontal directions, and a comparison of the two spectra obtained.

Naturally the rainband results are, for the reasons indicated in my paper, not all coherent or consistent. Were they so, would it not rather be evidence against the fidelity or trustworthiness of the observations in a case depending on so many conditions?

J. RAND CAPRON,
Guildford, Guildford, 24th Feb.

LATHES AND LATHE-MAKING.

[19767.]—WITH two first-class engines on the same line, of which neither is inclined to run behind the other, a collision is inevitable. The only remedy possible is for the first, whichever it may be, to keep up its speed so as never to allow the other quite to reach it. After all, our head lathe-makers stand on much the same position as the three first Wranglers, who prove so equal in merit yet withal so different in mathematical calibre that Cambridge has been forced to give up the old system of drawing a distinction between them. Priority of design rightly claims consideration as proof of inventive faculty; but, supposing such design unregistered, perfection of workmanship eventually becomes the real test of mechanical ability, and not a few of our readers know how difficult it would be to call either of the two combatants "facile princeps." Amateurs, as well as professionals, are highly indebted to both Mr. Holtzapffel and Mr. Evans for information readily given on mechanical matters; and both are, I think, equally ready to give every possible assistance to the readers of the ENGLISH MECHANIC, when they understand exactly what information is desired. Still there are trade secrets in details of work which I imagine will so remain. I hope this little spar with the gloves on will not interfere for one moment with the letters of either party in the ENGLISH MECHANIC. As regards the J and N tags, no doubt they can be had if desired, although not generally included in the sets of screw-tackle advertised at the toolshops, and I confess I myself thought it almost an excess of good nature on Mr. Evans's part to offer to lend his own set, knowing the risk thereby incurred. The construction I put upon that offer was, that as they were not usually made for sale, there were none in stock but those in the workshop, which were, therefore, called private property; and that, not being generally asked for, Mr. Evans thought it would suffice for this special applicant to borrow a set. But I have little doubt that Mr. Evans, as well as Mr. Holtzapffel, would at any time supply a customer if desired. I suppose all mechanics crib from one another; but if, in the construction of a piece of machinery there were screws used which appeared to have advantages in pitch, or otherwise, over those in ordinary use, any mechanic would, I conclude, be free to make for his own use a set of dies and taps of similar thread. Whether or no he might advertise such for sale is another matter, but probably that would depend upon his probable customers. Honestly, our two friends are too high-class to need the spur of jealousy, and each may well concede to the other all his due, and something more. Happy the

amateur whose workshop has been fitted by either—happier, perhaps, is he who has been supplied by both; and that both may be spared for many happy years of friendly rivalry is probably the hearty desire of others besides
O. J. L.

[19768.]—In the reply to my letter, No. 19731, the main question is ably left on one side, and is in no respect touched by the new reading your correspondent would now give as his meaning of private property. I am sorry that it is not possible either to modify the observations made upon his statement, No. 19675, or to omit saying that I have received more than one assurance that they were not uncalled for.

One word more on the subject. Mr. Evans is again unfortunate in his application of a part of a sentence; there has been no insinuation that he has acquired these particular tools by unfair means, and if he had thought there had been, it is remarkable that he should confine himself to so mild a word as "ungenerous." There are surely other and mechanical interpretations to my remark; but I should be sorry to attempt to instruct Mr. Evans after his repudiation of my capacity.

Dr. Edmunds will forgive my decrying some faint resemblance he bears to the hydra, inasmuch as the disposal of one question is the sure prelude to more, and he will readily pardon my inability to give him other than short replies, and indeed, I fear I must sometimes forego even that pleasure. The dimensions, page 566, are the outside measures—i.e., taken at the top of the thread, and being as already stated, only those for fixing screws. They do not include the dimensions of the mandrel, which, taken in the same manner, are usually 5in. 8125, and 6in. 9375; but these measures as Dr. Edmunds points out, sometimes suffer interference. He is also correct in supposing that a cast-iron chuck may be bored a little larger than one of brass or gunmetal; but this difference is not usually a matter for exact definition, and it is to some extent modified by the quality of the iron, skill, and individual practices. I have little doubt, from the particulars given by Dr. Edmunds, that the damage to the nose of the mandrel to which he has referred, arose either from the screw in the cast-iron chuck being taper, see Fig. 536, in the chapter on Screw-cutting, Vol. IV., or from some malformation in its thread towards the bottom of the internal screws, and still more from the exhibition of too great force, the gravity of which error, I trust I may be pardoned for saying, is perhaps insufficiently estimated by the average amateur. I embrace this opportunity for saying that for such mandrels as are in question cast-iron chucks have no other merit than that of cheapness; but the difference in cost between them and those of gunmetal or brass is, after all, but insignificant, and for many reasons the latter materials are usually preferable.

I may now ask permission to express my sincere thanks to your, and to me unknown, correspondent, "Ivory," for his kind and most encouraging letter, No. 19756. I believe that he will find the class of information he asks for in the forthcoming volume, to the advance of which I must at present continue to devote every otherwise unoccupied moment.
John J. Holtzapffel.

64, Charing-cross, S.W., Feb. 27.

[19769.]—ALLOW me to tender my sincere and best thanks to W. S. Brown, for his most valuable, clear, and lucid articles. With regard to the device of "F. W. G.," No. 19735, p. 568, for "Planing and Milling in the Lathe," I think he has no need to be deterred, or ashamed of his drawing, when he can send us a sketch like the one he has, which I am sure is very plain, and can be easily understood by almost any amateur; also I think it is an ingenious and useful adjunct to a lathe, and I beg leave to ask him if he would kindly give us a description, with a sketch, of the overhead motion, and drilling instruments he has made. I am sure it would interest a great many of our readers, who are, no doubt, in want of such appliances.
Liverpool.

H. P.

[19770.]—In answer to "Orderic Vital," letter 19747, I am extremely sorry if I have failed to answer any question he may have asked, and beg to assure him that it is not from any unwillingness on my part, but simply from the fact of my not having noticed any such queries. If our correspondent will make me acquainted with what he desires to know further, relative to dimensions, I will answer fully.

In answer to "Scorpio," letter 19745, I am sorry he finds the instructions for oval chuck not quite sufficient to help him over his difficulty; but I think if he refers to the article, page 415, the manner in which the elliptic chuck works is already shown (Fig. 4), the ring being adjusted on the mandrel-head with the zero line pointing to the same on the mandrel frame; it will be found that the chuck is concentric, and, as before described, directly the ring is moved from the centre, and the

steady pin removed, an elliptic form is obtained. I feel sure that if our correspondent looks again over the instructions, he will there see that the ring (Fig. 4) forms the fixed or unrevolving point he desires. I trust these few lines will be sufficient to explain the action of the chuck, and reduce the difficulties that have interfered with the making of the same.
J. H. Evans.

159, Wardour-street.

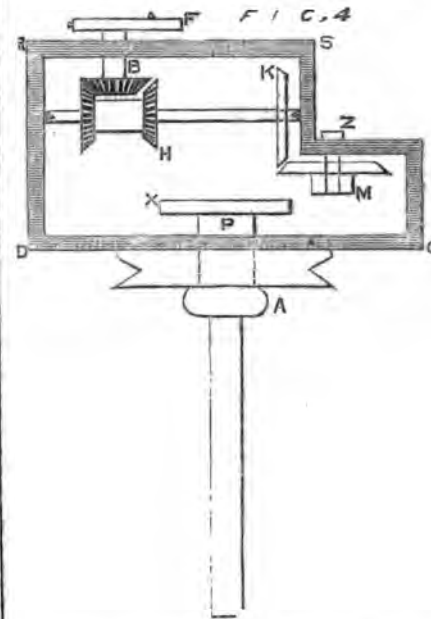
A NEW FORM OF TROCHOIDAL CUTTER.—II.

[19771.]—As the Editor has been good enough to offer space for further details, I will endeavour, as shortly as possible, to give dimensions and hints as to construction.

Referring to Fig. 3 in my former article, the frame R S C D should be of steel, nine-sixteenths of an inch wide, the depth of it at right angles to the paper being half an inch. The length of R S should be 7in., outside measurement; the square revolving bar should be 3-16 wide, and the bevel-wheels 1½in. in diameter, containing any convenient number of teeth. The spindle B should be ½in. in diameter, passing through a socket sliding in a slot ½ wide; consequently where the slot is the thickness of R S must be increased to 1in. The slot should be 7in. long, extending to 7in. past the middle towards the right. The position of the fixed wheel X was incorrectly shown in the figure; it ought to be in a different plane to M, nearer to the tool-box, so as to allow of change-wheels, on the same spindle, gearing with both X and M. These change-wheels will be carried by a spindle carried on a plate, which can be shifted so as to bring the change-wheels into gear with both M and X. The number of teeth in X should be 72, in M 24, of 30 pitch, that is, at the rate of 30 teeth to an inch diameter.

The change-wheels should be those recommended by Messrs. Holtzapffel for their machine, namely, 30, 32, 34, &c., up to 48, and also a 60 wheel. Two wheels of 48 should be supplied.

These details will, I think, enable anyone to construct the machine as designed; it has, however, appeared to me that as the revolving spindle must necessarily be thin enough to pass through the square bar which fits into the tool-box, it is somewhat weak for carrying the frame, which will necessarily be of considerable weight. I have, therefore designed another form of the instrument, shown in Fig. 4, in which the frame revolves round



the outside of the square bar instead of the inside. This has caused some necessary modifications in the shape of the instrument, but I think the figure, which is half the natural size, will explain itself in most respects.

The square bar which fits into the tool-box is enlarged at its extremity and turned round; on it rotates a large pulley, which is rigidly attached to the cutting-frame, R S C D; at the end of the enlarged portion is fixed the wheel, X; round the portion P a plate can turn, carrying the change-wheels which connect X and M. The wheel M and its accompanying bevel-wheel rotate round a spindle, whose head is countersunk into M, and which is clamped by the nut Z. The points on which the square revolving-bar turns are the ends of screws tapped into the square frame, so that they can be moved forward or backward for adjustments or to take out the bar for cleaning.

It will be noticed that the pulley H is now com-

posed of two pulleys connected together, and that when clamped so that one is driving F the other is out of gear. By this means we have a simple method of reversing the rotation of F without changing "initial position."

The nut A screws on to the enlarged portion of the square bar, to keep the revolving pulley, &c., in place.

In conclusion, it must be noted, both with regard to Messrs. H.'s machine and my own, that owing to the peculiar nature of the combined motion, the tool is sometimes cutting with its sides or back; hence it is necessary to use a very thin, sharp tool, and to cut our pattern very shallow. This drawback I have endeavoured to remedy, and have succeeded in doing so theoretically; but, practically, the carrying of it out involves great difficulties. I hope to recur to this point at some other time.

Finally, I would note that in Fig. 2 of my first article O B ought to have been drawn equal to O A.

Inverness College.

SHAPING ATTACHMENT.—TO "C.H.D."

[19772.]—I SHOULD certainly be much obliged if "C. H. D." would kindly give the description he refers to. There is a shaping attachment which has been advertised in "E.M." for some time past, but which, though commended by some, seemed to me, from the illustration supplied, to be a very clumsy and ill-arranged design, so ugly, that like old Gilray, it would to me be "a sorrow for ever."

I thought there was only one Dublin firm who had, since the Kennans gave it up, any dealings in lathes. And though I have been many times through their lathe show-rooms, I never saw anything of the kind, or indeed anything such as used to be at Kennan's. So that I am rather surprised to hear the attachment is made by a Dublin firm, or being made by them, that it will not prove to be 50 per cent. dearer than a similar tool made by any English house, for any Dublin lathes I priced lately were fully that above the English makers.

"C. H. D." will, therefore be doing us a favour if he will describe the attachment, and perhaps he may be able to give a rough sketch.

I suppose we must give up any hope of "Sunlight" throwing any light on the subject to which I invited his attention at the commencement of this discussion. Had he not promised it, his silence would have occasioned no surprise.

Fred. Carré.

DYNAMO MACHINES.

[19773.]—My thanks are due to "R. P." for so kindly explaining the R of armature being quarter of its total length. Another difficulty now presents itself to me, and that is, how is the circuit of armature and field magnets arranged? Are the F.M.'s in circuit with the lamps? I suppose that on the machines built in which the F.M.'s are fed by a shunted current, it would take more wire owing to the R being ten times the R of armature. Would "R. P." kindly explain the different methods, and say which requires less wire in construction of a machine giving equal current?

What has become of "Anglo Dane"? I have been looking out for him week after week hoping that he would come to our assistance.

It seems as if the subject must die out, as no one appears to take any interest in it. Surely someone will come forward to keep the "pot boiling."

Questor.

A VIOLIN WITHOUT A SOUNDPOST.

[19774.]—I AM very pleased to inform "ours" that the above is an accomplished fact. The new violin has been described in these pages, with the addenda of many shrewd ideas from those interesting themselves in it, but to improve on an idea, it is necessary to understand first principles. It is for the want of such simple knowledge that great savants have failed to improve the tone of the violin. For 700 years the shape has been the same, viz., in regard to the method of moving the soundboard. In Peterborough Cathedral roof may be seen the figure of a violin of yester period—it's the same as now—and Dr. Wyld, at Gresham College, now proclaims that it is of no resonant use to make or play a violin without a back or soundpost. Yet the thing is done by making another soundboard in lieu of the back, and so varying the thickness of the said soundboards that sufficient stability is given to them to resist excessive vibrations and properly return them as a reaction to the strings, producing a tone equalling the old violin and with a timbre perfectly smooth and round, no scratch or shriek. I don't know how long it took Stradivarius to make one of his violins, very likely from 3 months and over, but I will guarantee to make a violin of good, loud, and clear tone in two or three days, with other business to attend to at the same time. Probably I could make one, minus the varnishing, in six hours. However, let that rest; my ambition

is to make a good violin for little money, so that all may possess a good instrument, that is, as good as can be obtained for £5 in the ordinary and unsatisfactory way so generally in vogue.

My address will be found in the "Sixpenny Sale Column."

Fiddler.

VIOLIN IMPROVEMENTS.

[19775].—BEFORE any reader rips up his violin to make it à la Berliner, I would recommend him to try its suitability for this improvement. This may be easily done by cutting a strip of wood a little longer than the back of the instrument; an upright peg is fixed at one end to tie the tail-board to, and the other end is tied up close to the block at the end of the neck. Then from the corners of the scroll or indent a tying is brought round the front of the strip so as to prevent it being dragged back when the strings are tightened up. The twine used ought to be soft, so as not to abrade the edges of the instrument, and a piece of cork ought to be used to keep the strip in the centre of the violin back.

I have in this way tried the qualities of four violins. The light, cheap violin became nearly as good as the more expensive, but the really first-class instrument received no improvement.

E. B. Fennessy.

TRICYCLES.

[19776].—THE tilting action of the "Salvo" and that class of machine is, in my opinion, one of the drawbacks of the front-steerer. Supposing the safety-wheel arm to give way, one is likely to pitch out backwards, and the consequence of a fall if running at all fast is likely to be serious. For this reason, I should, as far as safety goes, never care for a front-steered machine. I like to sit well on a seat, and the fear of tilting up would be always on my mind. Much has been said as to the small weight on the steering-wheel of the open front class, and it is alleged that they steer wild. Surely, if that be so, a Salvo with so little weight on the leading-wheel that the act of sitting back tilts up the machine, must be at least quite as unsteady, if not more so, than the rear-steerer. At the Stanley Show I note several new front-steerers, but it certainly appears to me that they cannot be as comfortable as the other class; and, except that it is to retain the continuous axle, I fail to see the advantage. By the bye, there is a new machine out by a Coventry firm with the through axle and gear as the Salvo, and yet with a rear steering and open front. A friend who has tried it tells me it runs splendid and goes up hill splendidly. I shall be in the Midlands next week, and hope to personally give it a trial. If certain difficulties that I have several times suggested a remedy for are eliminated, I should consider that it ought to beat any front-steered machine known. I always feel nervous of any obstruction in front to jumping out instantly in case of collision. Only a day or so since I had to make a journey under very trying conditions to catch a train—and in travelling through some crowded streets, twice I feared a collision, but kept my seat well, knowing that with an open front I could jump out in a moment; this fact enabled me to drive a little harder than I should have dared to do with any form of inclosed front, and hence caught my train with several minutes to spare. I note that friend "Treadle," like myself, uses a seat, not a saddle. Does he use any form or arrangement to place the seat on an incline which increases in riding up-hill? I have settled on a plan that I find most invaluable—the seat rising bodily in a vertical direction, as well as the back part rising at the back and so increasing the slope which I find a great help in riding up-hill.

Sunlight.

PATTERN-MAKING—AMATEUR CARPENTRY.

[19777].—I WAS very glad to see query 46201 last week, and hope some correspondent will take up the idea and give us a short series on "pattern-making" as good as Mr. King's on "Cart and Wheel-Making," or Mr. Davies' on "Plumbing."

There is one other subject I should like to see treated—Woodwork. Many of us who have the tools would be glad of an occasional design for a corner cupboard, a bookshelf, or some other piece of household furniture that we could make ourselves. It is a long time since anything of the kind has appeared. I fancy "O. J. L." could do it if he would.

Ventosus.

NEW KILN FOR THE TREATMENT OF SULPHUR ORE.

[19778].—THE problem of separating sulphur from its ore is one that at first sight appears to be a most simple one, and many attempts have been made, with more or less success, to supersede the "calcherone," or kiln, that is used generally throughout Sicily for this purpose.

The calcherone is a large, rude, open kiln, consisting simply of a semicircular breast-wall, with a sloping floor. The diameter of a calcherone varies according to circumstances, from a few yards to 20 or 30 yards, and is capable of holding from 10 or 12 tons to several thousand. The ore is loaded by placing the large lumps of ore on the floor in such a manner as to leave numerous channels for the passage of the melted sulphur, and to allow it to run freely to the front and lower part of the kiln, where it is tapped, and received into wooden moulds. The smaller pieces of ore are next filled in, and the finer stuff is placed at the outside. The ore is carried up a certain height above the masonry wall, forming a truncated cone, which is covered with spent ore from former fusions. The ore is then lighted at the back, and after a few days, the heap becomes heated, and part of the melted sulphur finds its way to the bottom and flows to the front, where it is run off.

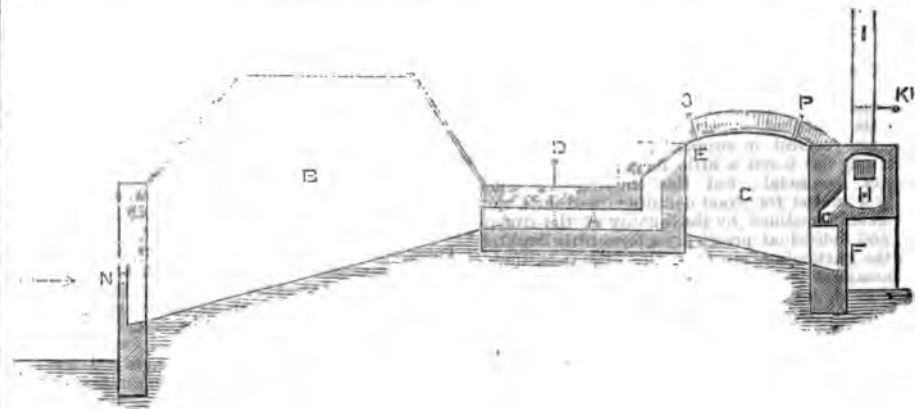
It will be readily seen that such a plan has the disadvantage that a large proportion of the sulphur contained in the ore is burnt as fuel, in order to furnish the necessary heat to melt out the remainder, and at the same time considerable damage to vegetation is caused by the fumes (sulphurous acid gas) given off during the operation. The amount of sulphur lost in this way is estimated at from one-third to half of the total quantity con-

two charges of ore, but a rectangular or square chamber is found to be the most convenient, with sloping floor towards the front. The kiln now working contains about 8 tons of ore. The chamber consists of four walls, and may or may not be covered with an arch; it is found, however, that an open chamber is the most convenient, from the facility that it offers for loading and unloading.

The kiln communicates, by means of a flue or heat conductor, A, with the back of an ordinary calcherone, B, which furnishes the necessary heat for melting the sulphur from the ore contained in the kiln, C.

The upper portion or cone of the calcherone should be covered with a layer of "genese," or spent ore, so as to prevent the dispersion of heat by any other channel than that offered by the flue A, which is provided with a damper, D, so as to regulate the introduction of heated air by one or more openings, E, at the back and upper part of the kiln.

A rectangular opening, F, is left in the front wall of the kiln, from which the melted sulphur is run. This opening, if of sufficient size, may serve for discharging the spent ore at the termination of the fusion. From the upper part of this opening, and also in the front wall, slightly above the level of the floor, flues G communicate with a horizontal passage, H, which, if of sufficient size,



tained in the ore, and in bad weather the loss is far more considerable. It will be observed that the fuel (sulphur) used is of low heating power, and that, at the same time it is burnt in a most wasteful manner, and a very small proportion of its thermal value is utilised.

Many plans have been tried with a view to extracting the whole of the sulphur contained in the ore; but one of the principal difficulties to contend with is its varying nature, so that a process that suits one particular class of ore cannot be successfully adopted for another, whilst the small margin of temperature between its melting point, 239° Fahr., and that at which it begins to thicken, 320° Fahr., is of no slight importance, for unless the heat is very carefully regulated, the sulphur becomes syrupy and difficult to flow, and at the same time, liable to collect the earthy impurities from the ore.

The enormous cost of coal in the interior of Sicily is a great drawback to the employment of fuel other than sulphur, as is necessary for the treatment of ore by super-heated steam, or by other processes that have been proposed, and in the face of this drawback, it is not to be wondered at that the "Calcherone" still holds its ground.

I have patented a kiln for the treatment of sulphur ore, which has been tried, and is now working with good results at some mines in Sicily, and shows an increase of yield of 30 per cent. over the ordinary plan.

In this process the waste heat from an ordinary calcherone, after all the sulphur has been run off, is utilised to heat to the required temperature the charge of ore in the kiln, and as soon as the moisture has been driven off and has been sufficiently heated, it is fired from the top.

The combustion, fed with hot air containing a certain quantity of sulphurous acid gas, is very slow, and for this reason the loss of sulphur by burning is less than is the case where, as in the ordinary calcherone, the ore has to be heated entirely by the combustion of the sulphur, whilst in the kiln the temperature of the ore is raised to the required degree before being fired.

The apparatus consists principally of three parts:—

- 1st. The flue or conductor of heat.
- 2nd. The furnace or kiln, in which the ore is treated.
- 3rd. The chamber for the condensation of the sulphur that is volatilised during the fusion, and in which it is collected.

The kiln may be of any suitable form to contain

serves as a condensation chamber, in which the sublimed sulphur deposited on the walls is collected.

At one end of this chamber is a vertical chimney, I, provided with a damper, K.

The kiln is loaded in the usual way by placing the large pieces of ore on the floor in such a manner as to leave passages for the flow of the liquid sulphur. The small pieces are next filled in, and the finer ore at the top.

A few blocks of rough stone, or, better still, of burnt ore, are placed at the opening in front in such a way as to leave a vacant place for the melted sulphur to collect before being run off.

When loaded, the charge of ore is covered with bricks, laid flat, and this is covered with a thick layer of "genese" (spent ore), well rammed and wetted, so as to form a nearly impermeable covering with a slight slope towards the walls, in order that the rain-water may run off.

The opening in the front wall, F, should be closed with a thin wall in plaster of Paris.

The ore in the kiln, which is now ready for fusion, is put in communication with the spent calcherone, B, by opening the damper, D, and at the same time a small hole, N, is made in the thin wall that closes the opening in the front, from which the melted sulphur has been run off from the calcherone, B. The current of air entering by the hole N, and passing through the incandescent mass of ore, is thus heated, and enters the kiln by the floor A, at a sufficient degree of temperature.

In this manner the heated mass of spent ore in the calcherone becomes a regenerator of heat, to be utilised in the kiln for the fusion of the sulphur that it contains.

In the upper covering, two or more tubes are placed, O and P, which serve not only for observing the internal temperature of the kiln with a thermometer, but the tube O also serves for firing the ore after the charge has been sufficiently heated, and all the moisture has been evaporated.

The combustion of the sulphur supplied with hot air, mixed with a considerable proportion of sulphurous acid gas, proceeds slowly in the upper part of the kiln, and the liquid sulphur dropping to the floor over the already heated ore cannot solidify and choke the passages, and so prevent the circulation of the heated air and products of combustion of the sulphur to the chimney, and in this manner the operation proceeds with regularity.

The success of this kiln is principally due to the manner in which it is heated from the top and

back towards the front and bottom, imitating to a certain degree the manner in which the heating of an ordinary calcareous proceeds, with this difference—that the heat is better utilised in the kiln, and therefore with less consumption of sulphur as fuel.

When the wall that closes the front opening F begins to heat, and from other signs, it is known that the kiln is ready for running, a small hole is made with a pointed instrument, so as to allow the melted sulphur to flow off into wooden moulds.

The horizontal flue or condensation chamber H should have a sloping floor, and when the temperature in it reaches the melting-point of sulphur, the flowers that have been deposited on the sides are liquefied and run off. Towards the end of the operation it will be found prudent to close all the dampers as well as the hole N, to prevent the overheating of the kiln, in which case the sulphur would become thick, and difficult to run off, and the yield in consequence lessened.

It will be readily seen that, as compared with all other processes that have been proposed, the working expenses are but slight, and consist only in the cost of labour necessary for loading and unloading of kilns, and the running off of the melted sulphur into moulds.

The first cost is but slight, as, being built of rough masonry, the materials are usually at hand, and there is no costly iron-work, as is the case with the steam process, where steam-boilers and other apparatus are required. P. Le Neve Foster.

SCREW PROPELLERS.

[18779].—I AM astonished at the assertions of "Mersey Engineer." He asserts, in effect, that there is no difference between the thrust of a connecting-rod and that of the piston-rod of an engine. I call upon the "slides," and their blokes or blokes, to bung him up. I maintain that "the gain in sinking the screw into denser water would be met by the loss occasioned by the push, not being in the plane of motion." I want to see a sensible reason enunciated for the assertion that "a side blow would even equal, not to say surpass, a straight tip from the shoulder"! The "M. E.'s" finale is a *rebuttal ad absurdum*, where he declares that the three different modes of propelling "are the best." Surely they cannot all be the best. Does he mean to insinuate, for instance, that he could scull any boat as quick as I could row the same? If so, then you are cr, any minute.

Liverpool.

J. J. A.

[18780].—I HAVE read with much interest the continued correspondence which has appeared in the columns of the "E. M." under the respective dates of the 17th and 24th Feb., from "Khoda Bux" and others; and in thanking the former for his encouraging remarks in respect to myself, I would point out to him that there is a wide difference between his friend's method of propulsion and mine; for in "Khoda Bux's" letter of the 3rd inst., he states that the propeller, as tried in the *Dudley Longley*, consisted of "paddles in each quarter not revolving," whilst my method consists of blades (applicable to any suitable part of a vessel), each blade revolving separately, but reciprocating with the others, and, entering and leaving the water perpendicularly, performing one-half of a circle in, and the other out, of the water; whilst the blade-propeller is not a "paddle-wheel," as "Treadle" infers, it has all its advantages without its defects—i.e., enormous size and weight, and flopping of the feathering floats into position. It is true that the paddle obtains a certain thrust, and that is why, as "Treadle" observes, "it gives a better duty" than the screw. In my letter of the 10th Feb. I urged that a direct thrust is the natural propelling law, and I argue that a perfect direct thrust cannot be got from a paddle-wheel, as the thrust is only obtained from a rotatory motion, and I submit that a direct thrust is obtained by the blade-propeller described in my letter of the 10th inst., as the blades are attached to connecting-rods, which uniformly keep in horizontal position. To give a homely illustration, everybody knows the difference in power between a hit made straight from the shoulder and that given in a roundabout fashion. I appreciate "Polyglot's" cautionary remarks; but earnest and long-continued researches have, perhaps, made me equally cognisant as himself of the various propelling ideas which have been started, and are crowding in, and being thought out by "master minds"; and I may remind "Polyglot" that, in my letter of the 10th Feb., I particularly stated that the propeller had been tried in the water in a working model, and that the results were eminently successful; and I may add that, independent of greater speed, a noiseless motion, with entire absence of commotion of the water, was obtained, which feature renders the propeller a most desirable one for rivers and canals, and if used in the Thames and other narrow rivers, many of the accidents arising from the wash from screw and

paddle, which constantly occur, would be avoided. Let "Polyglot," therefore, co-operate in effecting this improvement, and then, to use his own words, he "shall rest contented in the knowledge of having done some good."

I quite concur with Capt. Curtis, whose kind invitation I gladly accept, that scientific men, as a rule, ignore the possibility of any improvement, unless confined to a certain groove, and some engineers have become so wedded to the screw that, according to their theory, its principle cannot be bettered.

Great results have undoubtedly been obtained by it, but they come more from the use of enormous machinery and steam power than from any intrinsic efficiency of the screw.

Just imagine the waste of power necessitated by having, in a large ship, to drive a shaft weighing 20 tons, and running half-way through the vessel, in order that a screw, a ton weight, may be forced (transversely to the ship's course) through the water at a rate of 80 to 120 revolutions a minute. When I submit the blade propeller to Capt. Curtis, he will at once see that from the great grip the blades have in the water, they have a tendency to lift the vessel, and that the blades, at certain angles, have a motion like that of a duck's feet.

White Swallow.

OSSIFEROUS OR BONE-CAVES.—I.

[18781].—ANYTHING which throws light upon the existence of man and leads us to form conjectures, not only as to his antiquity, but also his mode of life in remote ages, is not only of deep interest, but also has a great claim upon our attention. Now, bone-caves are one of the most fruitful sources of evidence on this subject. To them also attaches an unusual interest beyond that of ordinary accumulations of geological specimens, from the extremely varied nature of the evidence they furnish, not only as to the animal life, climate, &c., of the age in which they were deposited, but also the circumstances under which the struggle for existence was carried on. They tell us far more than an isolated bone or even an isolated skeleton. The footmarks on the floor of the caves, the tooth-marked bones, the rudely-fashioned tools, the very corners of the caves worn smooth by the constant passage of fierce animals, seem to bring to the mind a picture of the appearance of the fauna of that age and of the life led by man with a vividness almost startling in its reality. Bone-caves are interesting alike to the geologist, paleontologist, and historian, to whom their contents afford very valuable information. The fossils so found are rare in other formations, occurring only in lacustrine and fluvial deposits, and in these only accidentally here and there, and unattended with any of those circumstances which lend a peculiar value and interest to those found in bone-caves.

Strange, and often romantic, have been the accidents which have led to the discovery of many of these caves, such as the subsidence of the surface, gas issuing from the earth, the sudden loss of some tool, the disappearance of some animal, &c.

Superstition has invested these caves with an additional charm by attributing medicinal properties to their fossil-bones, and even to-day, in the drug-shops of China, it is no uncommon thing to see them exposed for sale. In all ages superstition has taught the ignorant and credulous to regard caves of all descriptions with a supernatural dread. This feeling of superstitious awe has done much to preserve their contents from being ruthlessly disturbed. And considering the extreme size of some caves, which are many miles in extent, and intersected with sinuous and seemingly endless and unfathomable corridors, and then the beauty of others, with the artistic adornments which time and nature have bestowed upon them, it is scarcely to be wondered at that in a rude age the imagination should have been fascinated by them, and should have weaved all the fanciful and fairy legends which have been current. Thus, in mythological times, they were regarded as the places of delivery of the oracles, and as the abodes of nymphs and fairies, and many of the ancient deities were worshipped in them. The River Styx was also supposed to flow through a series of caverns which entered into the entrance-halls of Hades. And, in the Middle Ages, not only were they frequently the dwelling-places of anchorites, but they were also shunned by the multitude, who believed them to be the abodes of evil-spirits, dwarfs, and other supernatural beings.

Caves are formed in various ways. Some caves are found in sandstone, a few in gypsum rocks, a great many in the coral islands, but by far the larger number occur in limestone strata, where they are formed by the dissolving action of water saturated with carbonic acid, which it absorbs from the atmosphere, and in its passage through the earth, also from organic bodies, which are constantly giving off carbonic acid. In pure water limestone is perfectly insoluble. These caves which are found in cliffs are simply hollowed out by the continuous action of

the breakers of the sea. Others, again, are due to volcanic action and to earthquakes. Gases such as muriatic, sulphuric, fluoric, and others, when raised to a high temperature, are believed to be an occasional cause of the hollowing of caves.

In all caves belonging to the limestone strata are found a great number of stalactites and stalagmites, which are formed by the water losing its carbonic acid by evaporation, and thus depositing the carbonate of lime in a solid form. The greater portion, however, is not thus deposited, but is carried along by the streams into the rivers which convey it to the seas. The varied forms of stalactite and stalagmite render these caves which are thus embellished very beautiful and picturesque. Thus in Clapham Cave, Yorkshire, where they hang "like natural sculpture in cathedral caverns." This dripstone has also been seen in great perfection in the Black Rock Cave, near Tenby, and in Caldys Cave, Pembrokeshire. Writing of the latter, Mr. Boyd Dawkins remarks:—"A low entrance leads into a fairy-like chamber, the floor consisting of a rich red, crystalline pavement, perfectly horizontal, and studded here and there with round bosses, either red or snow white. From the roof hang stalactites, offering the same beautiful contrast of colours, forming a canopy of delicate tassels, or passing downwards to the floor, and constituting slender shafts about three feet long, and about the diameter of straws. Each of these is hollow, translucent, and more or less traversed by water, and in some places each stood next its fellow almost as close as straws in a cornfield."

The stalactites often seal up a cave, thus preserving the bones from the decaying influence of the atmosphere. In other cases the dripstone forms like a hard crust on the floor, effectually hiding the fossil remains.

Caves are a frequent cause of the submergence of rivers. A weak place in the roof falls through, and a cirque, swallow-hole, pot-hole, or kata-vothra, as they are variously termed, is formed; which, being generally funnel-shaped, readily conveys the water underground, depositing in its course, mud, sand, silt, and bones. It enters turbid, but at its efflux it is perfectly clear. This phenomenon occurs very conspicuously in the Morea, where the annual swellings of the torrents during the rainy season are disposed of through the kata-vothra, passing thence into the numerous caverns below. Other important examples are afforded by the great limestone caves of Kentucky; other instances occur in Ottawa; the Perth de Rhone, and the Caldes of Yorkshire. Some caves have large fissures, and it is thus that many animals have been allured into their dark recesses, whilst browsing on pasture-land in close proximity. This is sometimes the only way in which geologists can account for whole skeletons found in caves.

Cave exploration did not really commence until about fifty years ago. Like all pioneers, the early explorers of bone-caves had much prejudice and many difficulties to contend with, and the published accounts of the researches of some of the foremost, namely, M. De Perthes, Dr. Schmerling, and the Rev. McEnery, were regarded with suspicion and scepticism by the most eminent scientific men, who refused to accept their evidence touching the antiquity of man. Since then, however, the scientific world has become more interested in bone-caves, and has seen that it is impossible to ignore the testimony they afford.

Geologists have divided bone-caves into three classes, according to the fossil remains they contain: 1. The historic; 2. The pre-historic, embracing the period between the historic and pleistocene, and including the Stone, Bronze, and Iron ages; 3. The pleistocene, which is equivalent to the Palæolithic, or age of Unpolished Stone. It is often difficult to assign the precise age to caverns, as the fossil remains have not infrequently been mixed together by floods, which have inundated them from time to time. The action of water being shown by rounded pebbles and smooth surfaces of the bones, also by the deposit of sand, silt, mud, &c. These deposits, together with the stalactites, occasionally blocking up a cave. The proportion even in which the bones have parted with their animal matter cannot be taken as a perfect guide to their age, as the chemical action is influenced in a large degree by surrounding circumstances.

Thirty-six caves have been found in Great Britain alone, which are said to contain the remains of mammalia. We will begin our description of some of the most important bone-caves, by mentioning those which are included in the first division—viz., the historic. All those caves are said to be historic which have been occupied during the historic period, which in Great Britain is reckoned to begin at the temporary invasion of Julius Cæsar, B.C. 55. In this period we find the British fauna to differ considerably from the fauna of the preceding era. The ass, pheasant, domestic fowl, fallow deer, &c., have been introduced, and the cat has become domesticated, whilst many of the fiercer animals, such as brown bear, reindeer, wolf, beaver, and wild

boar gradually disappear. The two most celebrated caves belonging to this class are Kirkhead, near Morecombe Bay, and Victoria Cave, near Settle, in Yorkshire. The latter was so named from the accident of its discovery by Mr. Jackson occurring on the Queen's Coronation day, 1838. The cave is especially interesting from the fact of its bearing evidence of three distinct occupations. Upon the upper surface have been found large quantities of bones, broken pottery, works of art, jewellery, coins, &c. As these relics point to a state of civilisation too advanced for the people who left them to have made caves their permanent homes, it is most probable that they were only used as places of concealment during troublous times; Mr. Boyd Dawkins, considering them to have been used as temporary places of refuge by the Brit-Welsh during the wars of the Picts and Scots—the date of its occupation being judged by the latest of the coins, which assign it to the latter half of the fifth or beginning of the sixth centuries. Below this stratum, and covered with an accumulation of stone 6ft. deep, was found the neolithic stratum containing implements of stone, a bone harpoon, bone bead, and bones of animals. These remains prove its occupation by neolithic man. Then below the neolithic stratum, and buried by an accumulation of grey clay of several feet, was discovered a reddish grey or loamy-cave-earth, which has yielded a large number of bones of hyenas, besides the teeth of a young mammoth, and the bones of reindeer, red-deer, bison, horse, and bear. It is, therefore, believed to have been at one time the den of hyenas, the bones of the hyena all bearing traces of having been gnawed and broken open for the marrow, as do those of the other animals which constituted the prey of this fierce mammal. In addition, however, to these bones of animals, a fragment of human fibula has been found, which goes to prove that man was contemporaneous with the fauna existing at that period. No other remains of the man have been found, and he was probably devoured by the hyenas. Other caves are supposed to have been occupied by the Brit-Welsh, not only in Yorkshire, but in Staffordshire and Lancashire; but we must now leave the historic and pass on to the pre-historic.

The pre-historic embraces the Neolithic, or age of Polished Stone, the Bronze, and Iron Ages. The fauna of this period is marked by the introduction of many domestic animals which are wholly wanting in the Pleistocene Age. The dog has now taken his place as the friend and companion of man; whilst the horse, swine, goat, and cattle have become subservient to his will. Also conspicuous by their absence are the cave-bear, woolly rhinoceros, mammoth, and other wild carnivora, which had probably become extinct.

Very few caves have been discovered belonging to the Iron and Bronze Ages, as man had become too civilised at this period to continue living in caves; and the scarcity of bronze implements can partly be accounted for on the hypothesis that bronze implements, when broken, could be melted and refashioned. To these ages belong Whitcombe's Hole, in Somerset; Heathery Burn, Durham; Kirkdale Cave; Thor's Cave; the caves of Césareda, &c.

Very numerous are the caves belonging to the Neolithic, or age of Polished Stone. We find them to have been used not merely as places of habitation, but also as sepulchre for the dead. Some very interesting sepulchral caves have been explored at Perth-Chwareu, in Wales, also at Cefn, near St. Asaph. It was the custom for the people of the Neolithic Age to sleep in a contracted or sitting posture, and their dead are generally found buried in the same fashion. A clan or family is supposed to be interred together. They belong to a long-headed and rather short race, the tallest being only 5ft. 6in., and without prominent jaws. Other sepulchral caves have been found in France, Spain, and elsewhere. Three or four caves belonging to the Neolithic and Bronze Ages betray signs of having been inhabited by cannibals, especially on the shores of the Mediterranean Sea.

We remarked in the beginning that there are some caves to which it is difficult to assign the accurate age. To this class belong Paviland Cave, the Cave of Engis, Trou du Frontal, Aurignac, Cro-magnon, Cavillon, near Mentone; Bruniquel, Grotta dei Colombi, near Palermo, and others.

The interesting cave of Aurignac in France was discovered accidentally in 1852 by a peasant named Bonnemaison, who, whilst searching for a rabbit which he had seen suddenly disappear, happened to put his hand into what he supposed to be a rabbit-warren, and to his astonishment he drew out a human bone. Piqued by curiosity, he explored further, and at length discovered the entrance to a cave which was full of human bones, seventeen skeletons being believed to be the correct number. Also the bones of extinct animals, as well as works of art, were discovered. M. Lartet subsequently made a scientific examination of this cave, but it is not quite satisfactorily proved whether the interments took place in the Palæolithic Age. The Grotta dei Colombi, in the island of Palermo,

bears distinct traces of having been inhabited by cannibals.

We have now glanced cursorily at some of the chief caves belonging to the historic and pre-historic ages, and it only remains to speak of the largest and most important class of caves, viz., those belonging to the Palæolithic age; but our space is exhausted, and we must therefore defer our remarks for a second part.

Before concluding, it may be stated that it is gathered from the evidence concerning the fauna inhabiting Europe in the pre-historic age which is afforded by these caves, as well as from traces which still remain in submarine forests of the vegetable life of the period, that the climate of Europe was very much more severe than it is at present. The area of Great Britain was also of greater extent. A comparison of the skulls found in these caves has also been useful in guiding ethnologists to determine what races inhabited Europe in the pre-historic age. They are believed to have consisted of the Iberian or Basque races, which are now represented by the small, dark-haired peoples of Western Europe.

M. Sterndale Acworth.

MEDICAL REPLIES.

[17872].—THE four queries (46182, 46185, 46191, and 46197) all involve points that could only be solved by the analytic eye of the physician. No physician could safely or usefully prescribe for such cases without personally examining them; and if they are eligible for hospital help, I will give them every attention on their appearing at the Temperance Hospital any Monday at 2.30 to 3 o'clock. Working men suffering from some ailment that ordinary medical help has failed to cure, and to whom the loss of half a day's work is material, I will see gratuitously at my house at ten o'clock any Sunday morning. Neither the space of these columns nor my own time can be spared to deal with queries, unless such queries involve matters of general interest to a substantial section of readers. James Edmunds, M.D., &c.
Grafton-street, Bond-street.

AN "ENGLISH MECHANIC" MICROSCOPIC CLUB.

[17873].—As amongst the readers of the ENGLISH MECHANIC there must be a large number who have taken up microscopy as a recreation or study, it has struck me that it would be a good plan if we could establish a club somewhat on the principle of the Postal Microscopical Club, to be composed entirely of subscribers to the ENGLISH MECHANIC. The object of such a club would be the circulation amongst its members, at stated intervals, of a certain number of slides, to which each would be asked to contribute in turn; the slides to be accompanied by a note-book for the purpose of receiving notes, drawings, suggestions, &c.; these could be eventually published, if sufficiently good. The existence of something of the kind would, I feel sure, be a source of considerable gratification, whilst the payment of a small sum by way of entrance fee and annual subscription, would be amply sufficient to cover all expenses. Will those who feel interested in the matter kindly give us their ideas on the subject?
H. C. S.

COAL-TAR PRODUCTS.

[17874].—COAL-TAR, as most of our readers well know, is one of the by-products obtained in the manufacture of illuminating gas from coal. In the gasworks the coal is heated in long fireclay or iron retorts, heat is applied to the retorts by means of furnace underneath, the volatile products of distillation are conveyed, by means of pipes leading from the top of the retorts, into the hydraulic main, where most of the tar and oily products are condensed, the more volatile products passing on, through the purifying apparatus, to the gas-holder. The tar from the hydraulic main runs into wells or receivers, where it is allowed to settle, in order that the ammoniacal water with which it is mixed may separate. The tar, as thus produced, has a specific gravity varying from 1.140 to 1.190; the specific gravity of the ammoniacal liquor varies from 1.015 to 1.060. The tar is conveyed from the gasworks to the tarworks in boats or tanks. In the tar-distillery the tar is again allowed to settle, in order that it may be freed as far as possible from water, water being a disturbing element in the distillation of coal-tar. After settling, the tar is run or pumped into large wrought-iron retorts or stills, varying in capacity from 5 to 30 tons, or 1,000 to 6,000 gallons, preference being now given to stills holding from 5 to 10 tons. Heat is applied to the stills, and after several hours, distillation commences, the first portion of the distillate consisting of ammoniacal water and light naphthas. As the distillation proceeds, the quantity of ammoniacal water present in the distillate decreases, whilst the quantity and density of the naphtha increases, until a point arrives when most of the ammoniacal water pre-

sent in the tar has been distilled off: at this point distillation almost ceases. The heat applied to the still may now be increased, and distillation carried on more briskly. The separation or fractionation of the distillate from coal-tar varies in different works. In some distilleries the light naphthas, found in the first portion of the distillate, are collected in separate receivers until the distillate has a specific gravity of from .909 to .920: this naphtha is then ready for the rectifying-house. The distillate from .920 to 1.000 is known by the name of light oil. In other distilleries the light naphthas are not thus separated, the first portion of the distillate being run into one receiver until the distillate has a specific gravity of 1.000. This light oil, as it is called, is afterwards treated for carbolic acid, and benzols, toluols, &c.

The portion of the distillate from coal-tar, following the light oils, known as creasote or dead oil, contains but traces of benzol, and is run into separate receivers until the distillate has a specific gravity of 1.050 to 1.060, or until crystals of anthracene appear on cooling a small portion of the distillate.

This creasote or dead oil contains large quantities of naphthaline, which separates out on cooling. Some tars yield naphthaline in such quantities as to constitute a source of danger, and great care should be taken, when working such tars, to see that the water in the condensers is kept hot, and on no account should the distillation be allowed to slacken whilst the creasote oils are distilling off, for should the condensing-worm become cold, the pipes will be blocked with solid naphthalene, and, if the stillman be not on the alert, the pressure in the still accumulating, an explosion will be inevitable; many lives have thus been lost. Creasote or dead oils are used in immense quantities for the purpose of "pickling" or preserving timber, railway-sleepers, &c. The portion of the coal-tar distillate following the creasote oil is run into pans until a sp. gr. of 1.090 to 1.130 is reached, the specific gravity varying in different works and with different tars. This oil is known as anthracene or green oil, and on cooling deposits crystals of anthracene.

When the distillate has attained a sp. gr. of about 1.100, or when it has a waxy consistency on cooling a small portion, the distillation is stopped: the residue left in the stills is known as coal-tar pitch. This pitch has a degree of hardness varying with the quantity of oil distilled off. Pitch which softens when immersed in water, at a temp. of 140 Fahr., for two or three minutes, is known in commerce as medium pitch. Pitch which does not soften under these conditions is known as hard pitch. Coal-tar pitch is used chiefly for the purpose of making artificial fuel. Fine coal or coal dust is thoroughly mixed with from two to five per cent. of coal-tar pitch, also finely ground, the mixture is heated and submitted to strong pressure in moulds. Large quantities of fuel are thus made in the South Wales district.

The sp. gr. of coal-tar pitch varies from 1.25 to 1.36. An improvement in the distillation of coal-tar has been patented by Messrs. Fenner and Trueby, and is now in use in many tar-works. This improvement consists in introducing a current of steam into the tar still during distillation by means of a specially constructed coil. The steam may be introduced as soon as the anthracene-oil begins to distil from the retort. By this improvement the distillation may be carried further than by the old method. The patentees also claim that, by their process, an increased yield of anthracene is obtained, whilst the stills or retorts are kept in better condition, less firing being required; and the current of steam issuing from the coil at the bottom of the still preventing, to a certain extent, the deposition of carbon on the sides of the still, or, in other words, prevents the coking of the pitch. The extra hardness of the pitch left in the stills, caused by the increased quantity of oil distilled off, may be remedied by running creasote-oil into the molten pitch in the still.

Having thus briefly considered the general process of tar-distilling, we may now deal with the processes by which the crude products are separated and purified.

RECTIFICATION OF COAL-TAR NAPHTHAS.—The light naphthas obtained from the first portion of the distillate from coal-tar are conveyed direct to the rectifying-house. The light oil having a sp. gr. .920 to 1.000, is distilled (after treatment for carbolic acid) in large iron retorts, by means of steam or fire. The lighter portions of the distillate, obtained in the distillation of this light oil, are known as "once-run naphthas," having a sp. gr. from .880 to .910, and yielding, on distillation, from 30 to 50 per cent. distillate at 120° C., or 218° F.; that is, if 100 parts be distilled in retort, with thermometer inserted in the liquid, and distillation carried on until the thermometer registers 120° C., it will be found that from 30 to 50 per cent. has distilled over.

In the rectifying-house this once-run naphtha, also the crude light naphthas, are washed with about 5 per cent. of sulphuric acid, sp. gr. 1.850, in a vessel

fitted with agitating apparatus. After agitation, the waste acid, which settles at the bottom of the liquid, is run off, and the naphtha washed several times with water; then with water containing a little slaked lime or caustic soda, finally with water to remove alkali. The washed naphtha is distilled in stills or rectifiers, varying in capacity from 400 to 1,000 gallons. Distillation is effected by means of a steam coil in the interior of the still. After distillation has commenced, the vapours pass through a pipe leading from the top of the still to a fractionating column, or to a series of pipes or vessels surrounded with water, so arranged that the heavier portions of the distillate condense and flow back to the still, whilst the lighter hydrocarbons pass forward through the condensing worm, thence into the receivers, where the distillate is separated according to the quality of benzol, &c., required, or the quality of the naphtha which is being worked. By successive distillations of the various fractions the following commercial products are obtained:—

Boiling points and percentage of distillates of average samples from pure English coal-tars.

Commercial names.	Sp.Gr.	B.P.'s	C 85	C 90	C 95	C 100	C 110	C 120	C 130	C 140	C 150	C 160	C 190
			85	90	95	100	110	120	130	140	150	160	190
90 per cent. benzol.....	.881	82	31	71	84	90							
50 per cent. benzol.....	.877	92				50	78	90					
30 per cent. benzol.....	.874	96				30	81	94					
90 per cent. toluol.....	.872	109					2	90					
90 per cent. xylol.....	.870	130								90			
90 per cent. solvent.....	.880	133								36	78	90	
Burning naphtha.....	.920	160											30
	to	to											to
	.960	170											70

(To be continued.)

Chemistiana.

AN ELECTRIC BAROMETER.

[19785].—THE account in this week's "E. M." of Mr. Kemp's electrical barometer for indicating at the foot of a mountain the atmospheric pressure at the top, has made me look up a sketch for a similar instrument I designed last autumn, on learning the discontinuance of the Ben Nevis observations for the season.

My idea, it will be seen, differs very much from Mr. Kemp's, as I only use one barometer, while he proposes 25.

The barometer I suggest using is one of the ordinary column kind, but the glass-tube is rather longer; the reason for this will be seen.

The back of the case holding the tube, as far as least as the scale extends, should be made of ebonite or ivory (for insulation); and in the back of the glass-tube are fused platinum wires, one-tenth of an inch apart, and in line with the scale; these wires are continued separately through the ebonite back, where they are each attached to a fine silk-covered copper wire of a length to reach from the barometer to the observer. Another platinum wire is fused into the mercury reservoir, and its outer end connected with another covered wire.

For making contact, I use the following float:—A light glass tube, closed at both ends, of such a diameter as to slip easily up and down the barometer tube, and of a length a little longer than the barometer scale floats on the column of mercury; on its top end it carries a small cap of platinum; this cap is not quite 1-10th in. deep, so that as soon as the bottom of the cap has left one platinum wire-point or stud, its top shall touch the one above. A thin platinum wire runs through the tube from the cap, through a hole in the bottom of the float, and communicates with the mercury-column. Should it be found that the mercury attacks the platinum, contacts can be made with carbon plugs attached to the wire here and in the reservoir. If the mercury alone were left to make contact with the studs, of course, as it rose, several studs would be included in the circuit; and, when the amount of contact was sufficient to carry the battery-power, no further rise would be noted; as the float-cap only touches each stud successively, this is avoided.

The receiving station, at the mountain foot, has an ivory or ebonite dial mounted on a wooden box. This dial is marked with a barometer scale, and each tenth has a small platinum flat stud inserted in it; this runs through the back of the dial, and is attached to a binding-screw on the case or box. The centre of the dial carries a light metal pointer, balanced on a platinum point, and so arranged that it can pass over all the dial studs, just touching as it passes. The other end of the platinum support is connected with a binding-screw on the box. The "home" ends of the wires are then unwound from their rope, each under wire is fastened to its corresponding binding-screw on the box, while the reservoir-wire is attached to one battery-plate, the other plate being connected with the binding-screw attached to the platinum support. The dial should be covered with glass.

As soon, now, as the float in the barometer-tube touches a stud, the current runs down the wire attached thereto to the corresponding stud on

the dial; this then attracts the pointer, and the barometer-height is read.

A large thermometer might be similarly used; or a studded aneroid for the barometer.

By making a glass rain-gauge, studding the sides and arranging wires, &c., as above, the state of the gauge might be known.

By allowing wind pressure to pull a small weight up a studded scale (of ivory, &c.), the amount of wind-pressure could be indicated below.

Another form of receiver could be made by taking a narrow oblong case of glass, placing studs along the top corresponding to the degrees; attaching these, outside the case, to the wires from the barometer-tube, and allowing, on the inside, pith-balls, or strips of gold-leaf, to hang therefrom. Strips of gold-leaf corresponding are then to be fixed inside the glass, and all united at bottom to a platinum wire passing through the stand on which the receiver is placed; this wire is then connected like the reservoir-wire. On the

direction, there should always be a separate distant signal for each line, properly interlocked with the junction home signal, and with the facing-points.

A driver finding the distant "off" for the line upon which he requires to run would at once know that the points must be set right, and that the proper home signal was also off, even if fog or any other cause prevented his seeing the home signal as soon as usual.

If a signalman makes a mistake and places the points in the wrong direction, the driver finds out the error as soon as the "distant" are sighted, and has ample time to stop his train, or by giving the proper junction whistles to have the points and signals altered.

On the other hand, I have known many instances under the old system of one distant signal, in which a driver could not know that the points were wrong until in sight of the junction signal, and too late to prevent his train running several hundred yards upon the wrong line.

The Desford Junction Accident is most conclusive proof in favour of the system of separate distant signals for each line.

In all cases where two signal-boxes are near together, the distant-signal from the one box should be a swallow-tailed arm, placed upon the "home," or "starting," signal-post of the next, the two arms slotted so that the distant cannot be "off" without the home, or starting-signal, being also off; and that when the latter is put "on," the distant is also put "on" at the same time. The distant signal is therefore under the control of the two signalmen.

Upon some lines the all-right signal is given by lowering the arm completely inside the post in a vertical position, so that it cannot be seen. This plan cannot be considered good, as it is, in fact, not a signal, but only the absence of one. A direct all-right signal is required, and I very much prefer the arm lowered to an angle of 45 degrees.

The question of signal-lights is also one upon which much difference, of both opinion and practice, exists. Upon all lines a red light is a danger, or stop-signal; therefore no error can cause misunderstanding upon this part of the code. At junctions and important stations the all-right signal is a green light, and, generally, a white light is used at other stations and signal-boxes.

A white light can be seen much better than a green one; but, still, there is a great advantage to be obtained from the use of one all-right light

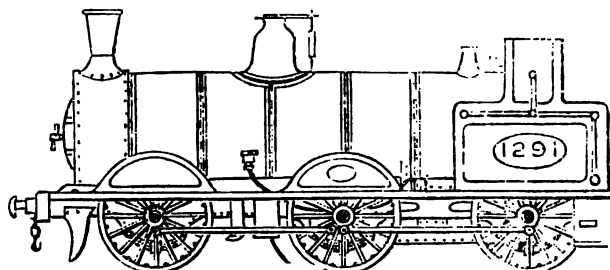
current passing, the pith-ball or suspended gold strip will adhere to the side strip, and show the degree touched above.

February 25th.

B. Harcourt.

N.E. GOODS ENGINES.

[19786].—I ENCLOSE a sketch and a few particulars of the Darlington class of N.E. goods engines. The following are a few dimensions of No. 1291. Cylinders, 17 by 26; leading, driving, and trailing wheels, 5ft. diam.; boiler, 11ft. long;



diam = 4ft.; 158 tubes 2in. diam. The safety-valves are pressed at 130lb. Engine No. 1291 was exhibited at the Darlington Jubilee in 1875. Engine No. 204, which burst in December last year, was of a similar class. This engine was built in 1880. The boiler of another engine built from the same drawings (No. 170) was subjected to a pressure of 300lb., at York, before Messrs. Johnson and Stirling, and a satisfactory report issued. The Gateshead class of goods engine have cylinders 17 by 24, and wheels 5ft. diam. Length of boiler = 11ft. 4in.; diam. = 4ft. 2in.; 181 tubes 2in. diam., 11ft. 9in. long; total heating surface, 1,204 sq. ft.; weight, 36 tons 2 cwt.

Meteor.

RAILWAY SIGNALS.

[19787].—I AM very glad to see that the subject of railway signalling is again under consideration in your columns, as efficient signals are a most important part of railway safety.

When "distant" signals were introduced they were of very various shapes, of boards, discs, and cross-bars, and when the semaphore arm was first used many mistakes were made. This cause of error has now been removed by the almost universal adoption of the swallow-tailed arm as the distant signal.

The accidents which have taken place from mistakes show that one standard code of both block working and signals is much to be desired, more especially by engine-drivers and guards who have to work trains over the lines of several other companies or joint committees.

With regard to distant signals at junctions, I am of opinion that the usual practice of having but one distant to be used for two or more lines is very inefficient. Approaching a junction in a facing

instead of two, and from the adoption of a standard system.

Upon the Great Northern line the all-right signal is given by a green light, and should a white light be shown, a driver knows that the signal is out of order, and is required to treat it as a danger-signal. I have had several opportunities of inspecting the working of signals upon this railway, and I find the system adopted gives satisfaction.

It has been considered that the lights of distant signals might with advantage be made of a different shape from those of home signals, so as to be easily distinguishable at night; and several suggestions have been made.

Many accidents have occurred in consequence of points being worked by wires; the untrustworthiness of wire-worked points has always been known, and it is satisfactory that those companies who used them are now carrying out the recommendations of the inspecting officers of the Board of Trade, and substituting rod-working for wire-working as far as possible; and at the half-yearly meeting of the Midland Railway, the chairman stated that during the last half-year, £6,704 had been spent upon the substitution of rods for wires. The recent accident at Hornsey, and other minor instances, have again called attention to the subject of "fogs."

The driver of a train is then working under the control of the fog-signalman, and when from any cause they have not arrived at their proper places (as was the case at Hornsey), great danger and risk must result. Many arrangements of audible signals, and for placing fog-signals upon the rails mechanically, have been invented, but have not come into practical use. Most certainly some improvement is necessary to prevent drivers in fogs passing signals at danger without any notice. A

quick means of communication is very necessary between signalmen. Many instances are on record of mistakes which might have been rectified, and accidents avoided, if information could have been given.

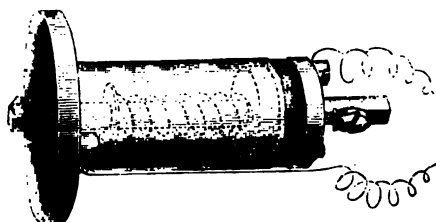
The telephone is, I believe, destined to become of the greatest use in signal-boxes; and those which are now so placed are found to be of very great advantage to the signalmen in the performance of their duties. **Olament E. Stretton.**
Saxe-Coburg-street, Leicester, Feb. 25.

CONTINUOUS BRAKES.

[19788].—I AM very glad to see, on page 592, that attention has again been called to the way brake-power is distributed and rendered useless on many trains; almost daily I see carriages of one system run upon trains fitted with another. It is very satisfactory that in Scotland the brake question is coming much nearer to a settlement; one difficulty, however, exists, and causes daily inconvenience. The West-Coast Joint Stock is fitted with the chain brake. The Caledonian Company (who are part owners) adopt the Westinghouse, therefore north of Carlisle inconvenience arises; however, it is very likely that in a short time these Joint Stock vehicles will be provided with the air-brake hose-pipes, the same as the East-Coast carriages. Every engine-driver hopes they will have good continuous brakes on all trains.
A Driver.

NEW DOOR-CONTACT.

[19789].—In introducing my new door-contact, I have especially designed it to overcome the necessity of using a hammer and chisel (which takes considerably more time, as most mechanics know that all circular work is much more readily done than any square work). It consists of a brass flange, either 1½ in. or 1¼ in. in diameter (these sizes being most convenient to go into the door-posts), and about ¼ in. thick; on the back of this is attached a short brass tube, the end of this being plugged with a piece of ebonite, which carries a brass cap; a spindle then passes through the brass flange and the ebonite, but does not touch the brass cap until allowed to come down upon it by the opening of a door. Inside, it has a strong spiral spring, which brings the spindle down, and makes contact, these parts being provided with thick platinum. In the door itself, where the spindle touches, I generally use an ordinary wood screw, so as to prevent it from cutting its way into



the door; at the same time it affords a very easy manner of adjustment, as by giving it a slight turn either way, it can be set so as to make contact on the door being opened the smallest degree. The spring and spindle being inclosed in the brass tube it keeps out all dirt from interfering with the action of it. The fixing of these contacts is done by means of two centrebits, the larger one being used first to allow the flange to fit in flush with the wood, then a smaller one is used to bore deep enough so as to let the back tube to pass. The wire then being attached to the screws provided, the whole thing can then be placed in position, and secured by means of three small screws. The woodcut is about full size.

H. Thorpe.

55, Theobalds-road, W.C., Feb. 27.

HERR DITTMAR'S method of solidifying petroleum consists in heating it in a still to 100deg. with two or three per cent. of soap. Vinegar is afterwards used to liquefy it. The method and results were unfavourably discussed at a recent meeting of the Russian Technical Society, St. Petersburg. It was said that the solidification was not perfect, and that oil leaks out of it which would saturate the proposed wood cases for transport and give off vapours; that the cost for soap would be considerable, and that large liquefying works would be required, and finally that the cost of the processes would not be covered by reduction of cost of carriage.

It is stated that a contract for building a tunnel under the St. Lawrence, at Montreal, has been let to Mr. J. B. Louillard, the amount of the contract being £700,000, including drainage and lighting. The tunnel is to be completed by 1886.

REPLIES TO QUERIES.

* * In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[45579].—**Metallurgical.**—I am sorry I cannot answer "D'Evelyn's" question, p. 594, from personal acquaintance with the process; but it may help him to know that the solution is double cyanide of copper and potassium; what strength I cannot find. If "D'Evelyn" has access to the photographic journals, he will find several notes on Biny's process in recent numbers.—**S. B.**

[45580].—**Sea-Wall.**—Old sleepers are of no use unless put in with a good feeler—i.e., a long bar of iron about 8ft. long, 1¼ in. round, and bitted about 8 in. or a foot up, 1¼ in. sq., taper something like a worn kitchen-poker. If this is put down very near the depth first, and the sleepers are driven down with a 10cwt. monkey, with 12 or 14ft. fall, then they might stand. They vibrate so much by being driven by a hand-maul that they will often float out. Get a bar, as above, to go down first by hand. If your wall at present is 15ft., and you wish to carry it at an angle of 45 up to the top, you will need to have 3ft. foundation. You will have to start foundation 18ft. from vertical line of top of old wall; let the quoins lay at an angle 45 from the weather. If you can get rough-dressed stone in the neighbourhood cheap, do; but in many cases there is none to be got for miles, and plenty of sand and beach to hand, that only the cement is required. Calculating your stone a foot thick at the angle stated would be 26 by 30 for plain wall. You might see what you could get it for, and compare notes. Your fender of piles before the foundation protects foundation very much, as it forms a bay between the two rows of piles, into which the beach washes into and breaks the force of the water. But the piling must be driven after the bar has been down, with a very heavy maul, quick, if driven by hand; and small stuff about 3 in. to 4 in. diameter will last a long time, from twenty to forty years, perhaps. And if any sign of giving way, another could be put in about 2ft. in advance or in the rear of them or both, at very little outlay. I should not carry the wall the same angle up to the top, but commence to curve it about 5ft. from the top, so that the top of wall about one foot stand vertical. The water will have a tendency to return then, instead of breaking over.—**JACK OF ALL TRADES.**

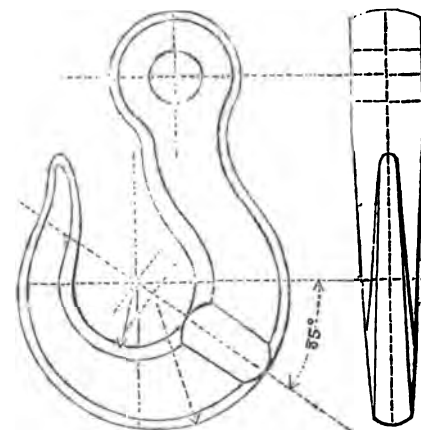
[45665].—**Picture-Frames (U.Q.)**—Size them with ordinary size; weak first. When dry, a very thin coat of oil-gold-size, or Japaners' gold-size, and dab your gold on when it is tacky or very near dry, and after a little while skew off.—**JACK OF ALL TRADES.**

[45669].—**To Jack of All Trades (U.Q.)**—I know nothing of them.—**JACK OF ALL TRADES.**

[45687].—**Throttle Valve.**—"J. J. A." may not approve of the valve I illustrated, but there is no difference between the one I describe and which he mentions at page 595. The two are identical, and if he fails to see this, so much the worse for his mechanical knowledge. The throttle-valve I described is exactly that used in thousands of steam-engines. The only thing being that being intended for a model, it is therefore better made in brass than cast iron, as "J. J. A." advises. Surely the gentleman in question can perceive there is a stuffing-box shown in my sketch. And if he examine further still, he will see that the valve needs but to move less than a quarter of a revolution to be fully open. And the valve he describes does exactly the same, the difference in "rise and fall," as he states, being absolutely nil between either valve. Had "J. J. A." been practically into the matter as I have, perhaps he would, instead of recommending a way of chucking the casting of the valve as he does, give the plan almost invariably used in engineering works. There the valves are cast with a spindle projecting at either end from the centre, the valve being at the inclination thereon it assumes when closing the steam-way. This allows the valve to be turned between centres. But the turning, even, does not get it up, as a rule, sufficiently accurate, and it is then fitted and scraped to a bearing-fit all round. Such a plan of a wood chuck, in an engineering establishment of any size, would, I fancy, make the foreman think the turner had been used to mere amateur work, and would not unlikely lead to take himself and experience elsewhere. If the valve was of any size, the hole for the spindle is always cast through of flat section, and drilled. "J. J. A." may rely on it I know what I am about when I describe this or that, and I do not attempt to deal with anything I have not had practical experience of.—**SUNLIGHT.**

[45700].—**Tools for Bending Iron.**—I quite agree with the remark made by "J. J. A., Liverpool," on page 547—viz., that it is no wonder we read of railway hooks giving way, if it is a correct

drawing of one given on page 524. That one was quite bad enough; but what did "J. J. A." think when he saw the one by "Ex-Blacksmith" on page 527? The hook itself seems to be properly proportioned, but just where the hook turns into the eye almost makes one shudder to think of it being used for railway work; such a hook would be more fit for the scrap-heap than the coupling of a locomotive. I inclose a sketch of a locomotive



coupling-hook, such as I have seen fitted in a locomotive shop.—**T. R. SAXTON.**

[45761].—**Concrete Pigsties.**—"Nun. Dor." pays me the compliment to refer "W. D." to me for information. "W. D.'s" question is a difficult one to answer, as he gives no data on which an answer is possible as far as relative cost goes. He gives neither price of bricks, lime, and sand on the one hand, nor of Portland cement and materials in the shape of aggregates on the other, at the place where he resides. As to concrete being suitable for pigsties, I have, taking all the year round, sixty or seventy pigs in sties entirely constructed of concrete—the walls, the roof, the floor are all concrete; nay, the iron feeding-troughs have been replaced with concrete ones. The only caution I must give is that the pigs must not be put into the sties before the concrete is well set, as a pig's snout is a powerful weapon. For ordinary walling, to make 100ft. solid, after well-rammed, it takes 150ft. material by measure, consisting of Portland cement, 15ft.; aggregates, 135ft.; consisting of four parts clean gravel or shingle, and one part sand; cost of Portland cement, 2d. per ft.; cost of material, 1d. per ft. Bill for the same: 15c.ft. cement at 2s., £1 10s.; 135c.ft. of aggregates at 1d., 11s. 3d.—total £2 1s. 3d. Product 100ft. in the solid, costing 4'95d.; add labour, 1½d. per foot, 1'50d.—total, 6'45d. Say 6½d. per foot. For roofs, floors, &c., 1 of cement to 5 aggregate; 25ft. cement at 2s., £2 10s.; 125ft. aggregates at 8s. 1d., 10s. 5d.; cost per 100c.ft., £3 0s. 5d.; cost per foot, material per foot, 7'20d.; labour per foot, 2d.—total, 9'20d. These prices are quite independent of the original cost of framing, and also the cost of putting up centres for arched roofs, and fixing the same with web plates of iron and tie-rods so as to retain the arches. The secret of making concrete is to have clean hard material thoroughly mixed, with as little water as possible, and rammed in the frames as hard as possible. I never allow my concrete to be more moist than clay sugar. One of the best tests as to the proper quantity of water is to put some of it into a mould and ram it as solid as you can, and if, after hard ramming, you bring a thin or very fine film of water to the top, you have quite water enough. The great difficulty is to get workmen to do their work as directed, especially those who are considered skilled mechanics. You cannot get the material properly mixed: unless your workmen are watched they will drown the material with water. As far as elbow-grease is concerned, lots of water makes work easier; but what is the result? The cement and finer aggregates all find their way to the sides of the frame, and your wall is like an egg; a thin hard shell outside and quite soft inside. I have said nothing about cost of framing, or about the sort of framing, but I have had to pay for my experience. I have had concrete on the brain for nearly twenty years. My first frames were very elaborate costly affairs lined with zinc, which I could never keep clean; my corners I could never keep in place; my double framing, which I made fifteen years ago on the banks of the Hooghly and sent home when freight was low, would, if made here in England, have cost me at least five and sixpence a foot run. This has now been superseded by frames entirely of wood, doing better work, at about two shillings the running foot. I originally started with frames 21 in. in depth, giving 18 in. work on each rise. My big tower (or Folly, as my

friends call it) is built with frames 24in. deep, giving 21in. work in each lift. I was, as it were, driven to this by reason of my being tied to the staircase carried up in a hexagon tower alongside, the risers of my steps being 7in., and three steps going in each inside face of the hexagon in one rise of 21in. of frame. I have only got 84ft. 6in. out of my intended 200ft., and shall say no more about it at present. Before I conclude, I must give "W. D." a piece of advice. If he be like the centurion of old, and have men under him, and expects to get his work properly done by the simple order, he had better not commence concreting. He will not get it properly done. He must get up a ladder and look over some neighbour concreting, and see what is being done, and think if he cannot do it better. If his work is of any extent he had better pay me a visit and see how my work is done. The only work on concrete that I know of is the work by Henry Reid, published by Spon; but it will not help him much. My days for concreting are pretty well numbered, and when I finish my big tower I shall finish off; but in the mean time I shall be happy to give my experiences to any one requiring them.—KRODA BRUX.

[45765].—Watch-Jobbing.—Put new bushes in barrel-holes, drill small holes in centre, and open them out to the proper size; but be careful and have them in the centre, or the barrel will not run true, and if not true, will stop the watch.—NICHOLLS.

[45774].—G.W.R. Engines.—"N.W., Ealing" has given the date of No. 163, 7ft. single, as 1879; but, unless the original has been rebuilt or replaced, the date of construction was 1862, by Sharp, Stewart, and Co., Nos. 670 and 682, goods (657 to 716) were built at Swindon, 1871. 914, goods, Beyer, Peacock, and Co., 1868, purchased by the G.W. Company from the L.C. and D. Company in 1873, along with 894 to 913, by various builders. 935 and 943 goods (927 to 946) built at Swindon, 1874.—R. N. H.

[45788].—Wind-Power.—I would recommend a small windmill, similar to what may be often seen here, on board American ships, for pumping out the leakage. Erect four poles, spread out pyramid fashion at the base, diagonally stay them, and bolt on at top a sort of circular framing, like a pillbox. On the cover of this larger sized pillbox bolt two journals, to carry the shaft, which is provided with a crank one-half the throw of the pump. Cut a slot in centre for the connecting-rod (an ordinary bar of round or square iron), and connect to pump (in the centre of the four poles below) by a swivel joint. At a guess from memory, I should think that the pump was, say, 6in. stroke and 3in. bore, and the mill head about 10ft. diameter. But, of course, you pay your money and takes your choice, *à la carte*. They turned the cover by means of a handspike.—J. J. A., Liverpool.

[45797].—Gelatine Moulds for Plaster Casts.—Pour the melted gelatine over the oiled model. When dry it must be varnished, or possibly the addition of bichromate of potash when in solution will do, if you expose to light for some hours afterwards. It has the effect of hardening and rendering insoluble.—E. G. M.

[45805].—G. and S.W. Engines.—Thanks to "Carstairs" for reply. I have not seen the engines in question, so that I cannot classify them. "Meteor" has also replied, but I had the details he gives, and simply wanted date of construction. In appearance they are like G.N. 28 class, which, I understand, came out in 1867. An engraving of one of the former appears in a work by Mr. Bourne, which was published about 1867. Hence my query. It will interest some of your readers to hear the M.S. and L. Company have brought out a new engine, having single driving-wheels and outside cylinders.—R. N. H.

[45814].—Curved Lever, &c.—If fulcrum, power, and resistance are the same in both cases, you can bend the lever into any shape you please, you will not increase its useful effect. In your figure 2 you show a longer throw of crank, although you say the resistance is equidistant from fulcrum in both cases.—MECHANICAL CUSS.

[45819].—G.W.R. Engines.—Particulars of narrow-gauge engines on pp. 19, 44, 94, present volume. Illustration at the place last cited.—T. P.

[45831].—Rubber Stockings.—Yes, grease does destroy rubber. You can mend your rubber stockings by painting them over with a solution of indiarubber in bisulphide of carbon. Do it out of doors.—S. M.

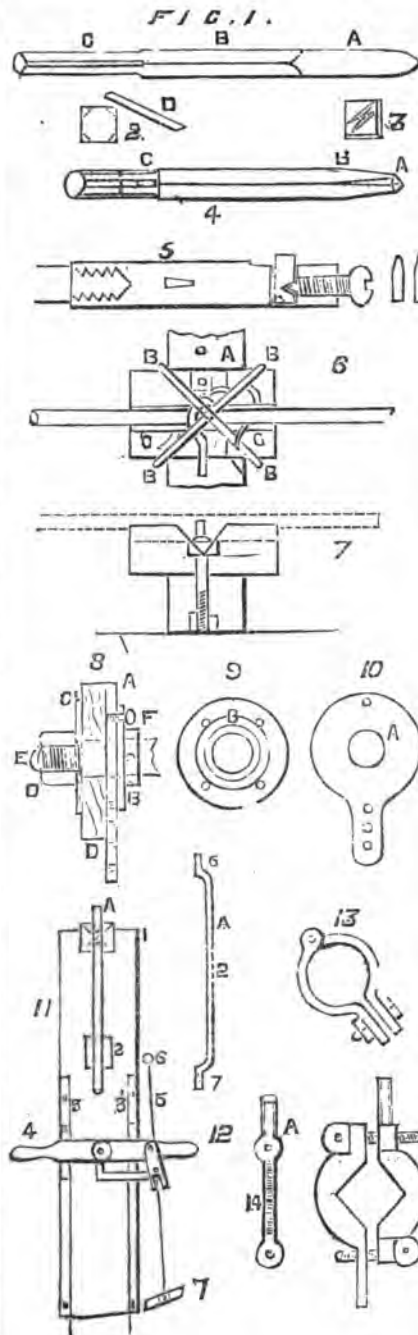
[45834].—M.E. Engines.—The 340 Midland engines with straight framings are the old Hawthorne build. Nos. 340, 610, and 933 have been rebuilt, but the cylinders have not been enlarged. There are no 18in. cylinders on the Midland line. The 210 to 223 class of shunting engines are old goods engines which some years ago were changed

to shunting tank engines and the old tenders broken up.—A DRIVER.

[45837].—Pottery Printing.—I don't know what the querist means by pottery engraving, especially as he speaks of transferring designs. He will find a tolerably full account in Ure's Dictionary. An engraved plate of the design is inked, and an impression taken on paper, which is transferred to the ware. Ink and colours vary with the nature of the work, whether underglaze or overglaze. See an article on "Pottery Decoration" on page 484, Vol. XXXII.—S. M.

[45854].—To "Sunlight".—In vain have I been looking for your reply to my query as you promised. I gave you the data you asked for on p. 527. I trust that you will answer it.—SAFETY.

[45863].—Drilling and Rifling Small Arms.—The following sketches will put "Rifle" in the way to do what he requires. The reason why many fail in this is because they have a notion that the



barrel should be cramped down rigid or bored between centres; but if you follow these instructions you will make a job that is not to be laughed at. If you are going in for making a barrel, do not attempt to bore one out of the solid, unless a short pistol barrel; but get some barrel tube made for the purpose, which should be twisted, or wrung, and welded. Fig. 1 is the first drill bit, which is best made of cast steel, whose section across the angles is the size you require it. The part is filed flat for about 2in. up, as shown at 3, showing end on at A B is square about 4in., and from C up to the end for wrench, which should be square; the

angles are taken off, see end on at 2. These square or cutting angles should be taken off a very little with a piece of hard oil-stone at about the angle shown at D. Mind you take it off right, as shown, as the bit is made to run right-handed, and the cutting edge should be a little prominent. 4 is the finishing broach about 6in. long from A to B; the angles are taken off as shown; the cutting angles from B to C treated to a touch of the oil-stone as before at C, file two flat sides and make a rod with a fork joint and pin it on. The rod will be best made of shear steel, and the angles taken off. The reason for this is that it is rather difficult to make a true broach in a continuous length. If this should warp in hardening, you can grind it up true. 5 is the rifling head about 4in. long, made to be screwed upon an iron rod; it should be steel, and hardened and tempered to a purple, the other bits to a deep straw or faint brown; about 1 1/2in. from the end a flat should be filed upon it, and a cutter-way the width of the rifle grooves, or a trifle larger, put through it, about 3/4in. from the end; up the end a hole is drilled, and tapped for a screw with a cone point to engage in the notch in the cutter, which will feed the cutter with a screw-driver; make the cutter a good fit, not too tight that the screw will not move it; 6 is the saddle, the top of which is a piece of hard wood, with two V-grooves cut in at right angles, the one across deeper than the longitudinal one for the driver to bury itself; this is bolted upon another piece, as shown at 7, with one bolt, but not too tight; the cross-piece, A, is bolted upon the lathe saddle, and the barrel packed up central with the lathe centres, and lashed upon the wood saddle, as shown, with a white leather thong or lace. See B, B, B, B, and when tied tight, the ends brought under the barrel fore and aft, see C, C. The next sketch is 8, sliding stock of the rifling bit. A is the bell crank, see 10. B is the fast collar upon the bit, and acts as a dividing plate, see 9. C is a washer, or plate of stout hoop iron to fit bar to, which is for nut and washer D to screw up against, and to be screwed upon the wood stock D, see 11, which is shown flat, the better to illustrate its position, but not right, as the proper position would be upon edge. 11 is the rifling board; may be anything in the shape of an 1 1/2in. board, 6ft. by 1 1/2in.; 1 is the saddle where the barrel must be fast, as before. But this must be the breech end, if breech-loading, but the muzzle if for muzzle-loading. The Fig. 2 is another block with a V-groove in it merely to pack the end somewhat near level; 3, 3 are slide-bars of hard wood; I have shown them wide outside of the board, but 6in. apart will be sufficient, which will give you a chance of getting your race 5, 6, and 7 for the follower, which is represented there right for a right-hand thread; this race is shown again at 12 A, made out of a piece of 3/4in. rod with a single eye at one end 6ft. and a quadrant at the other 7ft. to set it by; 13 and 14 are dogs that I have to hold the barrel by; 13 is for a piece of leather strap for the muzzle, that it may not squeeze it out of shape, and the 14 for the breech. When rifling, for every time you set your screw up for the cutter, pass your rod up two or three times to free itself, and wet with one of raw linseed-oil and two of paraffin; draw your cutter through steady, and do not be greedy, or you will spoil your job; in commencing, begin at the muzzle first, because you will have more stuff in the breach if it should happen to run out a little bit. But I am rather before my time. Do not attempt to bore your barrel out of a piece of solid raw iron or steel, but have it twisted and jumped, and a welding heat all over it, and passed through rollers or swaged up; when swaged up to the proper shape and size, and set true between the centres; if solid, pass a drill up the muzzle about 3in., very near the size of Fig. 1 bit; then take it to the fire and get a good red heat all over, and avoid hammering or bending of it afterwards. When it is bored rough, if filled with whitening and made red-hot all over, it will finish better; a forged barrel-tube, straighten until you can pass a straight rod of iron down through it; proceed before to soften it, and then proceed to bore it; the muzzle end for roughing of it out. Do not bore the back-centre in, but run it up against the by the rack return-handle upon the saddle. you have rough-bored it, put it between the and rough-turn it, fill with whitening and red-hot to soften, then proceed with the fire bore; if for breech-loading, breech first, muzzle-loading, muzzle first. After entering finishing-bit about two inches, take two white lace, about 3/4in. thick, 3/4in. wide long, and taking your bit out pass these point of it in the middle of the laces, a bit in again; thus packed and well with what I have stated before, or soft and oil, you will get a hole in it like a as true as it is possible to get it. Be your tools and the leather-packing, for follow this branch trade are as choice leather-packings as if they were gold, finishing your barrel in the lathe, make about 6in. long, turn 5in. to fit the muzzle breech nice and tight; see that the centre

are nice and true and a good depth; drive by the breech not by the plugs or mandrils. Now for the rifling: if for a muzzle-loading, muzzle at A, if for breech, breech at A. This board and apparatus will give you about one-third of a turn, and your barrel will be about 2ft. 8in. long, and give you one turn in about 3ft., which I should think quite enough; if you want more you will have to get a small pinion and substitute for bell-crank 10, and work with a rack; all the other fittings will do. 9 B acting as a dividing plate, only one hole tapped for the screw need be made in the pinion or bell-crank; the other can be divided into 3, 5, 6, 8, 10, or 12; rifles drilled plain to fit the thumb-screw F; the small outer for riding-bar need not be perfectly square; better narrower at the point and a little rounding.—JACK OF ALL TRADES.

[45919].—Filtering Feed-Water.—Kindly correct misprint in reply on p. 573. It should have been "outlet tin below," instead of feet, as inserted.—ON GUARD.

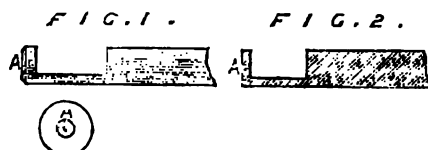
[45920].—The Audiphone.—R. Seager, like myself, refers to his own experience. The effect of the audiphone differs with nearly every one, and the form I selected was the result of experiment on myself. The Rhodes audiphone to me is almost useless. Under any circumstances, the material can be bought for 2s., and the question of straining or bending with a permanent set is a very simple matter for anyone to try.—THOS. FLETCHER.

[45943].—Pressure of Water.—The pressure is sufficient to drive a water-motor, though you give no information of the power required. As an example, it is sufficient to drive a water-engine for hoisting weights of about 5cwt. or 6cwt.—LANON OMNIA VINCIT.

[45943].—Pressure of Water.—The pressure of water you name would drive a water-motor right enough. As low as 20lb. to 25lb. would even do so; but the more the water-pressure, the greater the power obtainable from a given size engine. Have you seen the "Megy" water-motor? You would find it very good and reliable. "Haigh's" motor would also answer your purpose well, with such a fall of water.—SUNLIGHT.

[45949].—Copper Bits.—To "E. F. C."—You will assuredly find that if you rub off "all" superfluous solder from the "bit" before placing it in the "charcoal fire," and don't allow it to become overheated, that it will not be injured in any way. Note, "all" work soldered by means of any acid "must" be extremely well washed immediately afterwards. Neglect in this respect being the cause of the fatal frailty of all the tin-ware of the household, which speedily (especially in the presence of hot water) becomes pitted with pinholes. Friend, I disapprove of thy mode of splicing; 'tis a very weak connection, and a scarf joint would be immensely superior, more especially for bending purposes.—J. J. A., Liverpool.

[45967].—Broken Pivots.—Can you want a more simple form than I gave a short time ago? If so, take a piece of steel or brass wire, make it as shown (Fig. 1 and 2), let the root of the pinion



enter the hole, A; then if you put the point of any sharp instrument in the back of the hole, and press it lightly against the root of the pinion, holding the said instrument loosely in your hand, it is bound to find its own centre.—A FELLOW-WORKMAN.

[45970].—Drilling Hard Steel.—If you get one of Cohen's 12s. 6d. bench turns, they are fitted with every appliance for pivoting self-centring tools, &c. They are simple and good, and well worth the money. The address is 132, Kirkgate, Leeds.—A FELLOW-WORKMAN.

[45991].—Watches.—1st, oilstone dust; 2nd, putty-powder; 3rd, red stuff; to be obtained at any watch-tool dealer's. Mix with oil, use bell-metal polisher (4d.). Keep the surfaces of your polisher true, hold your polisher lightly, and do not turn too fast. Add more oil at the finish.—A FELLOW-WORKMAN.

[45996].—Watches.—The rules apply to most modern watches. Of course Geneva levers beat faster than English; but you can shift the hair-spring, can't you? Of course you must leave a little hairspring for this purpose. To shift hairspring, insert point of pivot-drill in slot in collet, prise open the collet, and then you will be able to turn it either way.—A FELLOW-WORKMAN.

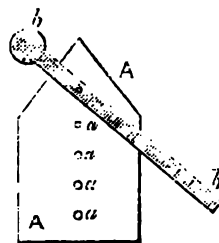
[46019].—Sausages.—I cannot inform you what the Cambridge sausages are made of. If you make them of all meat, they will keep for a twelve month with the following:—1lb. of salt, 2oz. of sage-leaves, 1oz. of knotted marjoram, 2oz. of fresh ground black pepper, 1lb. allspice; to those who like it, a 1oz. garlic, and six drops of creosote,—a level tablespoonful to a pound of meat; the herbs must be chopped very fine, and they must be well flayed and sweet. But for sale, it is usual to put from 2lb. to 4lb. of stale bread-crumbs to every 10lb. of meat, just dipped into water and worked up by the hand—not soaked, or it will be too wet. The least bread the longer they will keep. The ingredients should be dry and well mixed, and kept in a dry place until wanted, or the flavour will be spoiled.—JACK OF ALL TRADES.

[46024].—Cementing Silver to Marble.—I have frequently and successfully secured plates to marble clocks by first warming the marble by laying on it a hot flat-iron; melting on the cement while it was warm, and then applying the plate, also heated. The job must be done quickly.—ALFOJOK.

[46024].—Cementing Silver to Polished Marble.—Take the movement out of the case and send the case to a marble-mason to have two holes drilled through the case under the place where the plate should be placed; the holes must not be too far apart, or the plate will not cover them. Fill the holes in the case with fir-wood. Now take the block, which should be the exact size of the silver-plate and a perfect fit to the clock-mould, and with two ordinary screws secure the block to the plugs in the case. Now make four fine holes in the silver-plate; make four fine silver screws to fit the holes; countersink the holes; now screw the plate to the block, and replace the works in the case. If you carefully attend to the above your job will be perfect. Of course the holes must be in the corners of silver-plate; the fine screws may be about 1/4in. long, and the two large screws about 1in. long, or as may seem necessary.—W. M.

[46027].—Broken Watch-Chains.—I think "Neglected Apprentice" will find what he wants in ENGLISH MECHANIC, Vol. XV., p. 412.—K. L. E.

[46027].—Broken Watch-Chains.—I usually get the pin out by means of a very useful little tool (home made). Here is a rough sketch of same.



Take a piece of flat steel (A) (malleable preferred) 1-16in. thick, soften, and drill two or more holes, graduated (a' a' a') for different size chains; then, in a straight line with the holes you have drilled, drill a larger one, to hold rivet of the spring (B), which is made of a piece of thick clock-spring, hardened and tempered to blue, and holds the chain tight down on the steel plate while you push the rivet through one of the holes with a needle-point.—ARTHUR FROCHAM.

[46027].—Broken Watch-Chain.—Place the chain, with the oval side upwards, on a piece of boxwood, so that the rivet will run with the grain; then with a small punch drive out rivet. Use a very small hammer. The male end is got by opening the female end with a knife, and prising the leaves off. Now take a piece of fine piano-wire, file up a long pin, press it firmly into the chain, cut off close to the top and about 1/4in. from the bottom; now take hold of the bottom piece, which you have left on, with your nippers, taking hold close to the chain; hold the nippers in your left hand, give it a gentle squeeze so as to cut the wire part of the way through; now with your small hammer rivet the top end tightly. I think you will understand that the bottom or large end will also be riveted in consequence of the end resting on the face of the nippers. It will not require any further riveting. Take off the rough with a fine file and burnisher.—A FELLOW-WORKMAN.

[46034].—Amplifier.—I am sorry I made an error in my answer to above query. Please read biconcave instead of biconvex, and plano-concave instead of plano-convex. I might also have told you that the concave should be of flint-glass, and the convex of crown.—W. J. LANCASTER.

[46047].—Speculum Working.—I did not

notice "E. C. A.'s" inquiry till I saw "Prismatique's" answer, or I should have answered before. The true cause of "E. C. A.'s" failure to get two tools to fit perfectly is in the nature of the case, and cannot be obviated by any form of stroke or mode of grinding. He will find the real cause, and the only remedy I know, described in my last letter, page 569, third column, near the bottom. Can any one else give us a means by which the edges of two surfaces ground together can be kept on the general level, while they have only one-half the wear of the centre. Of course, I am supposing there is a yielding substance like emery and water between them. I have great hopes in "Prismatique's" polishing on paper (we are all deeply indebted to him for his kindness in so well describing it) as a means of getting the polisher to keep an exact fit to the glass surface, since the tripoli forms an unyielding face, and there is, therefore, contact all the time between the two surfaces rubbing together.—H. A. WASSILL.

[46066].—Furnace.—If you want your cupola to cast small jobs, for a cast of 5 cwt., the following sizes will suit your purpose: 12in. diam., 6ft. long, with bottom on a hinge to drop down when your cast is over. You can then reach up from below, to clay up any holes that may burn in it; the holes for the blast 12in. from bottom fire-bricks are best. If you want to cast a job 5 cwt., you will require to make your furnace larger than the above sizes, as the metal would not keep hot in a ladle until you had enough melted.—CAST IRON.

[46067].—Lifting Press.—It depends on the length of stroke of 1 1/2in. rams.—W. E. K.

[46070].—Air-Gas from Gasoline.—The best thing you can do is to either buy or make a generator after Mr. Fletcher's plan, which was fully described in this paper some time ago. I cannot refer you to the number, as mine are at the binder's. What you want is a good body of liquid and plenty of surface, such as cotton-wick, so that the spirit can climb up and be easily vaporized. I see Mr. J. Kendall, in reply 45884, page 549, recommends a querset to fit up a hydrogen apparatus in conjunction with a benzoline carburetter. I venture to say that if the querset does this it will be just equal to throwing his money into the street. It cannot be too well known that an illuminating flame cannot be produced from benzoline-gas in any way whatever. I have proved this beyond dispute, during an interval of over 12 years, having had good opportunity, seeing that we use more than most private houses do. A very good heating-flame can be produced by the apparatus I have mentioned, or any other on similar principles. If you want an illuminating flame you must use gasoline, and unless you are in a particularly favoured locality, you will find more difficulty in procuring this than you imagine. Small shopkeepers will have nothing to do with it, and railway companies will not convey less than a ton, and then only at very high rates. Mr. Kendall is also wrong in saying that air-gas is any more explosive, when properly made, than the gas he recommends. Mr. W. Burns, reply 45884, page 528, might well not take out a patent for his plan. In a country place, where would he get the ice, such a winter as this, for his refrigerator? When speaking of an illuminating flame, of course I mean one that is of any practical use. If the benzoline is heated, you can, for a short time, get a little better result; but then, as soon as ever the gas leaves the generator, it begins to condense in the pipes, and if your pipes do not happen to all fall towards the generator, you are in constant fear of the place being on fire, owing to a rush of benzoline coming, when least expected, out of the burner. No; it can't be done; you must have gasoline of 650 specific gravity.—J. HEMMAL-HALCH, junior, Fellscliffe, *near* Leeds.

[46071].—Mechanical Question.—Is an impossibility with toothed gearing. Suppose you make wheels D and G the same, then, according to the question, E and F must be same size also; consequently they (E and F) will act just as a common intermediate or stud-wheel, and shaft C have same motion as shaft A. And if wheels D and F be made same, note the result. They are both drivers, E and G drivers, and the square of number of teeth in driver must equal twice square of driven to make shaft C revolve twice for once of shaft A. Now, this cannot be; as the double or half of no square number is a complete square.—SCOTCH WORKING MECHANIC.

[46076].—Governors.—I must decidedly enter my protest against the statement made by "J. J. A." in his last paragraph. I may say that if the disc-valve, such as he puts his faith in, was the only form of any valve, how is it that the equilibrium-valve of the piston, or coupled form, is so much used? One finds but comparatively few engines nowadays fitted with a flat disc-valve, which have been made during the last ten years or so. Does not "J. J. A." see that his favourite valve when closed has almost the full pressure of steam on its spindle when it is closed, whilst the

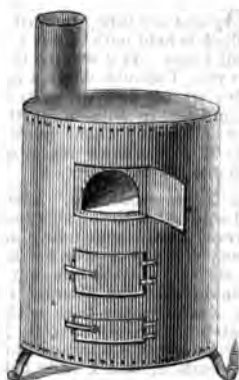
modern valves are in equilibrium whether closed or open? And then, again, my definition of a perfect valve is one that, if the strap runs off, or the gears break, automatically shuts off nearly all the steam. With the disc form, this is not the case, and hence disastrous breakdowns not unfrequently follow the breaking of the governor-strap or gears.—SUN-LIGHT.

[46081].—**Engine Diagrams.**—Thanks to "L. O. Vincit." I advertise my address this week, and if he will kindly forward me his address, I will send the particulars he requires, as they would occupy space, and be of little interest to any but myself.—ALPHA.

[46082].—**Driving Smith's Fan.**—If "Hot Iron" only wants a fan to blow a smith's fire, he need not go to the trouble of erecting an engine. I have a fan for same purpose which gives a splendid blast, and a child could drive it. It consists of a frame of light iron about 24ft. long, bolted to a piece of plank, so that it is quite portable, and can be placed anywhere. The fan is 6in. in diameter, with intermediate speed between hand-wheel and fan. (If I am right in my calculations, it goes at an average speed of 3,000 revolutions per minute.) If "Hot Iron" likes, I will give him dimensions and all particulars as to form of fan case, wings, &c. A former one I had, 24in., driven by 4ft. wheel with handle bellows fashion, same as "Hot Iron" has, was, as he says, heavy to drive, and did not give anything so good a blast as present one.—J. PERRY.

[46085].—**Coco.**—According to Maunder, this is the root of the "Colocasia Antiquorum," which grows in tropical countries. Both the leaves and roots are eaten.—W. E. K.

[46089].—**Muffle Furnaces.**—These are now sold at such very low prices—from £1 upwards—that it is hardly worth while making one's own. It is not stated if the fuel to be used is charcoal, coke, or gas. I presume it is one of the two former. As, possibly, the querist may prefer to make his own furnace, I send a sketch of a simple one. It is made



of sheet-iron riveted together, and lined with fire-clay. There are three openings—the muffle, fire-door, and ash-pit—each of which are furnished with doors. The flat top is useful for drying cups, &c. Not knowing the size muffle, I have sent no dimensions; the sketch is, however, about proportionate. If gas is at hand, better procure Fletcher or Griffin's catalogues, and select a gas-furnace to suit your requirements. A gas-furnace is much cleaner and handier to work with than one which uses solid fuel.—ARTHUR E. MORRIS.

[46091].—**Mechanics.**—Why not the law that "every action has an equal and opposite reaction"? It is on account of the recoil against friction, as it were.—W. E. K.

[46096].—**Iceland Spar.**—This mineral may be ground and polished in the same manner as marble. However, if "E. H." will advertise in the Address Column, I will give him all the information I can. To describe the process of marble-polishing properly would require more room than the editor could well spare.—H. H.

[46097].—**Photography.**—The single condenser would be but of little use for enlarging, except with a heliostat. A pair of 5in. condensers in a lantern with an achromatic front and a Silber lamp will enlarge from a quarter-plate negative splendidly. The body of the lantern should be 12in. high, 6in. broad, and 10in. from back to front. This will give plenty of room for adjusting the position of lamp. I shall be pleased to give you any further information on enlarging you may require.—W. J. LANCASTER.

[46099].—**Bronzing Brass.**—The chloride of platinum bronze is one of the best you can have to give a steel-grey surface on brass. The brass must be well cleaned before being bronzed; and I find the best way to bronze, to get a good colour, is to

have the bronzing-solution warm, then have another vessel with hot-water in, so that the bronzed articles may be dipped into it, and then, when taken out, will dry without stains.—W. J. LANCASTER.

[46100].—**Lever Escapement.**—The pallet-stones of lever watches are secured by means of shellac. To alter them take a pair of old tweezers and warm them in the gas, take hold of the pallets nearest the one you want to correct, having previously prepared a rigid pointed peg, you can move the stone to desired position.—CHRONOMETER BALANCE.

[46103].—**Hard Steel.**—I do not see any reason for hardening mould-bottoms, if you can make a good job of turning them after annealing. I certainly should not attempt to reharden, for this reason, if they do not crack, they will buckle, and be in a worse condition than at first; but if they must be so hard, you must make your tools harder. I remember, when a boy, many years ago, having to plane a printing-press table that had been drilled. Nothing would cut it; two strokes of the machine would spoil the best tool, hardened as hard as it would go. An old fitter, on passing my machine, asked me what was wrong; and on my telling him, he said, "Harden in lead, and try that." Now, if you make a dumpy tool, leaving just enough clearance at the heel, and no more; take a little pains in filing up. Now take a pig of lead, and drive tool with hammer into the lead about 1in., leaving thus the impression of tool in lead. Now heat tool to cherry red, and place in lead again; keep a little water sprinkled on lead, and after a few seconds, plunge the whole lot into cold water. Above all, do not withdraw the tool till quite cold. Drive your lathe slowly, and use plenty of soap-water, and I am sure you will succeed. At all events, I planed the table.—ON GUARD.

[46107].—**Indigestion, &c.**—"T. P." has one great truth to learn, that is, that the complaint which some medical men term "biliousness," arises from distress of the nerves, and it shows itself in various ways in different patients: some have simple headache, and others all degrees of sickness up to severe vomiting. When the vomiting is sufficiently severe, bile is ejected, and this has led to the misnomer. To show the fallacy of thinking that excess of bile is the cause of this, it will be found that a severe blow upon the head will produce the same effect. "T. P." avoids malt liquors, which are injurious to him; but he takes whisky, which is ten times more injurious to his weak nerves. And this is the cause of the complaint (which is misnamed) biliousness; the tobacco five times a day has also a mischievous effect upon the brain of a weakly man; he will find that tea and coffee are all of the same character. The foods which he takes are not improper for him if well masticated; the dandelion which he takes is quite useless and inert. If he takes baked apples instead, the costiveness will disappear. Soda-water has no effect.—H. BARNABY.

[46109].—**Oil for Lathe.**—If "Cloture" has been using paraffin, that is the cause of clogging. Lately, I added a few drops to the lubricant I use (sperm) for my lathe; after a few rapid turns of the mandrel, the cone appeared to jam into the collar. I repeated the process, always with similar results; after getting rid of the paraffin the mandrel ran well, and has since continued to do so. This apparent jamming after lubrication with paraffin struck me so that I was about to write to "Ours" for an explanation. I hope some of our contributors will notice this point. While on the subject, I may mention that after practically testing various advertised machine-oils, and divers home-made combinations of those oils most usually used, with more or less unsatisfactory results, I have, after repeated trials, come to the conclusion that sperm-oil is the best for light machines. True, the price is heavy; on the other hand, it never clogs unless left to dry for months. As to paraffin, besides its virtues as a solvent and cleansing agent, I find it expedites setting tools on the house, causing the steel to bite the stone more freely than when other oils are used.—A. T. F.

[46113].—**Secondary Battery.**—It is not possible to reach the E.M.F. of the charging battery. That would be like trying to make a pound weight pull a pound up by a single pulley, a result which would give us perpetual motion, the meaning of which is in fact the attempt to do work without expending energy. To charge with only a small excess of E.M.F. would be possible, but would take a long while with its attendant loss by leakage. Nor is it possible to get a greater quantity. A larger current is of course easily obtained, but that is maintained a shorter time. Study the principles of current, and all this is easy.—SIGMA.

[46117].—**Daniell's Battery.**—It wants time for the water to take up salts and become conducting. If you wish to hasten the action add a little acid or sulphate of zinc. But there may be

defective conductivity owing to dirt upon connecting wires.—SIGMA.

[46117].—**Daniell's Battery.**—You seem to have the battery built wrongly. Let me know whether you have copper or zinc in the porous cell. Now the simplest and most efficient method of making Daniell's is to have a rod of zinc in the porous cell, and to have the outer cell made of copper. You can, if you like, have stone outer cells, and then use cylinders of copper. You, of course, know how to charge the cells. In the porous cell containing zinc, put sulphuric acid one part, water twelve parts; and in the outer cell a saturated solution of sulphate of copper. Let me know exactly how your battery is put together, then I will tell you what is wrong.—W. J. LANCASTER.

[46119].—**Oil-Painting—Preparing Canvas.**—After the canvas is properly stretched on a frame or panel, give it a coating of hot size, or weak glue, with a stiff varnishing brush. When this is perfectly dry, apply another coat. Four hours afterwards lay on a coat of flake-white, using turpentine as the medium. This will give an excellent body, which will not crack.—J. R. Y.

[46121].—**Clarinet Tuning.**—On page 279 of our present volume a correspondent asks if a monochord is a suitable standard to tune wind-instruments to. The monochord is admirably adapted to illustrate the laws which govern the production of sounds in vibrating strings. For experiment, make a hollow box 3ft. long and 4in. wide, with a projecting piece of wood at each end. String a wire 30in. long over this by means of a pin and pianoforte peg; tune this wire to the first bass C; insert a movable bridge underneath the wire, and by it reduce the length of wire to one half. This will then produce its octave above. If the wire is now reduced to two-thirds of its original length by the aid of the movable bridge, it will produce the interval of a perfect fifth; if the wire, by the same means, is reduced to three-fourths of its original length, it will produce the interval of a perfect fourth; likewise, if the wire is reduced to four-fifths of its original length, it will produce a perfect third. The querist asks what is meant by the laying of the bearings of an organ? This consists of the tuning of certain intervals a slight degree flatter or sharper than pure. This is also called tempering, and in it consists the art of tuning. The Principal is the stop selected in the organ for this purpose. There are two methods of tuning, called the unequal and equal temperament. The latter method is the one usually adopted.—G. FRYER, SWANSEA.

[46122].—**Hydraulic Ram or Water-wheel.**—Fall 6ft., lift 40ft., supply 30 gallons per minute; delivery required, 55 gallons per 24 hours. For the above purpose, Mr. E. Harley can obtain from stock a lin. ram and fall-pipe, but exclusive of delivery-pipe, for £4 10s., or 1½in. for £6. A water-wheel, as described, would cost from ten to twenty times as much, and would have to be made. Smaller ones are to be had from stock of standard patterns. ½in. delivery-pipe is used with the lin. ram, and ½in. with the 1½in. The water lifted would be a part of that working the ram.—CHARLES L. HETT.

[46130].—**Spectroscope Construction.**—You can make bisulphide of carbon prism out of very thick glass bottles, stoppered ones, about 2½in. diameter, and about ½in. thick. Cut away the sides at an angle of 45°, then well smooth the sides, and cement two plates on the two sides. It will take you some time to work the sides off; but the success of the spectroscope depends upon the good shape of the prism. Having done this you can make up the collimator and telescope. It is essential that you should use a slit, and an adjustable one is preferable. You can make an adjustable one by means of a spring and screw, the spring to be so arranged as to push the plate towards the screw, then it will be much better working with it. An adjustable slit is very valuable, and really is not such a difficulty as it seems to be at first. You can have a couple of lenses, 10in. focus, one for collimator and the other for telescope; then, for the telescope, make an eyepiece out of two 2in. planes, mounted 1½in. apart, convex surface towards each other; the tubes can be 1in. diameter. You must have a telescope, otherwise the lines would be so crowded that you could not see them. One of the pocket achromatic telescopes, costing 7s. 6d., would answer every purpose, and would save a lot of trouble. I shall be pleased to tell you how to proceed if you intend constructing a spectroscope.—W. J. LANCASTER.

[46133].—**Stencil-Plates.**—First as to metal, choose either brass or zinc. The gauge is best determined by the size of the work in hand. Helpcock, of Compton-street, Soho, keeps what he calls stencil-brass of one or two gauges. Having fastened your brass or zinc on a piece of plate-glass, or other flat surface, such as a marble slab, proceed to get a decent surface with finest emery-dish. Lightly grease the metal, and draw with soft

lead-pencil, and improving it with a steel point (etching), and rule the top and bottom lines and uprights to guide you. You next get a graver (to be had also at Hedgcock's), sharpen it on its face (which will be already ground), and also on its two under sides, so as to raise its cutting-point out of the line of the tool, or you will not be able to turn it round for the handle. Take the graver, and grasp it firmly in the hand, and cut your pointed lines faintly at first, and deepen them until they are cut nearly through, working it on a piece of hard wood. You will be able, after two or three strong cuts, to see the impression of your cut on reverse side; you can then expedite matters by cutting along the impressed line at back very little, and return to the front again, and cut until you take the letter entirely out. Care must be taken not to force the metal, or it will double up, especially when it approaches completion. Stencil cutting is not very difficult when once you have acquired the knack; but don't give in at two or three failures, or a dozen. It is rather tedious work.—SCRATCHER.

[46133].—**Stencil-Plates.**—The best material to use for stencils is double elephant drawing-paper, which can be had at any ordinary stationers' shop. Now, the way stencils are done is simply this:—First you design your pattern: if it is a symmetrical pattern, you need only design half of it, then fold the paper for the other half. Having got your design, place the paper on a piece of glass and cut the pattern out with a very sharp penknife. Of course you must be very careful to leave your ties in, or you will not be able to work with them. When you have finished cutting your stencil, give it a coating of knotting, or, better still, a coating of oil varnish, as this will materially prevent the paint from adhering to the paper, and thus reduce the difficulty in working. Sometimes stencils are made from laminated lead, but, I believe, generally the material recommended above is accepted as the best. Should our querist attempt to use lead stencils, he will find it much better to cut the lead with a strong needle-point, as this gives a sharpness to them which cannot be obtained with the knife. If the pattern is to be worked in distemper, experience will prove that stencils will often break, just at the ties. The simplest way to repair them is to put a little knotting on a slip of fine linen, and then place it over the bottom part and allow it to dry hard. This difficulty is very much avoided in working with oil-colour.—A. MANOCK.

[46134].—**Fusing Copper.**—If your coins are copper, and not bronze ones, it is possible to melt them in an ordinary fireplace. All the stove and chimney must be entirely closed in, only admitting the air through the bottom of the grate, so as to procure a good draught. Use a London-made clay crucible with cover. Proper moulders' sand would be best for casting in.—ARTHUR E. MORRIS.

[46137].—**Silvering Glass.**—P. Donald should try once more and support the glass at the top of solution instead of the bottom. Most of the silver invariably rises, and I have been told, or read somewhere, that the reason is because it is not pure silver, but mixed with potash, and the best plan to get rid of it is to wash the silver film with alcohol instead of water, after taking out of the silvering bath. I have not silvered anything larger than a flat for Newtonian telescope, and know nothing about the difficulties with large surfaces, but should think if dirty glass and air bubbles were guarded against it would be all right. I should advise anyone silvering flats or mirrors to try the alcohol bath after silvering. It seems to alter the film, so that damp has not such a bad effect on it.—E. F. C.

[46138].—**Storage Battery.**—The difficulty is inevitable: it occurs in all forms to some extent, as it will be found that the entering current steadily diminishes as the charge grows. Of course it is greater where a metal is to be removed from the solution than where the constituents of the ever-present water are separated at the two surfaces. As it is only at the surfaces that actual decomposition occurs, it is evident that as the solution gets weaker in metal, the action must be diminished, owing to the necessity for more metal to arrive at the surfaces by the process of diffusion. In pretty nearly all things there are such difficulties and variations, and the only thing to be done is to make the best of them.—SIGMA.

[46138].—**Storage Battery.**—The case of the Sutton battery, mentioned by "E. F. C.," is very interesting, since it is exactly the reverse of what takes place in a "Faure." In this latter the resistance diminishes on charging, and increases on discharging. Perhaps, however, the resistance does not increase so much as the electromotive force; I do not happen to know exactly what the E.M.F. of a Sutton cell is; but I should certainly say that two Bunsens at least would be required to charge it with any speed under any conditions. Of course, when the charging commences the E.M.F. is very small. I doubt whether the change is so great as to make any difficulties in charging with a dynamo; but a rearrangement from series to

parallel is very easily made if there be any such difficulty.—LL.B.A.

[46139].—**To Mr. Wetherfield.**—In this case the county-court judge seems to have decided that A. had completed his contract by delivery of the goods to a bonded carman. He must, I think, have been led to this result by some facts which are not set out in the question. What were the exact terms of the intended contract? Where was delivery to be given?—at the docks, or at B.'s warehouse? and what has the bonded carman to do with the matter? All these points crop up for consideration, and I cannot settle them without further facts; nor can I review the decision of the county-court judge unless I know all that came before him. But, as to the other part of the question, whether "on" delivery means "before" deliver; that is a point of law as to the construction of contracts, which is, to some extent, independent of the facts. It must be remembered that every vendor has a lien upon his goods until the price is paid. When, therefore, it has been agreed that payment shall be made "on" delivery, the Courts have generally held this to mean "before" delivery; though here, as elsewhere, much might depend upon what the goods were. "On delivery" may be taken as implying that the payment and delivery shall be simultaneous. This is, however, not possible, for one side must begin, and, as I have stated, this is usually held to be the purchaser, who has to pay or tender the price agreed before he can compel delivery.—FRED. WETHERFIELD, 2, Gresham-buildings, Guildhall, E.C.

[46141].—**Tubes to Hold Mercury.**—An iron tube is the only metal I could advise you to use as being unacted on practically by mercury. Brass, with soldered joints, will not do at all. I do not think any solder would be of any good.—SUNLIGHT.

[46141].—**Tubes to Hold Mercury.**—Brass tubes will not do, as the mercury would act on it, forming amalgams with the copper and zinc. Mercury also forms amalgams with lead, tin, and iron; so these metals would not do. You do not say why you want to put mercury in metal tubes; would not glass ones do?—F. BARKER COOKE.

[46141].—**Tubes to Hold Mercury.**—Tubes soft-soldered will not do to hold mercury; the mercury forms an amalgam with the solder, and the bottom will fall out. You can, however, use strong tube; then turn a seat in one end, to hold a plate of brass, to be rolled in. See that the bottom is watertight; then it will be quite safe to hold the mercury in.—W. J. LANCASTER.

[46141].—**Tubes to Hold Mercury.**—Brass will not answer at all, nor solder; brass absorbs the mercury and becomes rotten. Copper tubes (drawn, not brazed) will answer, or iron tubing; they can be amalgamated by using nitrate of mercury. I use iron gas tubing turned clean, and close the end with a thick copper plate tightly turned in.—SIGMA.

[46141].—**Tubes to Hold Mercury.**—A brass tube will hold mercury for a certain length of time, said time depending greatly on the thickness of the tube, but if it is soldered with ordinary tinmith's solder it will only hold the mercury a few hours at most, when the bottom will probably drop out. Iron of any kind will be the metal to use for this purpose. If they are short the tubes can be drilled out. I should prefer malleable iron castings for this purpose, as the metal is more easy to work than ordinary cast-iron. If the tubes are long, iron pipes may be used, the bottoms being turned up and screwed in; the screwed piece would be better with a shoulder which would fit the end of the pipe. A leather washer could be used, or the screw could be luted with putty made a little thinner with more linseed oil. This would be better than red lead, as less likely to affect the mercury.—OS.

[46142].—**Heat for Horticultural Purposes from Waterfall.**—Air can be compressed sufficiently to ignite paper at the bottom of a cylinder, if the piston is violently forced down. Moral. There you are.—J. J. A., Liverpool.

[46143].—**Fusing Copper.**—The fusing-point of copper is 1996° Fahr., so you will require either a blowpipe or furnace.—F. BARKER COOKE.

[46143].—**Fusing Copper.**—The melting-point of copper is stated to be 1996° Fahr. You cannot melt copper in an ordinary open fire, but might do so in a closed kitchener. If you have a small open grate which you could close in above the level of the bottom bars with a sheet of tin or iron, so as to force the air right through the fire, you could, if the chimney draught is any good, be able to melt copper. For moulds, use moulder's sand. If you had a number of articles all of the same kind to make them you might use a plaster mould.—SUNLIGHT.

[46143].—**Fusing Copper.**—Copper melts at a good, white heat. It is not so easy to melt as brass, and you cannot cast pure copper. If you add 1oz. or 2oz. tin to every pound of copper, or else

4oz. of brass, you can make good castings. You will require a crucible to melt in, and a pair of tongs to take it out of the fire. A common kitchen grate will do if you turn back the oven door and put up a newspaper to make a good draught. Use coke or charcoal if possible, or else large cinders. Plaster of Paris alone will not do for moulds; you had best use clay and sand mixed. Dry your mould, smoke it with a candle, and heat nearly red hot before you pour in the metal.—J. SUTCLIFFE.

[46143].—**Fusing Copper.**—I have no doubt that you could melt copper in a (modified) open fire without crucible or blowpipe, and I have even less doubt that the copper would, when melted, run down among the ashes. You will require a crucible, and you should get a piece of sheet-iron to fit in the front of your fireplace above the bars, and if you have a good draught in your chimney you may melt almost anything. Plaster of Paris is a most unsatisfactory medium for casting anything in. I once tried to make a zinc casting in plaster, and failed, although the plaster was well-baked. It is impossible to remove all the water from the plaster without leaving it in a far worse condition than any sand could be in. Make a casting-box in two or three pieces, as you may require: wood will do for your purpose. Stamp the sand hard, and dry the mould before pouring; but judging from the tenor of your query, I should say, Leave it alone. You will probably get your casting made for a shilling if you take the pattern, and if you make it, it will perhaps cost five before it is done. I never like to throw cold water on the attempts of amateurs or others; but it is certainly better for them to dabble in something which they can manage more easily, and by which they may save instead of losing money.—OS.

[46144].—**Drilling.**—If you want a truly circular and straight hole, the work must revolve and the tool remain stationary. When the job is not to be a 1, your lathe should be provided with a small face-plate, with a turned shank to take the place of the "centre" in the shifting headstock. Then you can hold the work flat against this, and so be it.—J. J. A., Liverpool.

[46144].—**Drilling.**—I use a little chuck to fit on the sliding headstock-tube, against which the article to be drilled is held with either a hand-vice or a pair of small tongs. If I wanted to drill, say, a piece of brass rod, I should chuck it in the lathe and let it revolve whilst the drill in its chuck was held stationary and fed up with the shifting head. If of larger size or length, then chuck it with a drilling-plate so that the work revolves and the drill is held stationary.—SUNLIGHT.

[46145].—**2in. Telescope.**—To "ALDEBARAN."—B. Eason will notice that the most of his questions have been answered in the concluding article. If he has not already bought a cell for his object-glass, I should strongly advise him not to do so, for I am of opinion that the attempt to adapt a screwed cell to a home-made tube is the rock on which most amateurs are likely to split. The fewer screwing parts there are to a telescope the better is likely to be its definition, and I quite believe that many a good object-glass has been condemned as worthless when the fault was in a great measure due to a badly-cut screw-thread. Makers of high-class work practically endorse this theory by putting regulating-screws at each end of the body tube of their larger telescopes, so that possible errors of this kind may be compensated for and the lenses adjusted to one axis. The best advice I can give to amateurs who, like myself, are desirous of filling up their leisure time by optical work of any description, is never to miss a chance of picking up pieces of brass tubing (either rolled or mandril-drawn) that happen to fit closely one within the other, for the possession of such a series of sizes will often render them independent of skilled labour and enable them to put together a new eyepiece or to adapt one of the smaller eyepieces (such as are sold for combination telescopes at a very cheap rate) to their own tube, and, in fact, are likely to become useful in a hundred different ways if they are only ready to hand at the time they are wanted. One of the uses, for example, of such a pair would be to make a very simple and efficient carrier for the eyetube by fixing a disc of sheet brass at each end of about 4in. of the outside tube (so that it would resemble an exaggerated cotton reel) and trimming the edges of the discs in a lathe until they accurately fitted the inside of the body tube of the telescope.—ALDEBARAN.

[46146].—**Caustic Potash.**—Treat stains with spirits of salts (HCl) diluted with water, wash off with water, allow to dry, sandpaper, and then polish as usual.—J. M. STOCK.

[46146].—**Caustic Potash.**—I am afraid that "W. F. M." will find his canoe indelibly stained. He might try scraping with scraper or fine sandpaper; perhaps it may only be superficial. The stains are sure to show through the polish, without all the wood is darkened.—ARTHUR E. MORRIS.

[46146].—**Caustic Potash.**—I do not think you will be able to take out the stains. Perhaps your

mahogany might look better if it were all a darker colour. I should think the stains would show through the polish. Could you plane it off a little?—OS.

[46146].—**Caustic Potash.**—You may remove a great deal of the stain by sponging it with a dilute solution of sulphuric acid. Use a solution, say, one of acid to twenty of water, and when sufficiently removed, sponge with warm water. It is a very difficult thing to remove the stain caused by caustic potash; but by carefully following above instructions, you will nearly eradicate the stain.—W. J. LANCASTER.

[46147].—**Boiler Power.**—You say a "saddle boiler." Kindly explain more fully. If it is a boiler such as is used for greenhouse purposes, then that is quite sufficient to tell me it is of the wrong kind altogether. Let me have full particulars and I will tell you what is amiss. I may add a plain cylindrical boiler, 6ft. 6in. long, and 1ft. 6in. diam., with a grate of proper area, and draught, should keep steam for an engine with a 4in. bore and 7 1/2 in. stroke cylinder.—SUNLIGHT.

[46149].—**Oil for Lathe.**—Let "Cloture" try Galipoli, a commoner quality of olive-oil.—REX.

[46149].—**Oil for Lathe.**—I use ordinary colza oil, at about sixpence a pint, for my lathes, and I don't find any drying or other inconvenience. I used to use olive, but I find the colza quite as good. If I were you I would try a mineral oil.—OS.

[46149].—**Oil for Lathe.**—I have been using Rangoon oil for my lathe, and find it keeps it free from rust and quite clean, but it seems to evaporate quickly. Perhaps Mr. Evans would tell me whether it is ever used for that purpose.—W. E. K.

[46149].—**Oil for Lathe.**—I have always used sewing-machine oil for my lathe. It is rather expensive compared with what "Cloture" uses, but such a small quantity is sufficient that it is worth the extra cost. I have been told that there is a variety of vaseline made expressly for bicycles, lathes, and other light running machines, and intend trying it. I believe it can be got at any chemist's.—E. F. C.

[46149].—**Oil for Lathe.**—Use for all small machinery "unrefined sperm oil"; this will never clog, nor injure the tool in any way. 'Tis no wonder that your lathe runs heavy, when you use a vegetable oil. Wash it well out with the paraffin alone, and then do as I say. But for heavy machinery the sperm would be too thin, and there is an American article resembling butter, which gives remarkably good results.—J. J. A., Liverpool.

[46151].—**Hot-Air Engine.**—You would be decidedly infringing Bailey's patent by making an engine of that kind for your own use. You must take out a license if you want to make one. And I doubt if you would find they would grant you one, or, if so, it would pay you to do so, for the sake of making one engine only. I do not say, Don't apply to them—as they might allow you to make one. Should they do so, and if you are still desirous of making, I would, on reasonable terms, allow you to make one of my hot-air motors. By reasonable terms, I mean, to give an undertaking that but one engine would be made, and that not for sale, but for your own use solely, and the usual agreement in such matters.—SUNLIGHT.

[46152].—**Clock Repair.**—I see no difficulty in this job. Soak the old teeth with paraffin-oil, warm and pluck them out with a pair of "good steel pliers" (none of your eightpenny ironmonger's affairs, please). Next procure a rod of steel wire, a shade larger than the holes are, point the ends, cut off two teeth, and file; if any burr, slightly taper at the end; drill up a hole in the end of a piece of iron, give it a few knocks with a centre punch, to make it taper like the point of the teeth are, and gently drive them all home with this, and it ought to be quite a masterpiece.—J. J. A., Liverpool.

[46153].—**Induction Coil.**—To Mr. LANCASTER.—Out of the 16-gauge wire wind three layers of primary on to tube containing core. Begin at one end, leaving sufficient on the outside of coil to connect up; then wind carefully along to the other end, winding each layer as close as possible to the next one. Then, having reached opposite end, put a layer of paraffin-paper, and go on winding back again. Two layers will work very well; but as you have plenty of No. 16 wire, you may wind on a third layer. Then, to insulate primary from secondary, an ebonite tube is the best thing; but you can make a good insulator out of very thin ebonite, warmed and bent round a warm brass tube, same diameter as primary; then the ebonite can be put on to primary, and tied down tightly on to primary. At the two ends of this tube you should paste several pieces of paraffined paper, beginning with strips about 1 1/2 in. wide, gradually diminishing to 1/2 in.; then wind on secondary, each layer being carefully insulated from succeeding layer. I shall go thoroughly into all the details in

my articles on the induction-coil, and shall be pleased to give you hints as I go along. Sheet indiarubber is not so good as ebonite. You ought to be able to get it thin, and it is easily bent into shape. You will gain nothing by increasing number of coils of primary; in fact, you will really lose by taking secondary so much farther away from core. Two layers I like best; but three will not hurt.—W. J. LANCASTER.

[46154].—**Potash Carbonate.**—This is now largely manufactured from potassic sulphate by Leblanc's process.—F. BARKER COOKE.

[46154].—**Potash Carbonate.**—It can be prepared similar to sodic carbonate by Leblanc's process, but it has been found not to be so generally successful. At Kalk, on the Rhine, a process said to be based on Leblanc's is in operation, but the operations are kept secret, no one being allowed to visit the works.—ARTHUR E. MORRIS.

[46154].—**Potash Carbonate.**—If "Pearlash" will fuse about four parts of potassium sulphate, K_2SO_4 , with three parts of ammoniac carbonate, Am_2CO_3 , on a piece of platinum foil, they will give off white fumes. After the fumes have stopped, the residue left is potassium carbonate, K_2CO_3 . The sulphuric acid combines with the ammonia and forms ammoniac sulphate, Am_2SO_4 , which goes off in the fumes. The potash combines with the carbonate, forming potassium carbonate, K_2CO_3 . $K_2SO_4 + Am_2CO_3 = K_2CO_3 + Am_2SO_4$. It can also be prepared in the same manner with calcium carbonate, $CaCO_3$; but if it is prepared in this manner it has to be fused with the blowpipe for a good time. $K_2SO_4 + CaCO_3 = K_2CO_3 + CaSO_4$.—W. DUFF, Analytical Chemist.

[46155].—**Dowson's Water-Gas.**—A general description of this system has already appeared at p. 49 ante; but Mr. Cobley will find further particulars in the *Journal of the Society of Arts* for Feb. 24, and in the specification of the patent No. 2859, of 1881, price 6d., which can be had for 6d. of Mr. H. R. Lack, Patent-office, Southampton-buildings, London.—S. R.

[46155].—**Dowson's Water-Gas.**—The principle is, decomposing water by heat into its constituent gases. Many inventors have endeavoured to make this gas cheaply and effectively by passing steam through red-hot iron retorts; but owing to their rapid destruction, this was abandoned. Next, steam was decomposed by white-hot fires; the heat was found to be abstracted so rapidly that it necessitated shutting off steam, every few minutes, to get up the fire. This made the working not continuous, and caused the quality of the gas to vary. Mr. Dowson's method is to pass a mixture of superheated steam and air through the furnace; this keeps up the high temperature, while the continuous supply of steam is decomposed. The method is said to be extremely cheap, 12lb. of anthracite coal being sufficient to make 1,000ft. of the gas. The offices of the company are, I believe, in Great Queen-street, Westminster.—ARTHUR E. MORRIS.

[46156].—**Pendulum-Spring.**—I should say by your query that your spring is not equal in the round. If your spring is too large, put a lesser one in, and you will find it all right. If not suitable, write again.—NICHOLS.

[46156].—**Pendulum Spring.**—"Pivoter" should take out the balance, with pendulum spring attached, and open the outside coils just a little with his hairspring tweezers. It may be that the spring is too large in diameter, in that case it would be better to put on a new one of the proper size, if he wishes the watch to keep good time.—C. R. B.

[46157].—**Secondary Batteries.**—With apologies to Mr. Lancaster, to whom this query is addressed, I may give "A. S. R." the following figures from experiment. An 8-candle Edison lamp has a resistance of 117 ohms cold, and about 60 ohms when normally hot. About 1 ampere of current is required to develop the 8 candles light, thus a difference of potentials of about 60 volts must be maintained between the terminals of the lamp. This required 36 Groves' cells in series. These are equal to, say, 25 Faure's cells in series. If the lamp referred to has a platinum wire, these figures do not apply, the resistance being much less.—LL.B.A.

[46157].—**Secondary Batteries.**—To Mr. LANCASTER.—I am sorry I cannot give you any reliable information about secondary batteries. Of course one likes to believe all that is printed, but when results are unsatisfactory, I, for one, shall never lead others astray. I have, I was going to say, lost a lot of time in experimenting with secondary batteries, but perhaps it is not lost time. I have as yet met with nothing but disappointment. Perhaps I expected too much. Well, I expected to find results that others have said they have obtained, and when I do not obtain one-half as much, I am naturally disappointed, and do not wish to disappoint anyone else. The moment I can get what I consider satisfactory

results, I will communicate them to "ours" for the benefit of many who are, and have been, waiting for some reliable information on the subject.—W. J. LANCASTER.

[46161].—**Pumping to Pressure.**—Theoretically, 38lb. to the sq. in. should supply the houses; but owing to the small diameter and length of main, the pres. is increased by friction.—LABOR OMNIA VINCIT.

[46161].—**Pumping to Pressure.**—You can easily calculate the relative pressure by first taking the height of the reservoir above the engine-house, then multiplying 12-276lb. by the height, and the product is the pressure or weight of the column of water. Except at very slow speed you would find this less than the 25lb. shown on your gauge. As you do not state where the 3in. main branches off, I cannot help you beyond saying that the total height of the house above the engine-house in feet multiplied by 3 069 would give the pressure due to the head of water. But the length of pipe and the friction of it would cause the gauge to show more pressure than would be due to the height of the column of water.—SUNLIGHT.

[46162].—**Nascent Oxygen.**—If you heat a mixture of chlorate of potash and sulphuric acid, you may certainly look out for an explosion, as you will probably get more chloric peroxide (instead of oxygen) than you will care for.—J. M. STORM.

[46163].—**Coin or Token.**—It is probable that your coin is a token for 10d. I have seen them for 10d. and 1s. 6d., from which I should infer that silver tokens were not made of the same value as current coin. Yours, being in bad preservation, is only of intrinsic value.—OS.

[46164].—**Painting Hoop-Iron.**—Mix the orange-lead with oak varnish. Let the iron be warm, if possible, when you put it on.—OS.

[46164].—**Painting Hoop-Iron.**—If "A Fellow-Workman" will get the powder colour and mix up with the following, he will have a colour which will be dry in five minutes. Take one-third of shellac and dissolve in two-thirds of methylated spirits, add the colour to this and keep well mixed up while using.—PATTERN-MAKER.

[46165].—**Double Dry Slide.**—To Mr. LANCASTER.—It is impossible for me to give the sizes of the various parts of double-dry slides to suit your camera, without first knowing the size of your camera. The outside dimensions of the slide I make with Le Merveilleux are 5 1/2 in. by 4 in. by 1/2 in. Now the chances are against your camera being this size, most likely it would require a much larger slide. Let me know the size, and I will give you all the other information.—W. J. LANCASTER.

[46166].—**Rangoon Oil.**—Also called Burmese naphtha, Rangoon naphtha, Rangoon tar. This is a thick rock-oil, and is obtained by sinking wells about 60ft. deep in the soil, the liquid gradually oozing out, and being removed as soon as a sufficient quantity has accumulated. This naphtha contains about 11 per cent. of solid paraffin, which has a specific gravity of 0.915, melts at from 53° to 61° C., and has the composition of 85-15 per cent. C, and 15-29 per cent. H.—F. BARKER COOKE.

[46168].—**How to Make a 2in. Astro. Telescope.**—It would hardly be fair to specify any particular optician where 2in. object-glasses of Paris make can be obtained for 7s. or 8s.; but "Isoumy" need be under no apprehension about the correctness of the quotation. An off-hand inquiry might very possibly result in the statement that they were double this price; for opticians as but human after all, and would very likely delight in snubbing an inquirer who entered the shop with all the importance of an arbitrator; whereas if the circumstances of the case had been fully explained, he would probably have been willing to make things as easy as possible to a scientific student not overburdened with cash. A great many opticians also are readers of the "E. M." and I have found the mere mention of this journal a perfect "open-sesame" to their sympathies. But if these means should fail, there still remains the resource of forming a local "E. M. Scientific Association," which even if it consisted of but half a dozen members, would provide them with all the advantages of co-operation, to say nothing of the advice and assistance they would be entitled to receive from kindred branch societies. There is no absolute standard for the focus of object-glasses; but a comparative focus may be obtained by extending an imaginary cone of rays until its diameter equals that of the object-glass required. This would give the same field of view for all diameters, with a magnifying power directly proportional to the length of focus, and a light-collecting power according to area. If, for example, we accept 30in. as a proper focus for a 2in. object-glass, we should, with an eyepiece of 1/4 in. combined focus, obtain a magnifying power of 60 diameters, while if we increase the length of the focus to 60in. the diameter of the cone of rays, at that point would be 4in., which would represent an object-glass of that diameter, and with the same eye-

would give a power of 120, the amount of light being at the same time increased, roughly, to four times the quantity.—ALDKHARAN.

[46169].—Vulcanised Rubber for Gas Stoves.—Gas seems to have a softening effect on rubber. My tubes get quite soft and sticky on the inside; if you want to make them last longer, try a little oak varnish inside and out; although if the tube is bent much, this will crack. Always have a gas tap on the side next the meter, to keep gas out of the pipe when not in use.—OS.

[46170].—Bending Wood.—If "H. B." will go to a shipbuilding-yard and tip a small boy a penny, he will show him how they bend wood. The wood is steamed for a length of time (according to size, &c.) in a large wooden erection, made as steam-tight as possible. There is a boiler beneath to supply the steam. When dry, the wood retains the form to which it has been bent and secured.—OS.

[46170].—Bending Wood.—There is no secret or difficulty whatever in this operation. The agent is steam. In order to bend 3in. oak gunwales for a yacht, at one period I made a wooden cover for the wash-house boiler; a square pipe of 1½in. timber of sufficient length, merely well nailed together, stuck it upon trestles, connected it to boiler by a piece of gas-pipe; three fifty-sixes upon cover to keep it on its late of loam; half filled boiler with water, fitted covers to each end, kept in place by a bolt or two and plates, shoved in the oak gunwales, and as many timbers, or, as a landsman would say, ribs, as it would hold conveniently for hooking-out with a smith's tongs, lit the fire, and in an hour you could bend them any way required, but need to be very sharp, as they cool rapidly, whipping a nail or two at the large bend to keep them in situ, and finishing the nailing and riveting at your leisure.—J. J. A., Liverpool.

[46172].—Phial of the Four Elements.—Colour the alcohol with a crystal of magenta; saturate the water with potassic carbonate, or if that fails with you, saturate it with calcic chloride. Use petroleum instead of the essential oil you used.—J. M. STROOKS.

[46172].—Phial of the Four Elements.—The salt-and-water should be caustic potash, allowed to liquefy of itself in a damp place—it will not then mix with alcohol. This experiment is very ancient. One of the best forms is mercury for water, black glass in small lumps for earth, potash salt liquid for air, and alcohol coloured with aniline red for fire.—J. SUTCLIFFE.

[46174].—Ferric Oxide and the Magnet.—You want to know more than anybody can tell you. We cannot tell even why it is that a magnet attracts a piece of iron; and when you ask why Fe_2O_3 is attracted by a magnet, and Fe_3O_4 is not, we cannot answer it; certainly we can speculate, but as to the truth of our speculations no one dare vouch for them. You are evidently young, and I would advise you to pursue this line of study. Never rest until you have found out what magnetism really is. You will then have done a work that no one has yet accomplished,—a work that will take a lifetime to execute.—W. J. LANCASTER.

[46175].—Legal.—With reference to jewellers' plate license, it is the amount of gold or silver contained in each article sold or offered for sale that determines the liability; and this is not affected by the gross quantity of gold or silver in the stock kept. Therefore, however, two kinds of licenses—one where articles are sold containing more than 2dwt. and under 2oz. of gold, or above 5dwt. and under 30oz. of silver in each, and which costs £2 6s. per annum; and the other or wholesale license for the sale of articles of over 2oz. in gold or 30oz. in silver, and which is £5 15s. Many jewellers pay the former, but are careful to evade or avoid the latter.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[46177].—Tinning Bicycle-Spokes.—If your spokes are iron or steel I would not advise you to tin them yourself. I should consider it rather a difficult thing for a novice to attempt. Some spokes are made of phosphor-bronze, but these would hardly want tinning. Why not get them nickel-plated?—OS.

[46178].—Boring.—I should not attempt to bore such a thin tube of such a length. I should prefer to get a piece of mandrel-drawn tube, and lap it true with a lead lap. In boring, you would run a great risk of getting a taper bore, from the metal swelling from the action of the cut, and there is the additional chance that the boring would get under the cutting edges, and thus expand the thin walls of the tube. The nearest approach to a perfect plan would be a cutter-bar, nearly as large as the inside bore, applied vertically—not horizontally, as in the lathe.—SUNLIGHT.

[46178].—Boring.—This is rather a ticklish job. I would have the tube as it is so thin—viz., 1-16—say, 2in. longer than required; solder a piece of sheet brass into one end, drill your centre very

accurately in this, and place a balanced driver upon this end; fix temporarily another piece in the other end, and also centre this; now turn this end perfectly true, take out this end-piece, and substitute a boring collar; now we are ready for the borer. Some prefer a rosehead, but I would take a piece of beech and turn the end of it a shade, a very little less than the intended bore, tapering sufficiently to enter the mouth of the tube, and gradually rounded off behind; in fact, rather resembling a young mushroom on its stalk—said stalk to be, say, 4in. longer than the tube; with a tenon saw make a cut through the centre it was turned upon, as far up the head as your cutter, made of a piece of sheet-steel, will reach. Having made the cutter and driven it gently home, take a ½ gauge and make a cut along its length on two sides to allow the borings to clear away; screw a driver upon the end to hold it by, and gently and steadily send it home by means of the moving headstock. When finished boring cast a lead plug with a rod of iron held in the centre, this plug to be, say 2in. long, and grind up with emery as fine as the nature of the job demands; if to be very accurate, then recast said plug from time to time until the required degree of accuracy is obtained.—J. J. A., Liverpool.

[46179].—Boiler Pressure.—If the boiler is same pattern as an ordinary washing copper, I should not care to have more than 10lb. to sq. in. in it. You ought to be able to do the cooking with half that pressure.—LABOR OMNIA VINCIT.

[46181].—Planing with the Lathe.—I am afraid E. H. Alcock's method of planing with the lathe would not satisfy even himself. There are many difficulties in the way, some of which I may tell him. Supposing he was able to mount his work on an eccentric chuck which has a slide, by which the work could get "an up-and-down motion." There is, in the ordinary slide-rest, no arrangement by which the tool, after it had been traversed by screw across the face of the work, could be relieved, other than by working the long screw; this would have to be done after each cut, and then the tool advanced again by the same amount for the next cut, and this could not be done with sufficient accuracy. The mandrel, if held by the division-plate, would be liable to move, even when held by a strong peg. This kind of work would soon destroy a delicate chuck such as an eccentric, and it has no provision for cutting bevels, whereas all that could be done in this way could be done by plain turning, with no strain to any part of the lathe.—F. C.

[46184].—Wringing-Machine Rollers.—Are your spindles made with squares where they pass through the ends of the rollers? If so, you might use a small iron plate screwed or spiked to the wood and squared to pass over the square part of the spindle. In some places the spindles are simply driven in tight, the expansion of the wood gripping the spindle tightly when the rollers get wet. Sycamore is the best wood; but I fancy that beech is sometimes used. It is a class of work I have not had under my notice, except in a very slight degree, so that I cannot help you as much as I would like to.—SUNLIGHT.

[46186].—Intensity Coils.—There are no rules laid down to govern differences of length of wires, there are so many factors beside lengths to take into account, but, ceteris paribus, doubling the length of secondary wire will nearly double the length of spark. There is no necessity to alter the length of primary, two layers of primary will answer well for a mile of secondary or for a much larger quantity of secondary, but for coils having 6 or more miles of secondary I would have 3 layers of primary. I shall send No. 1 induction coil this week; the others to follow as quickly as possible.—W. J. LANCASTER.

[46187].—Watch and Clock Repairing.—This query is addressed to "Alfojo," but perhaps he will excuse me replying to it. Put a ferrule on the pinion of your eight-day clock 'scape-wheel, place it in the centres of your "turns," and "top it"; that is, revolve the wheel by means of a bow on the ferrule, holding a slip of Arkansas stone on the "rest" and in contact with the points of 'scape-wheel teeth; put a speck of oil on your stone, and work away till you have got all the teeth of one length; then take out, and with a 'scape-wheel file, trim up the teeth to proper depth and shape. Now take the pallets and grind out the notches and face them with bits of mainspring steel, taking care not to use more heat than is required in soft-soldering them on; file up to shape, and finish off with Arkansas stone. If you are careful to get an equal drop in the pallets, you will have a good 'scapement again. If the pendulum suspension is too stiff you might thin it by draw-filing on a piece of cork fixed in the vice, or put a thinner one on. To find the true centre of pinion to put in a new pivot, I will describe a tool which I made for putting new pivots in watch-pinions. "Hopeful" might make a larger one for clock-work; but if he has a practised eye, he ought to be able to get the

centre of clock-pinion without, by simply softening the pinion, then screwing in the vice, and with a marker having a fine point, hold the point to the centre and give a sharp tap with hammer, then examine to see if in the true centre, if not, try again; then punch the hole large enough for the drill to start in; drill it up, and put in your steel, which must fit the hole nicely, and drive tight; place in "turns," make a centre point, and file or turn down to size, and burnish. The centring-tool is made thus: drill a cone-shaped hole down one of the brass centres of the "turns," then with a finer drill continue the hole right through; into this hole make a marker to fit accurately, of steel, having a trifaced point. To use it, place the pinion into the cone and turn the marker round, and it will mark a true centre in anything that is round. To put mainspring in barrel of Geneva, you must unpin the stopwork at the back and take out the barrel end, wind in the new spring; see that your spring has nine or ten half-turns: before again replacing the stopwork, set the spring up half a turn.—C. H. B.

[46187].—Watch and Clock Repairing.—To "ALFOJO."—I am very much obliged to you, Mr. Editor, and to "Hopeful," for the commendation I have received from you, and for the invitation given me to step into the gap caused by the death of our old and lamented friend and adviser, "Seconds' Practical Watchmaker." I should be glad, indeed, if I could, for the benefit of my brother-readers, follow in the lines he has worked upon; but I feel that I am altogether unable to give such universal and practical instruction as he has done for many years past in the pages of the "E. M." It would be far better to let his mantle descend upon other shoulders than mine. However, I am perfectly willing to do in the future as I have done in the past, and give instruction and advice upon congenial subjects, when I feel I shall not uselessly be occupying valuable space. My business claims a large portion of my time, but what little I can spare shall be given freely. Passing at once to your batch of queries, I must say that it will be impossible to answer all in one letter, so I must take them seriatim until exhausted. Respecting the eight-day clock: unless the 'scape-wheel is truly out of truth, a little careful manipulation will put it right, and re-cutting by the machine be unnecessary. If you have a pair of "turns," or a small lathe, the wheel can easily be "trued up." If not, and you can have no access to either, adopt the following makeshift:—Get two pieces of square rod-iron about the substance of a penholder, and about two inches long; drill at the extremity of each piece a hole, about a quarter through; fix these firmly in the vice, and, having fixed a screw-urbor upon the pinion of the wheel, place the pivots in the holes in the rods, and get the pinion parallel with the face of the vice. Having a bow and gut, fix this up in the arbor in the ordinary way, and then fix up a rest in some way for the hand to rest upon when stoning or filing down the teeth of the wheel when revolved by the bow, which is best done by the left hand. Proceed with a gentle motion, and barely touch the tips of the teeth. Don't hurry with it, or the tips may be broken off. If a file is used, it must be a very fine one. If stone, "Arkansas" is best, slightly moistened with oil. Watch the operation closely, and hold the stone or file very firmly. As soon as it is seen that all the teeth have been touched, remove it from the improvised bearings, and carefully remove all "burrs" with a fine file, and bring the tips of the teeth to an equal thickness, just a blunt edge. Having "trued" the wheel, turn attention to the pallets, which, as you say, are "dented." To grind out the inequalities of the pallet faces would involve subsequent alteration in the span of the pallets, so you had better not attempt to do that. I admit that the plan I am going to suggest to you is not the most workmanlike; but I take it that you would not mind the appearance of the work. Take, then, a small square file and file the dent a little deeper. Get some mainspring, as hard as possible, and cut and fit it to the dent or rut as commonly called; fitting it so that the pallet face and the face of the piece of steel are in a line. Now apply a little spirits of salts and tin the rut with solder; tin the piece of steel in a similar manner and, holding the pallet in a small flame of gas, melt the solder and fix the piece of steel in its place. Carefully wash the acid off, dry and apply a little oil. Proceed in like manner with the other pallet, if necessary. Now place the 'scape-wheel and next wheel in their respective places in the plates and pin up; fix up the pallets and then try the escapement. If by accident the "drops" have come right, your trouble so far is at an end. If they are unequal through one pallet possessing a longer "run" before the "drop" than the other, stone or file the edge away, only a little at a time, until correct. Attention must be paid to this, or the clock, when set up, will inevitably fail. Getting a clock "on beat" and getting the "drops" correct are two very different things.

The "drops" may be perfectly correct, and yet the clock may stop through being out of beat. The ear is the best guide to the latter desideratum, and attention to it need not be given until the clock is set up in its case. You will readily perceive by the ear when the beat is unequal, and a little bending of the "crutch" to one way or the other is all that is necessary, taking care in doing so that the "crutch" or fork is set at right angles to the plates. As the suspension-spring in all probability is the original one, do not meddle with it. The newly-faced pallets should be well oiled when the clock is set going, so that any exuding acid may be neutralised. As regards the 'escape-wheel pivoting. Is it a watch or clock wheel? If a clock wheel, the centre may be easily struck with a sharp, hard, steel point, when the wheel and pinion are firmly held in the vice. If a watch 'escape-wheel, I should advise you not to attempt it. Only the very "light-fingered gentry" in the trade can manage the job nicely. You would require a special kind of pivoting-tool, and, altogether, you would find unforeseen difficulties in the way of success. A pivoting-tool, such as described by the late "S.P.W." can be bought at any trade tool-shop for about a crown. This tool finds its own centre for the pivot, and the drills do their work easily, and keep the chance of failure at a minimum. The wheel has, of course, to be removed from the pinion during the operation of pivoting. The pinion is revolved against the drill by a horsehair-bow, and a metal or bone arbor is waxed on. The remaining portion of your queries shall be replied to next week.—ALFJOZE.

[46188].—Hexagon Patterns.—I asked this question about two years ago, but without success. Mr. Lancaster mentioned a parallel instance of dark bands to be seen on looking from a train through two sets of railings about the height of the carriage-window, as may be noticed on leaving Victoria by L.C. and Dover, on the south side of Chelsea Bridge. I have mentioned the fact to many who I thought might suggest an explanation, but hitherto have failed to meet with one. To myself part of the phenomenon seems to be explained in this way. In certain areas there is nearly, or quite, unobstructed view through the perforations; then, on either side, after a time, the edges of the perforations are seen to overlap, and, at last, the view is completely obstructed, and the result is, as one might expect, a regular pattern. Why this should be hexagonal, however, is not clear to me, unless it be that one might expect to see circular spaces of light. Then it does not seem difficult to imagine that the line of greatest obstruction would lie along the tangents to the circles, and thus, of course, hexagons would be formed. The varying size seems to be a question of angle at which the light enters the eye.—H. H.

[46190].—Overstrung Violoncello.—How did you manage to tune the E string without breaking it? You may try a metallic string—it will sound better than gut, being so long. The reason of the roughness caused by untoward beats is that the string and soundboard do not move in unison or together. Mute the bridge and the excess of vibration is absorbed; there is no other remedy but having a thicker soundboard or thicker back. Nevertheless, cutting down the bridge might do something, but the power would be less also. Try another bridge, and see how it fits. If it is any consolation to you, I may tell you that if the erring note had not been out, but in, unison with the soundboard, it would have been the best note on the instrument. You might increase weight on soundboard by connecting the finger-board to it by means of a soundpost between the two. This is only a suggestion. Don't move the soundpost inside, because you will merely transfer the error to another note.—FIDDLER.

[46193].—Staining Floors.—Hold a red-hot shovel over the white places, but look out for blisters.—J. M. SROCKS.

[46193].—Staining Floors.—Spirit varnish does dry white if the temperature is not sufficiently high; oak varnish would have been better for a floor. You might revive it by rubbing it with a little spirit or more varnish, using it in the manner adopted with French polish.—OS.

[46193].—Staining Floors.—I have done mine this way, and they stand well. Make a distemper of colour required with sour beer. When quite dry, use ordinary copal varnish. The colour is as strong now as when first put on two years ago.—C. R. T.

[46195].—Photo. Washing Machine.—The best mechanical washer I have come across for a long time was one designed by Mr. W. England, and which is made by Rouch and Co., of the Strand; but the price is high. It consists of an oblong case or tray. Inside it is another a little smaller, and carried on a bar, so that it freely oscillates on it. The bottom of the rocking-tray is of gutta-percha. On one side of the outer case is a small zinc bucket-wheel, water being allowed to

flow into the buckets of the wheel, drives it round just the same as an overshot water-wheel. A crank and connecting-rod on its axis oscillates the washing-trough. The water from the wheel passes into the main case, so that the prints are in water constantly on the move. A siphon carries off the water as soon as it reaches a given level. To save cost I devised a cheaper plan, which consisted of an outer case or tray of circular form; inside it is another with a perforated bottom, and it is carried on a central bearing made of brass tubing of ample size and length. The inner or revolving trough has on its edges a series of small arms or vanes, and on one side of the outer trough a jet of water is carried in. This, by playing on the projecting-vanes, causes it to revolve, and thus always keeps it in motion. When the water has reached a given height a siphon empties the outer case; and thus taking off the retarding influence of the water the inner trough revolves fairly rapidly, thus throwing out every drop of water from the prints. As the trough fills again the speed slackens until it is full, when the siphon again empties it and it runs full speed again. A jet of water from the turn main of very small size is sufficient to do a very large amount of washing.—SUNLIGHT.

[46199].—Impurities in Acids.—Probable impurities in oxalic acid—iron, potassium and sodic oxalates, lime. Test for iron—Potassium ferri-oxanide, blue ppt. = iron. Potassium—Platinic chloride, yellow ppt. = potassium. Bunsen flame coloured violet on platinum wire, K. Soda—Potassium manganate, white ppt. = soda. Oxalates, calcic chloride, white ppt. = oxalate. Lime—Ammonia oxalate, white ppt. = lime. Probable impurities in tartaric acid—Alumina, sulphates, lime, which are best tested for by igniting some crystals on platinum, extracting residue, if any, with a few drops of HCl, and adding to one portion baric chloride, if white ppt. = sulphates. To another part add AmHo, if white ppt. = alumina. To another part add Am₂CO₃, if white ppt. = lime. Ammonia oxalate also gives a white ppt. if lime be present. Probable impurities in sulphuric acid—Plumbic sulphate, nitrates, arsenic. Test for plumbic sulphate—Add water, if white ppt. = lead sulphate (plumbic sulphate). Nitrates—Add ferrous sulphate, if brown where liquids meet = nitrates. Arsenic is best detected by passing SH₂ (sulphuretted hydrogen) through dilute acid, if yellow ppt. = arsenic. Nitric acid, probable impurities—Sulphuric and hydrochloric acids; dilute the acid and test portion with baric chloride, if white ppt. = sulphuric acid. To another portion add silver nitrate, if white ppt. = hydrochloric acid. Hydrochloric acid, probable impurities—iron, sulphurous and sulphuric acids, and arsenic. Test for iron—Potassium ferri-oxanide, if blue ppt. = iron. Sulphurous acid—Add a few drops of strong sulphuric acid, if smell of burning sulphur = sulphurous acid. Arsenic—Pass sulphuretted hydrogen into the acid, if yellow ppt. = arsenic.—W. DUFF, Analytical Chemist.

[46199].—Impurities in Acids.—Oxalic Acid. This is sometimes contaminated with nitric acid. To detect this, take a little strong solution of oxalic acid in a test-tube, and add about an equal bulk of strong sulphuric acid. Allow the mixture to cool; then add gently, by pouring down the side of the test-tube a strong solution of ferrous sulphate (or chloride), so that it will float on the surface. If any nitric acid is present, a black or dark brown ring will be formed at the surface of contact of the two liquids. This reaction is extremely delicate; care must be taken to cool the liquid before adding the iron solution, otherwise the dark brown compound will be decomposed.—Tartaric Acid. This sometimes contains citric acid. To detect this, mix the solution with acetate of potassium and an equal volume of strong alcohol. The tartaric acid will be thrown down as tartrate of potassium, but the citric acid will remain in solution. Filter and evaporate the filtrate to dryness. Take up with hot water, add calcium chloride, and boil. If citric acid be present, citrate of lime will be precipitated, which redissolves as the solution cools.—Sulphuric Acid. This may be contaminated with sulphurous acid, nitric acid, lead, and arsenic. To test for sulphurous acid, shake the acid in a half-filled bottle; if any sulphurous acid be present, it will be discovered by its odour. For nitric acid, treat in the same way as above in oxalic acid. To test for lead, evaporate some of the acid to dryness; the residue, if any, is sulphate of lead; or add some hydrochloric acid to the sulphuric acid in a test-tube; then, if the surface of contact is marked by turbidity (chloride of lead), lead is present. For the arsenic, mix some of the acid with pure zinc and water; hydrogen is given off, which, on being passed through a red-hot tube, must not deposit the slightest trace of arsenic.—Nitric acid. This sometimes contains hydrochloric and sulphuric acid. For the former, take a little of the nitric acid in a test-tube, dilute with water, and add nitrate of silver solution. The slightest turbidity indicates the presence of hydrochloric

acid. For the sulphuric acid take some more acid in a test-tube, dilute, and add solution of barium chloride. Should there be any precipitate, it consists of barium sulphate.—Hydrochloric acid. This may contain nitric or sulphuric acid (for which test as given above), iron, or arsenic. For iron, take a little of the acid in a test-tube and add potassium ferri-oxanide, which will give a blue precipitate or colour, if iron be present. For arsenic, pass through the acid sulphuretted hydrogen.—F. BARKER COOKE.

[46202].—Pattern-Making and Casting.—A complete series of articles on "Pattern-Making," by Joshua Rose, appeared in the ENGLISH MECHANIC a year or two since.—OS.

[46202].—Pattern Making.—"E. C." is evidently not aware that an excellent series of articles commenced in Vol. XXIII., page 18, and went through Vols. XXIV. and XXV., 33 articles in all. They were issued in book form by Van Nostrand, of New York, and can probably be had of Trübner.—INDEX.

[46202].—Pattern-Making and Casting.—I shall be only too glad to assist any of "ours," or give any information on the above. If "E. C." will state what kind or class of work he wishes the articles over, one thing must be borne in mind, that this subject is not easily explained except to those who know a little about it already.—CAST-IRON.

[46203].—Legal.—I do not understand how or for what reason the two new trustees came to be appointed; and so without further facts I cannot fully advise upon this case. But, presuming the two brothers to be now the lawful acting trustees, I see no way of disputing their authority. I presume "G. B." has only a life interest in the estate, and, this being so, the trustees are within their legal right when they compel him to pay them the rent for the trust property he may happen to occupy. As to the other point, although trustees can charge nothing for their own trouble, they can employ solicitors or agents to collect rents for them, and pay their fair commission.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[46203].—Legal.—If the marriage settlement is securely drawn up, "G. B.'s" twenty-four years of mere agency give him no power. The object of a properly-drawn marriage settlement is to secure to the wife the enjoyment of her property for life with reversion to her issue. The trustees have as much legal right to levy rent from "G. B." as from any ordinary tenant, and in default, can resort to any of the usual remedies. "G. B." is wrong in speaking of "our estate," the estate, in case of the settlement being stringent, belongs to "G. B.'s" children, subject to his wife's life estate. Perhaps there are circumstances under the surface not stated by "G. B." which have induced such near relations as two brothers acting conscientiously as co-trustees to deprive him of his position of trust; in all probability "G. B." has, after the twenty-four years, begun to regard himself as despotic, and has exceeded the limited power of an agent. In the present unsatisfactory state of English law as regards married women's property, a settlement often prevents a woman becoming a mere slave to her husband.—FAMILY SOLICITOR.

[46204].—Geometrical.—When a segment has for base an arc less than 180°, its area can be found in calculating—first, the area of the sector of circle having the same base, and then subtracting from this result the area of the triangle comprised between the same radii and the chord of the above arc. A little reflection will show that should the arc exceed 180°, the triangle's area has to be added instead of being subtracted. This is evident from the figure you can draw, and also from the following formula, wherein A designs the angle formed by the two radii bounding the sector. Area of segment = area of sector — area of triangle generally. Or = area of sector — $\frac{1}{2}$ (radius)² sin. A. So long as A is less than 180° sin. A is positive, but when A is greater than 180° sin. A is negative; then the formula becomes: area of segment = area of sector + $\frac{1}{2}$ (radius)² sin. A. This last case comes now under our notice. 1st. Area of Sector.—Area of circle of diam., 48.75' = 1866.55 sq. ft.; if 360°, or 21,600 minutes, are 1866.55 sq. ft., one minute is = 1866.55 / 21600, and 245° 45m., or 14,745 minutes, are: 1866.55 × 14745 / 21600, which gives 1274.1070 sq. ft. for the sector. 2nd. Area of triangle = $\frac{1}{2}$ (radius)² sin. 245° 45m.; but sin. 245° 45m. = — sin. (245° 45m. — 180°) = — sin. 65° 45m., or — sin. 65° 45m. = — cos. 24° 15m. Another way to obtain this result without this generalisation is to remark that the angle of the sector is = (360° — 245° 45m.), or 114° 15m., which have for supplement 65° 45m., &c.; but this could not fix us "a priori" as to the sign of this last operation — cos. 24° 15m. = — .91176. Area of triangle = — $\frac{1}{2}$ × .91176 × (24.375)² = — .45588 × 594.1406 = — 266.9154 sq. ft. 3rd. Area of segment = area of sector — (— area of triangle) = (area of sector + area of triangle) =

1274-1070 + 266-9154 = 1541-0224 sq. ft.—Ed. GOSKIN, B. Sc., Heskey-street, Nottingham.

[46205.]—Induction Coil.—Single covered wire is best with paper between the layers. After winding, warm the whole for some hours, and then run in melted paraffin.—SIGMA.

[46207.]—Weight of Cattle.—There is a small but dear (3s.) book published, I think, by Simpkin, Marshall and Co., called "The Farmer's and Grazier's Companion," being a sort of ready-reckoner, showing in a series of tables, the weight of cattle, sheep, swine, of any given girth and length. I think this would suit "X."—R. STACE.

[46207.]—Weight of Cattle.—In Stephens's "Book of the Farm" the following rule is given. Multiply the square of the girth behind the shoulder by the length from top of shoulder to the rump. Divide the product by 4,100, quotient is the weight in stones of 8lb. avoirdupois. As a matter of fact, this rule only gives the weight of moderately fat animals of shorthorn breed. A little observation and practice will quickly instruct the operator where a greater or lesser divisor than 4,100 becomes applicable. I am able to state from practical experience that the application of the rule above given, with a little practice as to the use of the divisor, will enable a novice to arrive at a more accurate estimate of weight than the most experienced butcher, guided by the eye and touch alone. I have a slide-rule, made by John Ewart, of Newcastle, constructed to calculate weight of cattle from the same measurements of girth and length, and which gives approximately similar results, but from its answers being in stones of 14lb. I never have made much use of it, preferring to work out the calculations in figures.—R. R. N.

[46207.]—Weight of Cattle.—When I first started my bucolical pursuits I was hot on not allowing the butcher to get to windward of me in buying my bullocks too cheap, and for two or three years I measured, and also weighed, every bullock I sold, and I was astonished how near the actual results in the scales came to the calculated weight, either by measurement or by live weight on the weigh bridge. The measurement of cattle has attracted the attention of growers of meat both in England and France. The subject is treated by Morton, title "Meat" in his "Encyclopædia of Agriculture," and there is also a very good article in French in "Le Bon Fermier," at p. 870, of the year (I forget which) I took it from. The results by French and English plan do not correspond. I find in my note-book, that the English plan gave, in actual result, a more favourable weight to the feeder than the French one. In a bullock sold by me as of 37½ score of 20lb. by the English mode of measurement, the bullock realised thirty-eight score three pounds in the scales as dead meat, sinking the offal; whilst the French plan gave only thirty-six score four pounds. This may probably arise from French bullocks carrying more offal than English. The rule is as follows. Take the length of body from junction of neck to body to the junction of the tail in feet and inches; then take the girth of the body square round immediately behind the elbow of the fore-legs. Square this girth, then multiply the square of the girth by the length above given, and the product by one of the constants, according to quality, condition, and sort of bullock, will be the weight in stones of 14lb. Taking, for example, the North Devon, of good average breed, the constant for half-fat, is, '23; moderately fat, '24; prime fat, '25; very fat, '26. By way of example, the girth being 6ft. 8in., and the length 4ft. 11in. (6ft. 8in.)² × 4ft. 11in. × '25 = 54st. 7lb. = 763lb., or 38 score 3lb. Care must be taken that the bullock stands on level ground, square, and not disturbed. These modes are very good for those who, like myself, have not been brought up in the farm-yard; but there are many men, both butchers and farmers, who, by eye and hand, can tell almost as near the mark. I have in several cases tested my own baliff, and seldom found him out, one way or the other, more than half a score; but this wisdom is not learnt in a day. I have made experiments in weighing, but not measuring, both in sheep and pigs; but accuracy is more difficult than with bullocks. In the case I gave by way of example, the butcher realised four or five pounds less than the weight calculated by measurement, but still more than he paid for. I took particular note of this case, because I took the trouble of sending my baliff in to ascertain the actual weight; but, judging from results with another sort of bullock, I found '27 would have been a better constant. Trusting this will be of service, I subscribe myself—KRONA BOX.

SEVERE earthquake shocks have recently killed a large number of people in China, and done much damage.

THE Chinese authorities gave the public free use of the telegraph lines for a month when these were recently opened.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, "Jack of All Trades" has replied to 45665, 45669.

45581. To "L. W." and "W. L.," 387.
45591. Deafness, 387.
45606. Jacquard Loom, 387.
45617. Chatterton's Compound, 387.
45618. Lodgers and Landlords, 387.
45620. Quantity of Coal Carbonised Annually, 387.

45792. L. and N.W. New Tank Engines, p. 482.
45796. Snuff Mill, 482.
45799. L. and N.W. Engines, 482.
45809. Lunar Cat-rs 482.
45810. Aperture of Object-Glasses, 482.
45820. Weaving, 483.
45823. Oval Chucks, 483.
45830. Lighting Watchmaker's Shop, 483.
45849. Artists' Canvas, 483.

QUERIES.

[46209.]—Photographic.—Could any brother-reader tell me the difference in transmitting power between ruby pot-metal and flashed, or stained, whichever it is called? What I mean is this: How many inches square would a pane for a photographic dark-room in pot-metal have to be to let the same quantity of light through as a square foot of flashed glass, for I presume the latter, from only being coloured on the outside, would let more light through than the former? but will it be equally as efficient? Would Mr. Lancaster be able to throw any light on the subject? Also, what is the difference in price? I may say I bought a piece of ruby glass for the above purpose, and having paid at the rate of 2s. per foot for it, I thought it would have been pot-metal; but, I suppose I expected too much. I would also like to remind Mr. Lancaster of his promise of about six months ago to give us in-triet-ions, through the columns of "ours," of how to make double dark-slides for his little gem of a pocket camera. I was in the hope of being able, this winter-time, to have made myself a few ready for the summer, as I thought we should have had the instructions long before. I am aware Mr. L. has sometimes pleaded want of time, and pressure of other business, but I think he might, at least, take things in turn, for I have seen a great many queries he has answered since last August, when he promised us instructions for the above; and, as I see he has also lately promised some paper on coil-making, which, I have no doubt, will be very interesting, I hope he will think of the photographers first.—No Sig.

[46210.]—Wheatstone Bridge.—I have just about finished a Wheatstone bridge from ½ ohm to 220; but how am I to make connections for measuring the R of wires and liquids? I have read Ferguson on this subject until I have got quite muddled; the terminals are as follows:—

A { Galvanometer terminals } Then E { Wire to be
and B { } say F { measured.
C { Bridge terminals }
and D { }

Fig. 195, page 226, in Ferguson's Electricity, is the plan of my bridge; but he does not give the galvanometer terminals there, and I cannot fit in with the plan Fig. 193, page 222, in same book. Would "Sigma" kindly say how I am to act in making a galvanometer on his plan, but using 16's, 20's, and 36's wire, instead of the numbers he gives in his book. I will commence, as he advises, with 80 turns No. 20's; now as to the 16's, how many layers shall I lay on to be any multiple of the 20's and still leave me a nice flat surface to fill up the unoccupied space with 36's?—NUMBER AND ANGLE.

[46211.]—Engine for Driving Lathe.—To "SUNLIGHT."—Will you kindly say what bore and stroke a vertical engine ought to be to drive a 6in. screw-cutting lathe? Would you also kindly give size of vertical boiler for above? Also, length of cylinder from end to end, and thickness piston ought to be; also thickness metal should be round cylinder and steam-chest? Also please give size of steam-chest inside, and size of steam and exhaust ports, and diameter of steam and exhaust-pipes; also size slide-valve should be, and diameter and throw of eccentric; also diameter of shafts and flywheel, and weight flywheel should be; also diameter of governor balls, and distance centre of balls should be from centre of vertical shaft when engine is at rest.—AS YOU LIKE IT.

[46212.]—Vegetable Black.—In my business large quantities of the above are used. It comes in casks from Hull, 2ft. 6in. high, each cask containing 5 to 6lb. of the powder; strange to say, in two instances shortly after their arrival, these casks have caught fire, although I am very careful to keep them in a place far away from fire or light. Can anyone oblige me with the probable cause for this morning, on my foreman going into the place, he was surprised to find one cask completely red hot and burnt within 3in. of the ground; fortunately, it was in a detached shed, or the consequences would have been serious; the only other substance stored in the place is boiled linseed oil, which the black is finally mixed with for waterproofing purposes. I have an idea the fault lies in the lining of the casks: they are lined with old newspaper placards. Perhaps something in the printer's ink decomposes; anyway, I shall be grateful for the opinion of our various analytical friends.—M M.L.S.C.S.

[46213.]—Measuring Steam.—To "SUNLIGHT" AND OTHERS.—A. and B. have promises adjoining one another. A. having an abundance of steam beyond his requirements, agrees to supply B. with sufficient to do the work of driving his engines, &c. The present method

of charging for the steam is according to the pressure desired by B., say 20 or 30 or 40lb., and so on, the price rising with the increase of pressure. This method, however, is faulty and unreliable, as it does not measure the quantity of steam consumed, and offers no encouragement to using it economically. What is wanted is some means of measuring the volume of steam supplied on the same principle as a gas-meter. Is there such a thing, or is any better way of charging for the steam known? and oblige—G.

[46214.]—Stone Lathe.—Having a lathe for stone turning, and some work being too heavy for foot-power, I beg to know if some of your able correspondents on lathe work will inform me (with simple sketch) if I could in place of treadle attach a flywheel on end of strong beech frame to work with overhead gear with flat strap. Please to state what size wheels required, my present wheel being 2ft. over; mandrel ditto, 6in.—STONE LATHE.

[46215.]—Stamping Ink.—Will any contributor kindly give me recipe for making ink for use with metal stamps for stamping stationery? It is necessary that the ink should be quick-drying, and last a moderate length of time on pad of stamp.—H. S.

[46216.]—Strength of Materials.—Can anyone inform me if there is any method for finding the amount of pressure that cast and sheet-iron and brass will resist, after having ascertained the thickness? I wish to find the resistance of a small model boiler and cylinder that I am making.—ROBCK.

[46217.]—Model Electric Engine.—Will any of our readers kindly instruct me how to make a model electric engine as minutely, and with drawings, as possible?—W. F. C.

[46218.]—Solder.—Can anyone up in jewellery jobbing inform me how to make a hard solder that will run at a lower heat than silver solder requires?—W. F. C.

[46219.]—Viola.—Will some one kindly give dimensions of a good viola, and, if possible, instructions how to make it?—CLARIONET No. 1.

[46220.]—Link Motion.—Will some reader be good enough to give me the rules to find the dimensions of the link motion? I wish to fit a vertical engine with it, but I am in a fog as regards the rule. A sketch will greatly oblige.—A. B. C.

[46221.]—Calculating Watch and Clock Trains.—Will any of our mathematical friends kindly help me in the following?—I can calculate the train of a watch or clock from a stated number of vibrations per hour, if I predetermine the number of 'scape-wheel teeth and the pinions; but not otherwise. What I wish to know is, can it be done without the pinions and 'scape teeth being predetermined. ELUSIA.

[46222.]—Link Motion.—I have a horizontal engine that I intend making into link-motion; the length of stroke is 1ft.; distance fr. in crank-shaft to rocking-shaft is 3ft. 3in.; where the link will be coupled, the throw of the eccentric is 1½in. What length shall I require the link? Will it matter if I have the link long enough? or will it require it to be an exact length? Please say if a straight link will do as well as a curved one geared in the same way?—AMATEUR.

[46223.]—Electric Alarm.—To Mr. LANCASTER.—I have an electric bell, battery, and push, in case complete; how can I fix same to Seth Thomas lever clock, so as to make bell ring at 6 a.m.?—BLACK VIC.

[46224.]—Silver Solution.—Will some of our practical correspondents kindly help me?—I made up one gallon of silver solution to brighten plate spoons, &c., as follows: To one gallon of water (previously boiled), I added about 4oz. p.tash cyanide, and 1oz. chloride of silver, stirred the whole well up, and allowed to settle till next day; then added a few drops bisulphide of carbon, which turned the solution as black as ink, and twice as muddy, to get rid of which I filtered the whole solution twice through filter-paper. It plates well enough; but if I leave the articles in the solution without constantly moving them about, they are covered with black streaks, and are difficult to burnish. Will some one tell me where I am wrong? I use two three-pint Daniell's batteries, and plate about 1 dozen forks or spoons at once, using old silver spoons for anode. I should like to go fully into this line, and will be glad to know the best works on the subj. et.—R.

[46225.]—Steam Launch.—Would "Sunlight" kindly tell me if an engine 6in. dia. by 6in. stroke, with one of Cochran's 3 n.h.p. pat. n. launch boilers would do for a boat 28ft. long, 6ft. 6in. beam by 3ft. 6in. deep? And at what speed it would drive it? Also, would the boiler be large enough to follow engine at 300 rev. per minute?—ONE IN A FIX.

[46226.]—Gold Solution.—I shall be glad if some practical hand will tell me the reason of my failure to gold!—I had one quart of gold solution, which had previously worked well, and given good colours, but which lately worked very badly. I resolved to make up a new solution, so evaporated the old one to dryness, added carb-nate of soda, and fused, obtaining a clean button, weighing 2½dwts., which I redissolved in aqua regia, adding an excess of hydrochloric acid to throw down any silver that might be present; then added half a gill of water (previously boiled), filtered out the silver then precipitated the gold by adding to a filtered solution of sulphate of iron, 1 iron to 10 water; washed the precipitate, and redissolved in aqua regia, evaporated to dryness, and dissolved the torchloride in boiling solution of cyanide, about 1oz. to the pint; boiled the whole in a water-bath for one hour, then tried to gold, using half-sovereign rolled thin for anode. I failed to get a deposit on a small brooch with one three-pint Daniell; so coupled up two three-pints intensively; but the only colour I could get was a dirty greenish-yellow. Will someone tell me where I failed?—I use the ordinary cyanide of potassium at 2s. 6d. per lb. I may say have never read any books on the subject; what I have learnt has been from the ENGLISH MECHANIC.—B.

[46227.]—Ground Pipeclay.—Some of our largest calico printers are beginning to use vast quantities of this new thickening clay for their colours. What superiority has it over gum or china clay, and is the pipeclay trade

carried on at any other town besides Bacup? As the colour-shops where I am employed at are kept under lock and key, I should feel obliged if some of "ours" could give us some particulars as to the quantity of clay found necessary to thicken such description of colour.—A MACHINE-TESTER.

[46228.]—Grinding Sandstone.—I wish to commence business as a grinder of hard and soft sandstone, for the purpose of sprinkling on house-floors. Can any of "ours" recommend the best practical way of grinding, and also where the operation may be seen in full swing?—LANCASHIRE LAD.

[46229.]—Transit of Venus, and Earth's Distance from Sun.—Would "F.R.A.S." inform your amateur astronomical readers if they can in any way assist by observations the solution of the question of the earth's distance from the sun during the transit of Venus next December? Or what they can do (supposing weather permit) in the way of observing the commencement of the transit in this country.—E. J. B.

[46230.]—Sensitised Paper.—Would Mr. Lancaster, or some other obliging correspondent, tell me how to apply emulsion to paper, and what kind of paper to use? Does the emulsion get weaker, or can you use it all up; also, does the paper keep as well as the plates do?—W. E. K.

[46231.]—Cleaning Flower-Pots.—In a conservatory there are some clay flower-pots of superior make, finished with a smooth dark red surface. A few hours after being cleaned they become disfigured with a whitish bloom, that increases in a few weeks to a coating that is not easily removed by brushing, or even by pumice-stone and water. If the plants are taken out and the pots are soaked in water for about two days, the coating is perfectly dissolved. Is it possible to prevent the discolouration altogether, without interfering with the porous nature of the ware, or in any way injuring the plants? The pots have been in use nearly two years, and have received repeated cleanings. It is remarked that those containing plants that receive but little water, remain clean much longer than the others. Rain-water is always used to the plants.—G. H.

[46232.]—Storage Batteries.—Having found Mr. Sutton's storage battery very successful on a small scale I should be glad if any of your readers could inform me what is its E.M.F.? Is it the same as Planté's secondary battery—2.5 volts? The following actual case I should be glad to see discussed in these pages:—Given a spring of water running 24 gallons per minute through, say, 800 yards of 1½ in. lead pipe, with a fall of 42 ft. in that distance, what will be the best method of turning it to account to produce an electric light for domestic use? As the spring is running all the 24 hours, and the light would only be required five or six, would it be advisable to use storage batteries or the current direct? What would be the best type of dynamo, and would it be preferable to wind the wire, so as to give a small E.M.F. and large current, so as to charge the storage batteries in multiple arc, or to have high E.M.F., and charge them in series? What should be the sizes of castings, wires, and resistances? What size should the storage batteries be? What power should be given off by a small turbine on the "Thirlmere" system by the above spring? Would it come up to 1,000 foot-pounds per minute? What would be the best form of lamp to use—the Swan, or some modification of the Werderman system? The Swan Co. state that their lamps are about 60 ohms resistance when cold; and that to give a light of 20 candles, a current of 42 to 45 amperes is required. I think there must be some mistake in the latter statement, as that would require an E.M.F. of 2,730 volts. I may say that at the castings would be purchased ready to fit up, so as to only need the wire laying on.—J. HAZMALHAICH.

[46233.]—Magnets.—Will "R. P." (letter 19505), who says, "10 amperes will require No. 12 wire for the magnets"; kindly explain how it is so? Will the same correspondent (letter 19447) kindly say why, in finding the horse-power, he multiplies by 41? Formulae of this kind "chuck" in bodily, are not of the slightest use to general readers, unless they are thoroughly explained.—J. HAZMALHAICH.

[46234.]—To "Peganredstuff".—Could you kindly suggest any means of making the round brass French timepiece, with one tooth escapement, go without putting in new pallets?—THORALD.

[46235.]—Reducing Balance-Springs with Acid.—I have tried to reduce a balance in a watch-glass of water with one drop of nitric acid; but it seems to have had no impression, as the watch gains as much as ever.—T.

[46236.]—Watch Mandrel.—I have a good mandrel (Swiss), with rest, but in cutting a groove with the slide-rest, the bottom of the groove is cut in very fine lines instead of a fine flat surface. I believe the cause of this is owing to the form and sharpening of the cutter. Would someone kindly say the real cause, and how to remedy it?—THORALD.

[46237.]—Lithography.—Some lithographic stones, on which I put sketches in black litho. ink, would not print at all after keeping three months. I inked them up with the printing ink, and gummed over to preserve them. What can be the cause? Previously, they printed lovely.—F. W. THOMAS.

[46238.]—Turnstiles.—Can any of "ours" inform me how turnstiles are made that indicate the number of passengers who pass through; and, if possible, give a sketch of the working parts?—ALERT.

[46239.]—Movable Hand Drilling Machine.—Will some reader give information of an American invention—i.e., a small machine for drilling holes in iron and wood at any angle or position? I have heard the drills are driven with an endless rope running in grooved pulleys, and balance weights adjusted to keep rope at a proper tension. Hope someone will give a note of construction and driving power.—RURAL CHIPS.

[46240.]—Legal.—Will Mr. Wetherfield or some of your legal readers kindly answer the following question: I engage a firm to do some work with my engine and boiler; they send one of their workmen to do the work. Whilst the man is examining the work, to see if it is

properly done, the steam-valve accidentally explodes, which injures him. Who is liable for the man's wages, &c.—Am I, or the firm that I employed to do the work?—AN EMPLOYER.

[46241.]—Slate Roof.—In taking out the weight of slates, &c., on a roof, why is it that the span $\times$ weight per square foot of load $\times$ distance between principals, is taken as the load, instead of—length of both rafters by weight per square foot of load by distance between principals?—JAMES BRAND.

[46242.]—Patent Law.—To Mr. WETHERFIELD OR OTHERS.—C is a patentee, say of a vacuum brake, enter into an arrangement with a railway company, whereby the patentee is to receive a lump sum from the said company for the privilege of constructing and using his invention for their own use only, without preventing the patentee from receiving a similar acknowledgment from various other companies for the right of constructing and using the invention? What I want to know is, whether receiving a sum of money for the right of making and using for their own use, would be disposing of the patent to the company from whom the money was received?—ISIDORE.

[46243.]—Throat Affection.—Will Dr. Edmunds kindly advise us to the following?—My wife, age 43, has suffered for about two years with an affection of the throat. The symptoms are a fulness about the lower part of the throat, a feeling as if something foreign was there, and a continual inducement to make an effort to remove it, accompanied at times with a considerable amount of aching. These symptoms are not always present. At intervals it appears to be almost or quite gone, only to return with more or less severity. When very troublesome it seems to affect her spirits, being apparently constantly reminded of its presence by the continual efforts made to clear the throat. I have consulted two local medical gentlemen, who say it is the result of nervousness; but no permanent benefit has resulted from their treatment!—T. R. P.

[46244.]—Differential Calculus.—Will somebody explain and illustrate with an example how to find the heat generated by an electric from the following formula given by Prof. Clerk-Maxwell:—

$$h = \frac{1}{2} R \int \gamma^2 dt.$$

Where J is Joule's dynamical equivalent of heat, R resistance, γ current, and t time. Must h be multiplied by the products of the mass of the conductor into its specific heat, in order to determine the increase of temperature due to the current?—GIULIELMO.

[46245.]—G.E.R., No. 385.—Was this goods engine, which exploded lately, four or six-coupled? It is described as having a bogie.—R. N. H.

[46246.]—Sulphate of Copper.—Will "Analyst," or some other kind reader, inform me of the best means of converting nitrate of copper into sulphate of copper, for use in a Daniell cell? There is a large quantity of free nitric acid in the nitrate of copper I have to use.—ETHELIA.

[46247.]—Photography.—Will some kind photographer tell me how I am to know when to stop developer on dry plates? If I wait till I can see picture through back, there is no clear glass. In fact I can't get clear glass at all. All my pictures have a deposit on the shadows, and I don't know if continued development makes this worse or cures it. Is it over-exposure or developing. A hint to put me on the track might serve many.—PHOTO. BEGINNER.

[46248.]—Amateur Dramatic Club.—Myself and a few friends are going to do something to amuse the working man. We thought of a comical farce, or a little play. Will some fellow-reader kindly give name of some play or farce, where to get it, and what price? Also a little instructions how to get on. We have got a nice large room with stage. It is really for the benefit of the Snedland Working Men's Club.—A FELLOW-WORKMAN.

[46249.]—Rheumatism.—My daughter when about seven years of age fell into a river on a cold day, since which time she has suffered from rheumatism. She has had rheumatism seven or eight times. It appears now to be strong and healthy, although it is but three months since her last severe attack. She is now 19 years old, and although I take great care of her, she somehow catches cold and has a return of rheumatism. Will Dr. Edmunds kindly say if there is any hope of her permanent recovery, or will she get worse as she grows older? Also, if he would kindly inform me of best means of preventing recurrence of these painful attacks, and if diet has anything to do with it?—A. G.

[46250.]—Fitting up Battery.—Will someone kindly tell me how to fix the carbon and zinc plates in a trough battery? I want to fix them to a rising cover, but do not understand how to screw them or wedge them. How should the carbons be connected without using clamps? And how can a wire be soldered to amalgamated zinc? Have tried several times and cannot do it.—R. L. S.

[46251.]—Inhalation-Compound Oxygen.—An inhalation treatment for catarrh, consumption, and kindred diseases originating in the U.S., and called the compound-oxygen treatment is effecting numerous cures. The article looks like water, but deposits a white sediment after a time. About a tablespoonful is added daily to an inhaling bottle containing about a half-pint of water, the whole being warmed by being placed in a pan of hot water, and the inhalation through the mouth and expelling through the nostrils, being continued for from two to six minutes morning and evening. Fifteen dollars (£3) is charged for about a pint bottle of the liquid and inhaling apparatus. The bottle is said to arise from water having taken up four times the usual quantity of oxygen, which it gives off when warmed; and this going through the lungs to the blood, revivify and benefit the whole system. Could any of your chemical readers suggest a method by which this absorption of oxygen by water could be effected in a cheap and efficient way to serve the same purpose?—TOM.

[46252.]—Electric Bells.—I want the proportions for the following sizes of electric bells: 2 in., 2½ in., 3 in., 3½ in., 4 in., such as size of magnets, diameter and length

of bobbins, number of wire used, and the number of layers on each bobbin, size of armature, and so on.—AMATEUR ELECTRICIAN.

[46253.]—Spin-Wheels.—Will some correspondent kindly inform me how to loosen spin wheels which are fixed on drying cylinders heated by steam? The spindles which the wheels are fixed on are 2½ in.; the wheels are rusted on.—W. H.

[46254.]—Parasol Rods.—How are they made? I have thought a hollow steel spindle might be used with crown saw at one end, with separate steel tubes with crown saws to telescope, for different diameters, to be fixed with bayonet fastenings.—W. F.

[46255.]—Steel Stencil Plates.—I want a few stencil plates about 36 in. by 6 in., and for the purpose require them, neither copper nor zinc is hard enough. Could I get thin sheets of steel (something like what is used for strengthening body-stays) large enough? What kind of shop would be likely to keep them? I suppose it would be too hard for stencil cutters to cut in the usual way; if so, would I require to protect the plate with Brunswick black and bite it with nitric acid?—STUCKFAST.

[46256.]—Poor-Rates.—To Mr. WETHERFIELD.—I manage a business, the premises of which are on a lease for £75 per annum; it is assessed at £120; rated at £20; have the guardians power to rate me more than my rate? The surveyor (whom I have seen) tells me it is for machinery, the whole of which, including 6 h.p. engine and boiler, is not worth more (being old) than £250, and some of it not in use. Advice on the above will greatly oblige.—H. H.

[46257.]—Astronomical.—Would any of your readers kindly inform me (1) Whether, with the focus of a refracting telescope, having an aperture of 12 in., I could find Uranus, as I see that it will shortly be in opposition? (2) Would the disc be perceptibly magnified with a power of 220? and if so, to what extent compared with the disc of Saturn with the same power?—ALMA.

[46258.]—Discolouration of Bricks.—My house, which is built of red Bridgewater bricks, is much disfigured, its more exposed side by a whitish discolouration, which is washed off by every shower, but reappears in a day or two. I believe such discolourations are a common fault of red bricks. Perhaps some of our practical readers can advise me how to remedy it.—S. H.

[46259.]—Piston-Speed of Locomotives.—Please give simple rule to find piston-speed of locomotive. An engine has 7 ft. wheels, cylinders 18 by 25. 2:30 miles an hour what is the piston speed?—A DRIVER.

[46260.]—Railway Brake Formula.—I have a table giving the results of some brake experiments in seconds. Will any correspondent give me a formula or instructions how to obtain the distance run in feet in the time; and, on the other hand, if distance of stop given in feet, how to find the time?—A DRIVER.

[46261.]—Brakes.—Will any correspondent kindly favour us with any further details of the continuous brakes now being tried on the N.W.? Also, what is the new Holbeck brake lately patented, and about to be tried on some railways?—A DRIVER.

[46262.]—Battery.—Can Mr. Lancaster or any other electrician kindly inform me of the best form of battery for constant use? I require a power equal to four gas Bunsen cells, and am at present using square zinc, charging the inner cell containing the carbon plate with bichromate and acid solution, the outer cell holding zinc immersed in acid solution; but I am not pleased with performance, as it gets very weak, and at times gives up altogether. Is this due to the carbons polarising?—MALLETS.

[46263.]—Porous Slabs.—I am making up a brick Daniell, and thought of using slabs of plaster of Paris instead of earthenware. I should be glad of any information as to their relative durability and resistance.—L. B. A.

[46264.]—Panoramas.—I am anxious to obtain information as to how panoramas are worked;—that is, having a long roll of paintings, I want to know what is at once the simplest and most inexpensive method of rolling and un-rolling. Any information upon these cognate matters will be thankfully received by, amongst others.—ENRY.

[46265.]—Dumbleton's Screw-Cutter for the Lathe.—I once saw this machine (made by Faint & Maccheater) used for cutting a screw to a wooden bolt about 4 in. in diameter with perfect success. As such appliances for originating screws on lathes appear in my paper, I think it would interest many of your readers, some one of your correspondents would give a full description, with drawings and dimensions, of the above instrument.—EYE WITNESS.

[46266.]—Lathe-Division Plate.—Mr. Edmunds, a circular, kindly offers to show at his works in London "The Automatic Counting and Dividing Apparatus," invented by a member of the Amateur Mechanical Society, any member of that society. Would he, or the inventor, be so kind as to send a description of it, for the general benefit, and more especially for that of those residing in the country.—ONE INTERESTED.

[46267.]—Curious Clock.—Many years ago I saw what was called an American clock. It consisted of a glass tube about 15 in. long, and about 3-16 in. in diameter, enclosed in another about 1 in. bore, which was attached to a board similar to a thermometer, and hung in a vertical position, but had to be reversed daily. The tube had a small ball of wool or other substance which which constantly and regularly kept sinking, and as there were marks indicating hours, halves, and quarters by the side of the tube, the position of the ball denoted the time. Can any correspondent inform me what substance was in the inner tube? and also, why it did not fall to the bottom suddenly or hang up by itself against the side of the tube?—B. R.

[46268.]—Electro-Gilding.—Having at times small steel articles that require electro-gilding, will one of your able correspondents give a recipe for making a solution that will deposit the gold direct upon the steel?

of electric carbons when consumed in the arc; that would be carbonic acid plus any impurities.)—**ANIL.** (We do not remember them. Any large bookseller will be able to help you.)—**ANATKUR,** Glasgow. (Use the coloured gelatine in preference, or paint with water-colours and varnish. The designs are etched with fluoric acid. See the indices.)—**ONE IN THE DARK** (Stationers' Hall-court, Ludgate-hill. You can do it all in one visit if you are the author, and take a printed copy of the book.)—**PIANO WINGS.** (See replies in this and recent volumes. No definite answer can be given without inspection.)—**5218, INVINCIBLE.** (See pp. 240, 531, Vol. XXXIII. 2. Hang the linen up, damp it, and then paint with linseed oil. See back numbers for several recipes.)—**Ego.** (The principle is Hero's. See p. 20, No. 417; and in No. 405, p. 368, one method of utilising it.)—**RANDAL.** (You are quite right—something to act on the system is what is required; but to get that you must consult a medical man, for personal examination only is a safe guide.)—**GERMAN SUNSHINE.** A. H. (Yes, the catalogue of the Crystal Palace Exhibition is published. It can be had of the secretary, price one shilling.)—**MARCH.** (If you cannot find what you require in back numbers, you must procure Webb's 'Celestial Objects,' Longmans, &c.)—**MYERS.** (If they suit you, how can they be injurious! Not uncommon.)—**F. F. C.** (See p. 88, present volume. Camphor-water is used, and the time as long as you please. Heat of fluid, temperature of air.)—**J. K.** (You can wipe over with a paraffin rag, or smear with grease. A rub with washleather and Bath brick will quickly bring up polish again.)—**S. H.** (Use the aniline dyes.)—**POMONA.** (See p. 241, present vol., and pp. 407, 556, Vol. XXXIII.)—**J. CHAMBERLAIN.** (It is simply a system in which the electric or other (especially other) artificial lights are employed with reflectors, semi-transparent screens, &c. Merely a trade term.)—**A. Madras.** (Several recipes in back volumes. You will be able to judge what effect the climate will have on the following—2oz. of black rosin is to be melted in a glazed pipkin, and 3oz. of beeswax added. When thoroughly combined, add 1oz. of fine lampblack and 1 drachm of Prussian blue in powder. When thoroughly mixed, thin with turpentine to a paste and let it cool, remembering that it becomes thick as it cools. Apply a coat with a rag, and then polish with a brush. You will probably find a smaller quantity of beeswax do. Or dissolve shellac in methylated spirit, and add lampblack and Prussian blue. No polishing required, but it cracks.)—**C. O.** (See the reply given last week. As to other queries, you must give full dimensions. Depth under door is incomplete, because it does not give total height of back part of firebox.)—**S. W. WATSON.** (Personal inspection needed; probably the vibrator of the larger reed touches the wood. See that it clears, and is firmly screwed down.)—**DECRATOR.** (Why not write to your friends in Chicago! Our space is really too much occupied to admit the query.)—**ISQUIR.** (Possibly there is no damp-proof course, or no hollow space between the brick and the walls, in either of which cases damp is almost sure to find its way inside.)—**2.** We do not know where such tables can be obtained.)—**M. C. H.** (Several firms supply such sash cords. We think the best, however, is Hookham's patent steel ribbon sash line, sold by Tonks and Son, of Birmingham.)—**A. R. ANDER.** (We do not see how else you can manage it, except by wrapping with thin wire. Such covered cords may be bought more cheaply than they can be prepared.)—**M. K. C. W.** (We do not know what legal query you refer to. Send again.)—**E. GOSWERT, T. S., BETA, A. A., CLOTURE, C. R. B., INQUISITIVE, ASTROLOGOS.** (In type.)

COWMAN.—V. G.—Your queries can only appear in the "Sixpenny Sale Column."

MURCATL.—G. H. Matthews.—F. White.—Epora.—W. A. S.—C. O. G.—Willie.—Scotch Working Mechanic.—C. H. B.—Analyst.—C. R. B.—P. M. O., and others have replied to queries already similarly or adequately answered.

THE LATE "SECONDS' PRACTICAL WATCH-MAKER"

We have communicated with M. S. Coates since our last issue appeared, and we find she is disposed to adopt "Gimel's" suggestion of opening a small shop, and so endeavouring to keep a home together for her children, of whom she has three—two sons and a daughter—all of whom are at present partially dependent on her. The Rev. R. Younger Roberts, the minister of the place of worship attended by Mr. Coates and his family, has written to us, stating that he has known them for thirty-two years, and that any help given will be well deserved and judiciously expended. Mr. Roberts has also kindly undertaken to advise and assist Mrs. Coates in the application of the little fund our readers are raising. Mrs. Coates has received three small amounts from "A Watchmaker," T. B. Howe, and a gentleman at Buckingham, which have been sent to her direct, and which she wishes us to acknowledge.

"F. M. Crichton" and "C. R. Beaumont" suggest that the articles contributed by Mr. Coates to our columns should be revised by some friend and republished for the benefit of his family. We do not think the probable profit would be very great, but should be glad to afford any facilities in our power if the idea were taken up. C. R. Beaumont bears strong testimony to the value of the information given by Mr. Coates. He says:—"I was an orphan, and had to shift for myself, and was working in a woollen mill when I saw the commencement of 'Seconds' articles in 'ours.' I read them with avidity, and practised watch and clock work at night till I felt qualified to undertake a situation as improver in a watch and clockmaker's shop. I went improving to several good shops at a pound a week for two years, and afterwards worked as a journeyman for two years more, and then commenced in business for myself. Thanks to the ENGLISH MECHANIC, I have, for the last five or six years, been able to undertake anything which came in my way. Certainly, I should never have had a trade at my fingers' ends but for the articles of our late friend, 'Seconds' Practical Watchmaker."

We have received the following sums since our last list appeared. We trust those who mean to contribute will

do so at once, and enable us to send the amount as quickly as possible to Mrs. Coates.

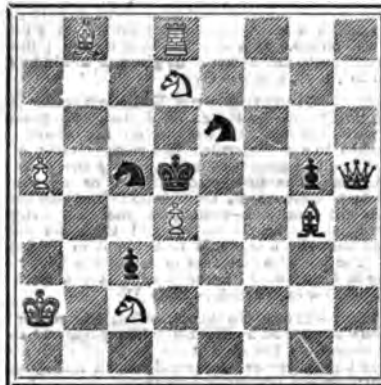
Amount previously acknowledged	£	s	d
T. M. Bear	1	0	0
H. P. "e"	10	0	0
Gimel	2	0	0
"E. F. C."	10	0	0
"S. J."	2	6	0
J. J. Gilbert	1	0	0
Alfojee	5	0	0
H. A. Wassell	5	0	0
C. R. Beaumont	2	6	0
F. M. Crichton	1	0	0
	£11	0	6

CHESS.

All Communications for this department must be addressed Chess Editor, 22, Chancery-lane, W.C.

PROBLEM DCCXXXVIII.—By Miss F. F. BEECHER.

Black.

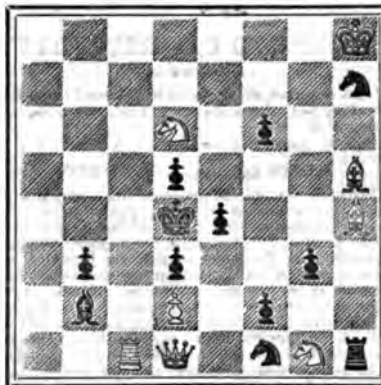


White.

White to play and mate in two moves.

PROBLEM DCCXXXIX.—By G. J. SLATER.
Second Prize Problem in the Croydon Guardian Problem Tourney.

Black.



White.

White to play and mate in four moves.

SOLUTION TO 729.

White.	Black.
1. Q to R 6.	1. B to Q or Kt 3 or Kt 3 or (A).
2. Q to Q 3.	2. Anything.
3. B mates.	(A) 1. Kt to B 2 or (B).
2. B to Kt 4 (ch).	2. K to Kt 3.
3. Kt to B 8 mate.	(B) 1. P to Kt 4 or (C).
2. Kt to Kt 7 (ch).	2. R x Kt.
3. B to Kt 4 mate.	(C) 1. Q R to Q or K B sq.
2. Kt to B 8.	or Q K moves
3. B to Kt 4 mate.	2. Anything.

SOLUTION TO 730.

White.	Black.
1. Q to Q 3.	1. Anything.
2. Mate acc.	

SOLUTION TO 731.

White.	Black.
1. R to Q sq.	1. Anything.
2. Mate acc.	

SOLUTION TO 732.

White.	Black.
1. B to B 5.	1. Anything.
2. Mate acc.	

SOLUTION TO 733.

This problem is a "mound." A white pawn on K B 4 and a black pawn on K B 4. The author thinks, added to the diagram will render it "mound." The author's solution is:—

White.	Black.
1. Q to Q B 2.	1. K to K 4.
2. Q to R 7.	2. K to K 4.
3. Q to Kt 7 mate.	
2. Q to R 7.	
3. R to R 8 mate.	

CHESS ITEMS.

"A COMPLETE GUIDE TO THE GAME OF CHESS." By H. F. L. MEYER. London: Griffith and Farran.—The title of this book fairly represents its contents, which have been compiled from almost every available source, and arranged and edited by one who brings an extensive practical experience of the game in all its varieties to bear upon his work. In an appendix is a prize problem to be solved in eight moves (23 pieces). The first solution and analysis, which must be complete, received within eight weeks, will be awarded £3; the second, Miles's Chess Gems; and the third a copy of Mr. Meyer's book. Mr. Meyer uses the universal notation, which will in this country undoubtedly help to limit the number of his readers, though many will, on the other hand, acquire the new notation in order to understand the author's remarks.

MR. STEINITZ has, on the expiration of the month he allowed for the acceptance of the challenge issued to Messrs. Zukertort and Hofer (which has not been accepted), issued the conditions under which he is willing to play Dr. Zukertort single-handed. The following appear in the *Chess Players' Chronicle*:—1. A stake of £200 a-side. 2. Nine games up. 3. Fifteen moves an hour. 4. About ten games a month. 5. All other conditions same as in the Blackburne-Zukertort match. 6. An adjournment over the Vienna Tournament. 7. Play to begin four weeks after acceptance of challenge. Mr. Steinitz states he is willing to listen to any modification, except in clause seven, which he desires should remain unaltered. We think these should fetch the Doctor, and we trust terms may be amicably arranged, so giving the Chess world one of the greatest treats they will have ever experienced, for doubtless the games will be very fine specimens of modern chess tactics.

MR. STEINITZ is still continuing his "Analytical Warfare" in the *C.P.C.*, where it seems to go very rough with the joint editors of the *Chess Monthly*.

A "VEESE COMPETITION" in connection with the *British Chess Magazine* is announced, and prizes offered for the best poem on Chess, not to exceed 40 lines. Conditions will be published in the *H.C.M.* for March, or apply to F.E.B., Dovedale House, Matlock, Bath, Derbyshire.

Society's end Game Tourney has resulted in favour of one of our correspondents—Mr. C. H. Coster. Mr. J. Norwood Potter, Chess Editor of *Land and Water*, acted as judge. There were only four positions entered. Mr. J. Crake started this competition in a periodical published in Hull, but owing to the collapse of the paper it was conducted in *Society*.

THE City of London Chess Club held their Annual Meeting on Wednesday, the 22nd ult. The report shows the Club to be in a most flourishing condition. There was a numerous attendance, and everything passed off peacefully, which was rather unexpected, as from a certain quarter the reverse was anticipated.

A DUSSELDORF paper says that about a fortnight ago the first train on the Continent lighted with electric lamps ran between Frankfurt-on-the-Maine and Hanau with complete success. A dynamo machine was fixed on the locomotive, besides which it is stated the rotary motion of the carriage axles was used for creating a current, presumably by other dynamo machines in brake vans. The entire apparatus was constructed by the locomotive engineer of the line, and worked to the satisfaction of all who attended the trial.

THE Metropolitan Board of Works have just published a new specification for cement. Briefly, the conditions are, not more than 10 per cent. residue on sieve of 5,800 meshes—76 per lineal inch; to be gauged with three times its weight of dry sand which has passed through a 400-mesh sieve, and retained by a 900, and 10 per cent. of their weight of water. Briquettes from this, kept in damp atmosphere, are put in water twenty-four hours after made, are then kept for test by board. The neat cement at any time of year must not set in less than an hour, and must bear 200lb. per square inch twenty-eight days after briquettes are made.

Every Workman connected with the Building Trade requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 21, Tavistock-street, Covent-garden London, W.C.

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